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JEE-2022 Aspirants

PHYSICS MARATHON

PHYSICS
FORMULA RACE

PHYSICS DEPARTMENT

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JEE ADVANCED 2021

द्वितीय वर्ष में अद्वितीय परिणाम

7 IN TOP 200 **19** IN TOP 500 **34** IN TOP 1000

AIR 67

ANKAN SARKAR
Roll No. : 20771420 | CCP

ALL STUDENTS WERE ENROLLED IN **CLASSROOM COACHING PROGRAM SINCE INCEPTION**

AIR 109
KUSHAGRA GUPTA
Roll No. : 20975433 | CCP

AIR 118
MONIL LODHA
Roll No. : 20771425 | CCP

AIR 132
UJJAYAN PAL
Roll No. : 20771408 | CCP

AIR 149
HARSH BIHANY
Roll No. : 20771419 | CCP

AIR 155
SWASTIK SINGHAL
Roll No. : 20770487 | CCP

AIR 186
AKSHAT RAJANI
Roll No. : 20771411 | CCP

AIR 254
HARSH VARDHAN
Roll No. : 20770555 | CCP

AIR 255
VISHWAJEET SOLANKI
Roll No. : 20770578 | CCP

AIR 259
ARNAV PATI
Roll No. : 20771417 | CCP

AIR 305
NAVNEET RAJ
Roll No. : 20771638 | CCP

AIR 306
ADITYA RAJ
Roll No. : 20770366 | CCP

AIR 350
ADITYA THOMAS
Roll No. : 20771415 | CCP

AIR 360
PARTH K. SAKALKALE
Roll No. : 20770379 | CCP

AIR 362
ANKIT CHAUDHARY
Roll No. : 20770495 | CCP

AIR 408
ARYAN BIBHUTI
Roll No. : 20771405 | CCP

AIR 467
PRANAV JAIN
Roll No. : 20771421 | CCP

AIR 493
BEDANTA BHAUMIK
Roll No. : 20770392 | CCP

AIR 500
HARSH KATARA
Roll No. : 20770468 | CCP

OUR CATEGORY TOPPER
AIR 12 (SC)
AIR 802 (GEN)
MEGH H. GOHIL
Roll No. : 20770866 | CCP

JEE MAIN 2021

AIR **72**
KUSHAGRA GUPTA
CCP
100 %ile in PHYSICS

AIR **92**
ANKAN SARKAR
CCP
100 %ile in MATHS

AIR 120
ANKIT CHAUDHARY
CCP
100 %ile in PHYSICS & MATHS

AIR 120
JENISH JAIN
Roll No. : 20771425 | CCP
100 %ile in PHYSICS & MATHS

AIR 123
PRANAV JAIN
Roll No. : 20771408 | CCP
100 %ile in MATHS

AIR 141
UJJAYAN PAL
Roll No. : 20771419 | CCP
100 %ile in PHYSICS

AIR 184
ARNAV PATI
Roll No. : 20770487 | CCP
100 %ile in MATHS

AIR 186
NAVNEET RAJ
Roll No. : 20771411 | CCP
99.98%ile

OUR CATEGORY TOPPER
AIR 4 (SC)
MEGH H. GOHIL
CCP
100 %ile in PHYSICS & MATHS

2 IN TOP 100 **8** IN TOP 200

20 IN TOP 500

77.79% Students Qualified for JEE Advanced 2021

All Students were Enrolled in Classroom Coaching Program Since Inception

PHYSICS FORMULA RACE

Reliable
INSTITUTE
Unleashing Potential

ALTERNATING CURRENT

❖ Root mean square current :

$$i_{rms} = \sqrt{\frac{\Sigma i^2}{N}}$$

$$i_{rms} = \sqrt{\frac{\int_0^T i^2 . dt}{\int_0^T dt}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. **The alternating current is given by**

$$i = \left\{\sqrt{42}\sin\left(\frac{2\pi}{T}t\right) + 10\right\} A$$

The r.m.s. value of this current is ..... A. **[JEE-Main 2021]**

Ans. **11**

Q. An AC current is given by $I = I_1 \sin\omega t + I_2 \cos\omega t$. A hot wire ammeter will give a reading :

[JEE-Main 2021]

(1) $\sqrt{\frac{I_1^2 - I_2^2}{2}}$

(2) $\sqrt{\frac{I_1^2 + I_2^2}{2}}$

(3) $\frac{I_1 + I_2}{\sqrt{2}}$

(4) $\frac{I_1 + I_2}{2\sqrt{2}}$

Ans. (2)

❖ Effective Impedance in RLC series circuit :

$$z = \sqrt{R^2 + (x_L - x_C)^2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	7	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	2	2016	1
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 11 (JEE-Main)

Q. In an ac circuit, an inductor, a capacitor and a resistor are connected in series with $X_L = R = X_C$. Impedance of this circuit is : [JEE-Main 2021]

(1) $2R^2$

(2) Zero

(3) R

(4) $R\sqrt{2}$

Ans. (3)

❖ Power factor :

$$P.f = \cos\phi = \frac{R}{Z}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. An ac circuit has an inductor and a resistor of resistance R in series, such that $X_L = 3R$. Now, a capacitor is added in series such that $X_C = 2R$. The ratio of new power factor with the old power factor of the circuit is $\sqrt{5} : x$. The value of x is ____.

[JEE-Main 2021]

Ans. 1

Q. In a series LCR circuit, the inductive reactance (X_L) is 10 Ω and the capacitive reactance (X_C) is 4 Ω. The resistance (R) in the circuit is 6 Ω. The power factor of the circuit is :

[JEE-Main 2021]

(1) $\frac{1}{2}$

(2) $\frac{1}{2\sqrt{2}}$

(3) $\frac{1}{\sqrt{2}}$

(4) $\frac{\sqrt{3}}{2}$

Ans. (3)

❖ Resonance Frequency :

$$f = \frac{1}{2\pi\sqrt{LC}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. A 100 Ω resistance, a 0.1 μF capacitor and an inductor are connected in series across a 250 V supply at variable frequency. Calculate the value of inductance of inductor at which resonance will occur. Given that the resonant frequency is 60 Hz.

[JEE-Main 2021]

(1) 0.70 H

(2) 70.3 mH

(3) 7.03×10^{-5} H

(4) 70.3 H

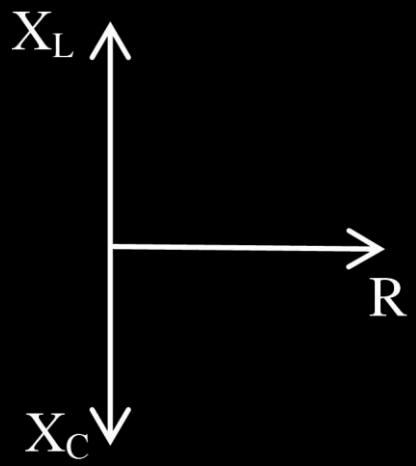
Ans. (4)

Q. Two circuits are shown in the figure (a) & (b). At a frequency of _____ rad/s the average power dissipated in one cycle will be same in both the circuits.

[JEE-Main 2021]

Ans. 500

❖ Phasor Diagram :



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	5	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 6 (JEE-Main)

Q. Match List-I with List-II : [JEE-Main 2021]

	List–I		List–II
(a)	$\omega L > \frac{1}{\omega C}$	(i)	Current is in phase with emf
(b)	$\omega L = \frac{1}{\omega C}$	(ii)	Current lags behind the applied emf
(c)	$\omega L < \frac{1}{\omega C}$	(iii)	Maximum current occurs
(d)	Resonant frequency	(iv)	Current leads the emf

Choose the correct answer from the options given below :

(1) (a) – (ii) ; (b) – (i) ; (c) - (iv) ; (d) – (iii)

(2) (a) – (ii) ; (b) – (i) ; (c) - (iii) ; (d) – (iv)

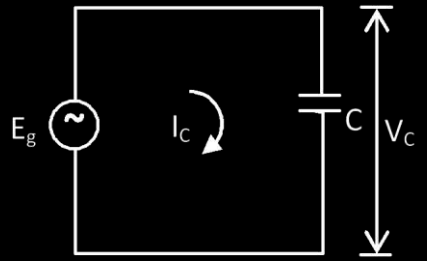
(3) (a) – (iii) ; (b) – (i) ; (c) - (iv) ; (d) – (ii)

(4) (a) – (iv) ; (b) – (iii) ; (c) - (ii) ; (d) – (i)

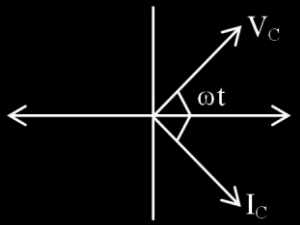
Ans. (1)

Q. In a circuit consisting of a capacitance and a generator with alternating emf $E_g = E_{g_0} \sin \omega t$, V_C and I_C are the voltage and current. Correct phasor diagram for such circuit is :

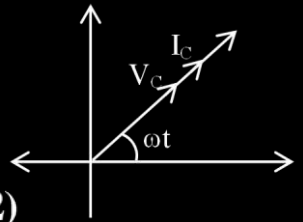
[JEE-Main 2021]



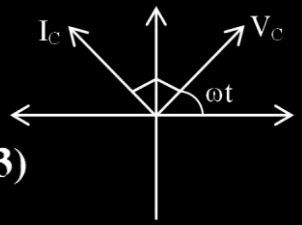
(1)



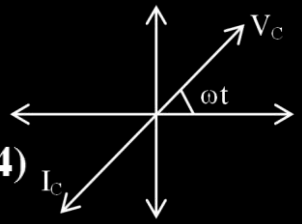
(2)



(3)



(4)



Ans. (3)

❖ Power dissipated in A.C. Circuit :

$$P = V_{rms}\, I_{rms} \cos\phi.$$

$$= \frac{V_{rms}^2}{Z}\cos\phi = i_{rms}^2 R$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 1 (JEE-Advanced) and 3 (JEE-Main)

Q. A sinusoidal voltage of peak value 250 V is applied to a series LCR circuit, in which R = 8Ω, L = 24 mH and C = 60μF. The value of power dissipated at resonant condition is 'x' kW. The value of x to the nearest integer is _____. [JEE-Main 2021]

Ans. 4

Q. A series LCR circuit is designed to resonate at an angular frequency $\omega_0 = 10^5$ rad/s. The circuit draws 16 W power from 120 V source at resonance. The value of resistance 'R' in the circuit is ___Ω. [JEE-Main-2021]

Ans. 900

❖ **Quality factor :**

$$Q = \frac{X_L}{R} = \frac{L\omega}{R} = \frac{1}{2}\sqrt{\frac{L}{C}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	1	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 5 (JEE-Main)

Q. In a series LCR resonant circuit, the quality factor is measured as 100. If the inductance is increased by two fold and resistance is decreased by two fold, then the quality factor after this change will be_____. [JEE-Main-2021]

Ans. 283

Q. A resonance circuit having inductance and resistance 2×10^{-4} H and 6.28 Ω respectively oscillates at 10 MHz frequency. The value of quality factor of this resonator is _____.

[$\pi = 3.14$] [JEE-Main 2021]

Ans. 2000

❖ RC Circuit :

$$Z = \sqrt{R^2 + X_c^2}$$

$$V_0 = \sqrt{V_R^2 + V_c^2}$$

$$\tan \phi = \frac{X_C}{R}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	1
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	1	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 2 (JEE-Main)

Q. A resistor 'R' and 2μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5s after the switch has been closed. ($\log_{10} 2.5 = 0.4$)

[JEE-Main 2012]

(1) $2.7 \times 10^6\ \Omega$

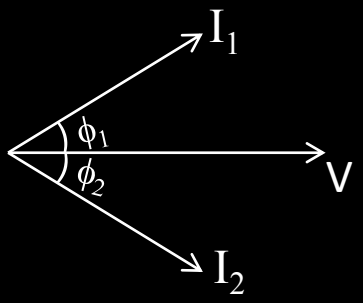
(2) $3.3 \times 10^7\ \Omega$

(3) $1.3 \times 10^4\ \Omega$

(4) $1.7 \times 10^5\ \Omega$

Ans. (1)

❖ LCR Circuit in parallel connection :



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 0 (JEE-Main)

Q. In the given circuit the AC source has $\omega = 100$ rad s^{-1},Considering the inductor and capacitor to be ideal, what will be the current flowing through the circuit ?

[JEE-Main 2021]

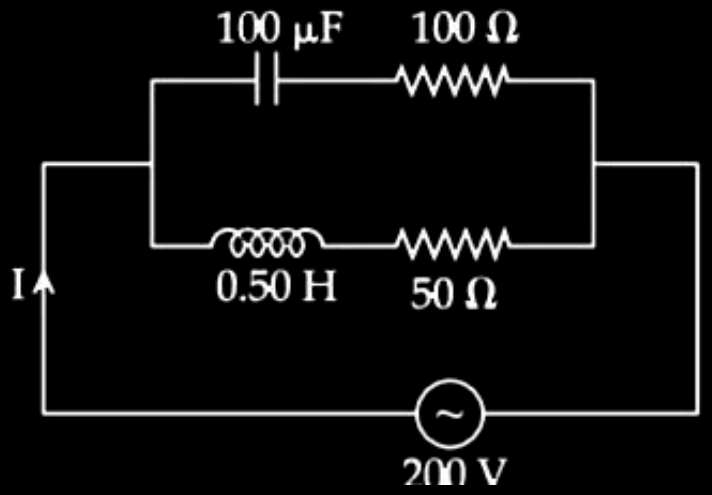
(1) 5.9 A

(2) 3.16 A

(3) 0.94A

(4) 6A

Ans. (B)



❖ Transformer :

$$\frac{V_P}{V_S} = \frac{is}{ip} = \frac{N_P}{N_s}$$

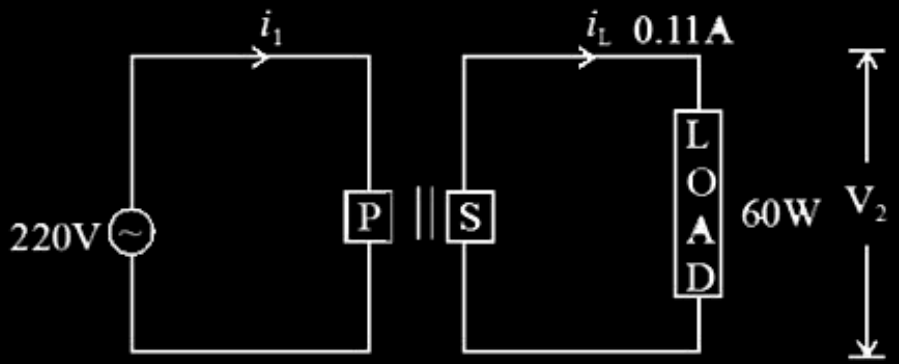
$V_P > V_S \Rightarrow$ Step down

$V_P < V_S \Rightarrow$ Step-Up Transformer

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. For the given circuit, comment on the type of transformer used : [JEE-Main 2021]



(1) Auxilliary transformer

(2) Auto transformer

(3) Step-up transformer

(4) Step down transformer

Ans. (3)

Q. A common transistor radio set requires 12V (D.C.) for its operation. The D.C. source is constructed by using a transformer and a rectifier circuit, which are operated at 220 V (A.C.) on standard domestic A.C. supply. The number of turns of secondary coil are 24, then the number of turns of primary are _____. [JEE-Main 2021]

Ans. 440

Thanks!

PHYSICS FORMULA RACE

CAPACITORS

❖ Series and parallel combination of capacitor :

For series combination

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + ...$$

For parallel combination

$$C_{eq.} = C_1 + C_2 + ...$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	10	2021	-
2020	1	2020	1
2019	4	2019	-
2018	1	2018	-
2017	2	2017	-
2016	3	2016	-
2015	2	2015	-
2014	1	2014	-
2013	-	2013	1
2012	-	2012	1

☛ Total Questions in last 10 years in 3 (JEE-Advanced) and 24 (JEE-Main)

Q. Two equal capacitors are first connected in series and then in parallel. The ratio of the equivalent capacitance in the two cases will be: [JEE-Main 2021]

(1) 4 : 1 (2) 2 : 1

(3) 1 : 4 (4) 1 : 2

Ans. (3)

Q. Consider the combination of 2 capacitors C_1 and C_2, with $C_2 > C_1$, when connected in parallel, the equivalent capacitance is $\frac{15}{4}$ time the equivalent capacitance of the same connected in series. Calculate the ratio of capacitors, $\frac{C_2}{C_1}$. [JEE-Main 2021]

(1) $\frac{15}{11}$ **(2)** $\frac{111}{80}$ **(3)** $\frac{29}{15}$ **(4)** $\frac{15}{4}$

Ans. (2)

❖ Charging and Discharging of capacitor :

For charging

$$q = q_0\left(1 - e^{\frac{-t}{RC}}\right)$$

$$i = i_0 e^{\frac{-t}{RC}}$$

For discharging

$$q = q_0 e^{\frac{-t}{RC}}$$

$$i = i_0 e^{\frac{-t}{RC}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	7	2021	1
2020	-	2020	-
2019	-	2019	1
2018	1	2018	-
2017	1	2017	2
2016	-	2016	1
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 5 (JEE-Advanced) and 10 (JEE-Main)

Q. A capacitor is connected to a 20 V battery through a resistance of 10Ω. It is found that the potential difference across the capacitor rises to 2 V in 1 ms. The capacitance of the capacitor is _____mf. Given

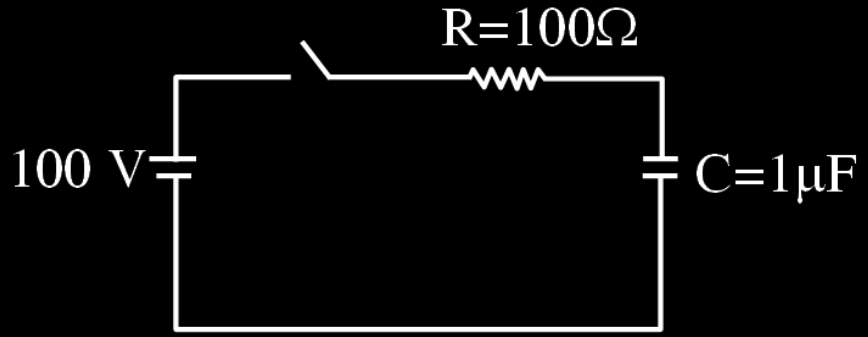
$$\ln\left(\frac{10}{9}\right) = 0.105$$

[JEE-Main 2021]

(1) 9.52 (2) 0.95 (3) 0.105 (4) 1.85

Ans. (2)

Q. A capacitor of capacitance C=1 μF is suddenly connected to a battery of 100 volt through a resistance R = 100 Ω. The time taken for the capacitor to be charged to get 50 V is : [JEE-Main-2021]
[Take ln 2 = 0.69]



(1) 1.44×10^{-4} s
(2) 3.33×10^{-4} s
(3) 0.69×10^{-4} s
(4) 0.30×10^{-4} s

Ans. (3)

❖ Dielectrics in capacitor if capacitor is completely filled with dielectric :

$$C = \frac{A\varepsilon_0 K}{d}$$

If capacitor is partially filled with dielectric with thickness't'

$$C = \frac{A\varepsilon_0}{d - t\left(1 - \frac{1}{K}\right)}$$

For conducting slab $k \to \infty$ $C = \frac{A\varepsilon_0}{d - t}$

$$q_b = q_0\left(1 - \frac{1}{K}\right)$$

q_b = Bounded charge on dielectric slab

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	7	2021	-
2020	3	2020	-
2019	6	2019	1
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	2	2014	-
2013	-	2013	-
2012	-	2012	-

☛ **Total Questions in last 10 years in 1 (JEE-Advanced) and 19 (JEE-Main)**

Q. For changing the capacitance of a given parallel plate capacitor, a dielectric material of dielectric constant K is used, which has the same area as the plates of the capacitor. The thickness of the dielectric slab is $\frac{3}{4}$d, where 'd' is the separation between the plates of parallel plate capacitor. The new capacitance (C') in terms of original capacitance (C_0) is given by the following relation : [JEE-Main-2021]

(1) $C' = \frac{3+K}{4K}C_0$

(2) $C' = \frac{4+K}{3}C_0$

(3) $C' = \frac{4K}{K+3}C_0$

(4) $C' = \frac{4}{3+K}C_0$

Ans. **(3)**

Q. The parallel combination of two air filled parallel plate capacitors of capacitance C and nC is connected to a battery of voltage, V. When the capacitors are fully charged, the battery is removed and after that a dielectric material of dielectric constant K is placed between the two plates of the first capacitor. The new potential difference of the combined system is :- [JEE-Main 2019]

(1) $\frac{V}{K+n}$

(2) V

(3) $\frac{(n+1)V}{(K+n)}$

(4) $\frac{nV}{K+n}$

Ans. (3)

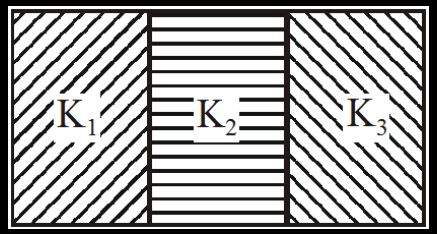
❖ Series and parallel combination of dielectric capacitor :

For parallel combination

$$C_1 = \frac{A_1\varepsilon_0 K_1}{d},\ C_2 = \frac{A_2\varepsilon_0 K_2}{d},$$

$$C_3 = \frac{A_3\varepsilon_0 K_3}{d}$$

$$C_{eq} = C_1 + C_2 + C_3$$

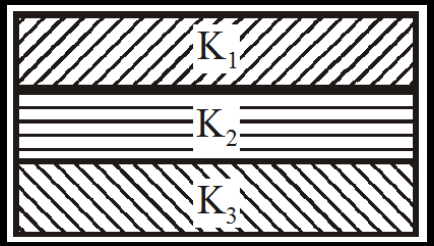


Series combination

$$C_1 = \frac{A\varepsilon_0 K_1}{d_1},\ C_2 = \frac{A\varepsilon_0 K_2}{d_2},$$

$$C_3 = \frac{A\varepsilon_0 K_3}{d_3}$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	4	2019	-
2018	-	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	2	2014	1
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 3 (JEE-Advanced) and 9 (JEE-Main)

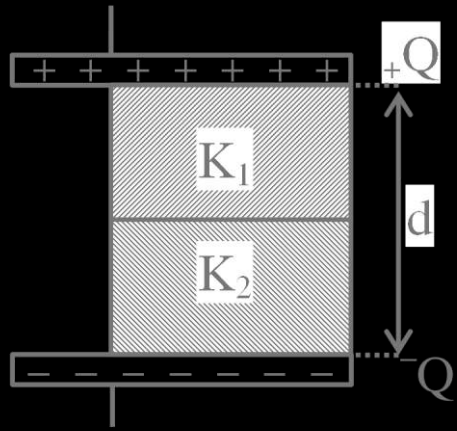
Q. A parallel - plate capacitor with plate area A has separation d between the plates. Two dielectric slabs of dielectric constant K_1 and K_2 of same area A/2 and thickness d/2 are inserted in the space between the plates. The capacitance of the capacitor will be given by : [JEE-Main 2021]

(1) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1K_2}{K_1+K_2}\right)$

(2) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1K_2}{2(K_1+K_2)}\right)$

(3) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{K_1+K_2}{K_1K_2}\right)$

(4) $\frac{\varepsilon_0 A}{d}\left(\frac{1}{2}+\frac{2(K_1+K_2)}{K_1K_2}\right)$



Ans. (1)

Q. A parallel plate capacitor with plate area 'A' and distance of separation 'd' is filled with a dielectric. What is the capacity of the capacitor when permittivity of the dielectric varies as : [JEE-Main-2021]

$$\varepsilon(x) = \varepsilon_0 + kx, \text{ for } \left(0 < x \le \frac{d}{2}\right)$$

$$\varepsilon(x) = \varepsilon_0 + k(d - x), \text{ for } \left(\frac{d}{2} \le x \le d\right)$$

(1) $\left(\varepsilon_0 + \frac{kd}{2}\right)^{2/kA}$

(2) $\frac{kA}{2\ln\left(\frac{2\varepsilon_0 + kd}{2\varepsilon_0}\right)}$

(3) 0

(4) $\frac{kA}{2}\ln\left(\frac{2\varepsilon_0}{2\varepsilon_0 - kd}\right)$

Ans. (2)

❖ Force between plates of capacitor :

$$F = \frac{Q^2}{2A\varepsilon_0} = \frac{1}{2}\varepsilon_0 A E^2$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A parallel plate capacitor with area 200 cm^2 and separation between the plates 1.5 cm, is connected across a battery of emf V. If the force of attraction between the plates is 25×10^{-6}N, the value of V is approximately :

$\left(\epsilon_0 = 8.5 \times 10^{-12} \frac{C^2}{N.m^2} \right)$

[JEE-Main 2018]

(1) 150 V

(2) 100 V

(3) 250 V

(4) 300 V

Ans. (3)

Thanks!

PHYSICS FORMULA RACE

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CURRENT ELECTRICITY

❖ Drift velocity

$$I = neAV_d$$

$$\text{Mobility} = \frac{\text{Drift velocity}}{\text{Electric Field}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	2	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. In the given figure, a battery of emf E is connected across a conductor PQ of length 'l' and different area of cross-sections having radii r_1 and r_2 ($r_2 < r_1$). [JEE-Main 2021]

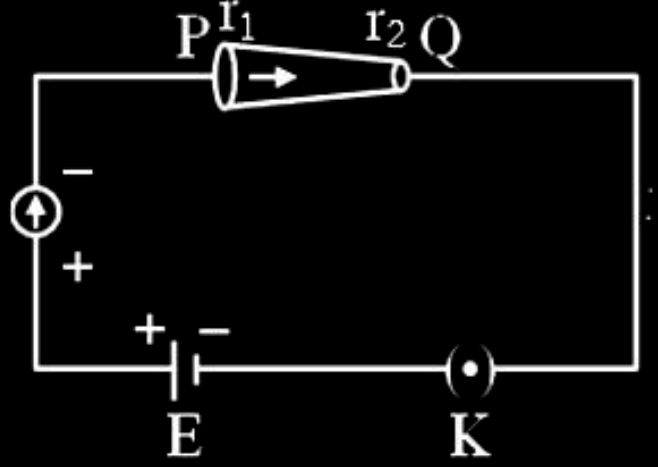
Choose the correct option as one moves from P to Q :

(1) Drift velocity of electron increases.

(2) Electric field decreases.

(3) Electron current decreases.

(4) All of these



Ans. (1)

Q. Drift speed of electrons, when 1.5 A of current flows in a copper wire of cross section 5 mm, is v. If the electron density in copper is 9×10^{28} /m^3 the value of v in mm/s is close to (Take charge of electron to be $=1.6 \times 10^{-19}$C) [JEE-Main 2019]

(1) 0.2

(2) 3

(3) 2

(4) 0.02

Ans. (4)

CURRENT ELECTRICITY

❖ Resistance:

$$R = \rho \frac{\ell}{A}$$

Resistivity:

$$\rho = \frac{m_e}{ne^2\tau}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	3	2019	-
2018		2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	1
2013	-	2013	-
2012	1	2012	-
2011	1	2011	-

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. What equal length of an iron wire and a copper-nickel alloy wire, each of 2 mm diameter connected parallel to give an equivalent resistance of 3Ω?

(Given resistivities of iron and copper-nickel alloy wire are 12 μΩ cm and 51 μΩ cm respectively) [JEE-Main 2021]

(1) 82 m

(2) 97 m

(3) 110 m

(4) 90 m

Ans. (B)

Q. Two wires of same length and thickness having specific resistances 6Ω cm and 3Ω cm respectively are connected in parallel. The effective resistivity is ρ Ω cm. The value of ρ, to the nearest integer, is_____. [JEE-Main 2021]

Ans. (4)

❖ Temperature dependence of resistance:

$$R = R_0 (1 + \alpha \Delta T)$$

where; α = coefficient of linear thermal expansion

R_0 = resistance at zero kelvin.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	1
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015		2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 2 (JEE-Main)

Q. A heating element has a resistance of 100W at room temperature. When it is connected to a supply of 220 V, a steady current of 2A passes in it and temperature is 500°C more than room temperature. What is the temperature coefficient of resistance of the heating element :- [JEE-Main 2018]

(1) $1\times10^{-4}\ ^{\circ}C^{-1}$

(2) $2\times10^{-4}\ ^{\circ}C^{-1}$

(3) $0.5\times10^{-4}\ ^{\circ}C^{-1}$

(4) $5\times10^{-4}\ ^{\circ}C^{-1}$

Ans. (2)

Q. The temperature dependence of resistances of Cu and undoped Si in the temperature range 300-400K, is best described by :- [JEE-Main 2016]

(1) Linear decrease for Cu, linear decrease for Si.

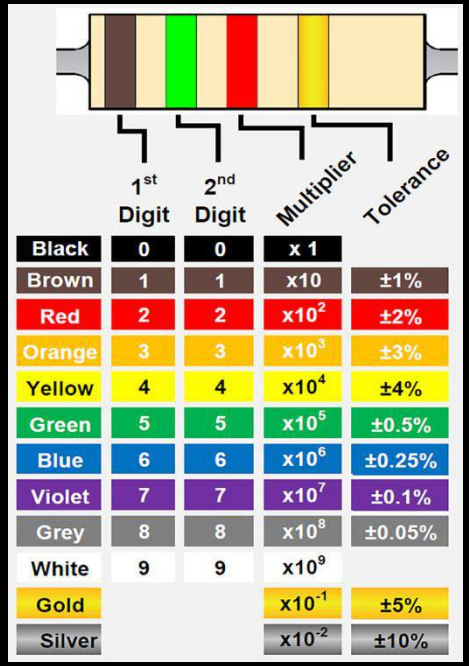
(2) Linear increase for Cu, linear increase for Si.

(3) Linear increase for Cu, exponential increase for Si

(4) Linear increase for Cu, exponential decrease for Si

Ans. (4)

❖ Color code of resistor :



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	4	2019	-
2018	-	2018	-
2017	-	2017	
2016	-	2016	-
2015	-	2015	-
2014		2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. A 200 Ω resistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be : [JEE-Main 2019]

(1) 100 Ω

(2) 400 Ω

(3) 500 Ω

(4) 300 Ω

Ans. 3

Q. A 2 W carbon resistor is color coded with green, black, red and brown respectively. The maximum current which can be passed through this resistor is : [JEE-Main 2019]

(1) 63 mA

(2) 0.4 mA

(3) 100 mA

(4) 20 mA

Ans. (4)

❖ Equivalent Resistance :

$$(R_{eq})_{\text{series}} = R_1 + R_2 + \ldots..$$

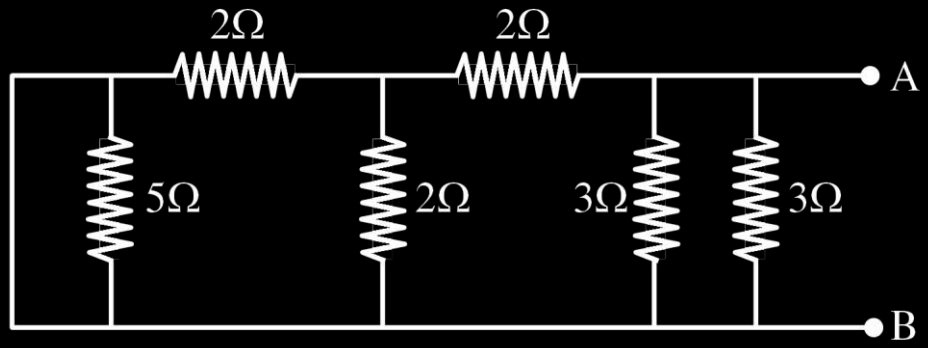
$$\frac{1}{(R_{eq})_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots.$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	10	2021	-
2020	3	2020	-
2019	3	2019	-
2018	1	2018	-
2017	1	2017	-
2016	-	2016	1
2015	-	2015	2
2014	-	2014	-
2013	2	2013	-
2012	-	2012	1
2011	-	2011	-

☛Total Questions in last 10 years: 4 (JEE-Advanced) and 20 (JEE-Main)

Q. The equivalent resistance of the given circuit between the terminals A and B is :

[JEE-Main 2021]



(1) 0Ω

(2) 3Ω

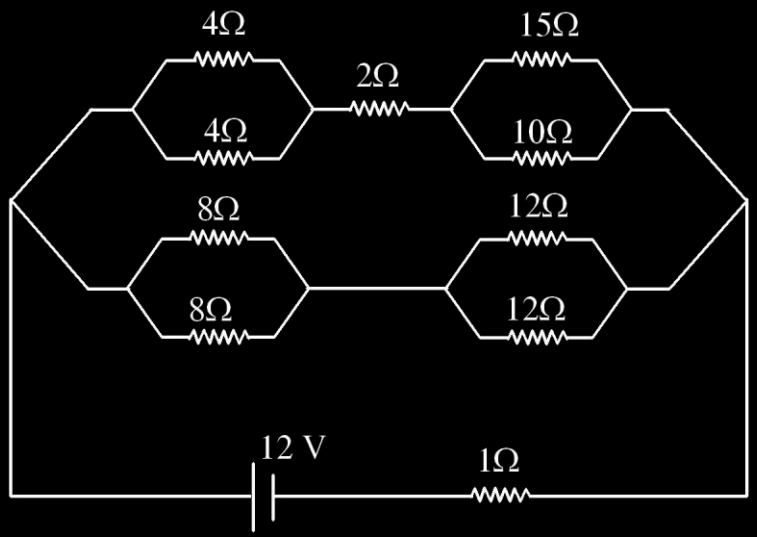
(3) $\frac{9}{2}\Omega$

(4) 1Ω

Ans. (4)

Q. The voltage drop across 15Ω resistance in the given figure will be_____V.

[JEE-Main-2021]



Ans. 6

❖ Equivalent Emf :

$$\left(\xi_{eq}\right)_{parallel} = \frac{\frac{\xi_1}{r_1} \pm \frac{\xi_2}{r_2} \pm ....}{\frac{1}{r_1} \pm \frac{1}{r_2} \pm ....}$$

$$\left(\xi_{eq}\right)_{series} = \xi_1 \pm \xi_2 \pm ....$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	1	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. Five identical cells each of internal resistance 1Ω and emf 5V are connected in series and in parallel with an external resistance 'R'. For what value of 'R', current in series and parallel combination will remain the same ? [JEE-Main 2021]

(1) 1 Ω

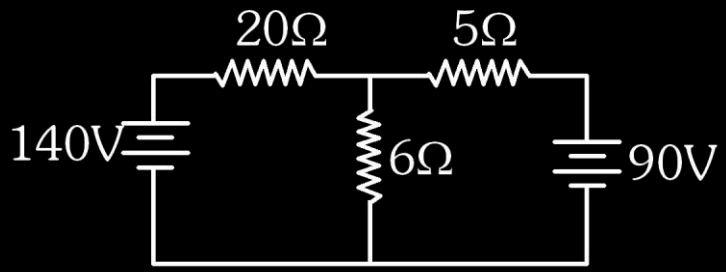
(2) 25 Ω

(3) 5 Ω

(4) 10 Ω

Ans. (1)

Q. The value of current in the 6Ω resistance is : [JEE-Main 2021]



(1) 4A

(2) 8A

(3) 10A

(4) 6A

Ans. (3)

❖ Kirchhoff's Laws

1. Junction Law:

$$i_1 \pm i_2 \pm i_3 \pm \ldots = 0$$

2. Loop Law :

$$\sum \xi \pm \sum ir = 0$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	6	2021	1
2020	3	2020	1
2019	4	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	2	2015	-
2014	1	2014	1
2013	1	2013	-
2012	-	2012	-
2011	-	2011	1

☛Total Questions in last 10 years: 5 (JEE-Advanced) and 17 (JEE-Main)

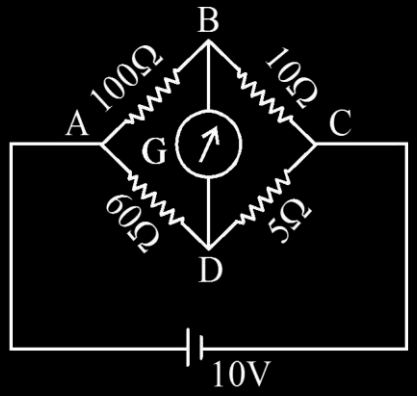
Q. The four arms of a Wheatstone bridge have resistances as shown in the figure. A galvanometer of 15 Ω resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of 10V is maintained across AC. [JEE-Main2021]

(1) 2.44 μA

(2) 2.44 mA

(3) 4.87 mA

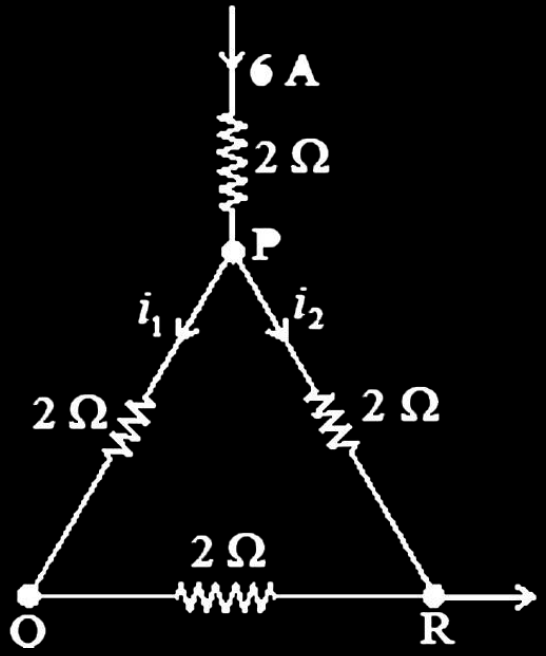
(4) 4.87 μA



Ans. (3)

Q. A current of 6 A enters one corner P of an equilateral triangle PQR having 3 wires of resistance 2Ω each and leaves by the corner R. The currents i_1 in ampere is _____.

[JEE-Main 2021]



Ans. 2

❖ Power dissipation in resistor:

$$P = \frac{V^2}{R}$$

$$P = i^2R$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	-
2020	2	2020	-
2019	5	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	1
2013	2	2013	1
2012	2	2012	-

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 22 (JEE-Main)

Q. A uniform heating wire of resistance 36 Ω is connected across a potential difference of 240 V. The wire is then cut into half and potential difference of 240 V is applied across each half separately. The ratio of power dissipation in first case to the total power dissipation in the second case would be 1 : x, where x is..... [JEE-Main 2021]

Ans. (4)

Q. The energy dissipated by a resistor is 10 mJ in 1s when an electric current of 2 mA flows through it. The resistance is _____ Ω. (Round off to the Nearest Integer)

[JEE-Main 2021]

Ans. 2500

❖ Heat Produced :

$$\text{Heat} = \int \frac{V^2}{R} dt$$

$$= \int i^2 R dt$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. Due to cold weather a 1 m water pipe of cross-sectional area 1 cm^2 is filled with ice at –10°C. Resistive heating is used to melt the ice. Current of 0.5A is passed through 4 KΩ resistance. Assuming that all the heat produced is used for melting, what is the minimum time required? (Given latent heat of fusion for water/ice = $3.33 \times 10^5 J\ kg^{-1}$, specific heat of ice = $2 \times 10^3\ J\ kg^{-1}$ and density of ice = 103 kg/m^3.) [JEE-Main 2021]

(A) 0.353 s

(B) 35.3 s

(C) 3.53 s

(D) 70.6 s

Ans. (B)

Q. A resistor dissipates 192 J of energy in 1 s when a current of 4A is passed through it. Now, when the current is doubled, the amount of thermal energy dissipated in 5 s in_____J.

[JEE-Main-2021]

Ans. 3840

❖ Galvanometer to Ammeter & voltmeter conversion & reading :

- Heavy resistance is connected in series to galvanometer coil and this arrangement is connected in parallel to the resistor.
- Very small resistance is connected in parallel to galvanometer coil and this arrangement is connected in series in the circuit.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	
2020	2	2020	
2019	2	2019	1
2018		2018	1
2017	1	2017	
2016		2016	1
2015		2015	
2014	1	2014	1
2013	1	2013	
2012		2012	
2011		2011	

- Total Questions in last 10 years: 4 (JEE-Advanced) and 8 (JEE-Main)

Q. Consider a galvanometer shunted with 5Ω resistance and 2% of current passes through it.

What is the resistance of the given galvanometer ? [JEE-Main-2021]

(1) 300 Ω

(2) 344 Ω

(3) 245 Ω

(4) 226 Ω

Ans. (3)

Q. A galvanometer of resistance G is converted into a voltmeter of range 0 – 1V by connecting a resistance R_1 in series with it. The additional resistance that should be connected in series with R_1 to increase the range of the voltmeter to 0 – 2V will be : [JEE-Main 2020]

(1) R_1

(2) $R_1 + G$

(3) $R_1 - G$

(4) G

Ans. (2)

❖ Potentiometer wire :

$$\varepsilon_0 = \frac{\varepsilon - iR}{L}\ell_1$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	3	2020	-
2019	3	2019	-
2018	1	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-
2011	1	2011	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 12 (JEE-Main)

Q. The given potentiometer has its wire of resistance 10Ω. When the sliding contact is in the middle of the potentiometer wire, the potential drop across 2Ω resistor is :

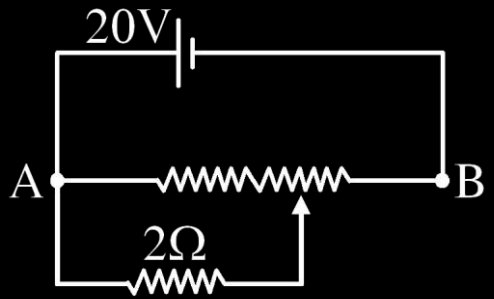
[JEE-Main 2021]

(1) 10 V

(2) 5 V

(3) $\frac{40}{9}$ V

(4) $\frac{40}{11}$ V



Ans. (3)

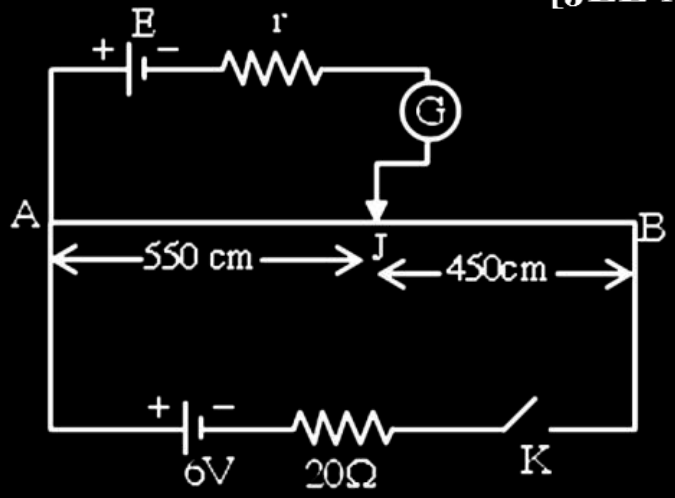
Q. In the given figure, there is a circuit of potentiometer of length AB = 10 m. The resistance per unit length is 0.1 Ω per cm. Across AB, a battery of emf E and internal resistance 'r' is connected. The maximum value of emf measured by this potentiometer is : [JEE Main 2021]

(1) 5 V

(2) 2.25 V

(3) 6 V

(4) 2.75 V



Ans. (1)

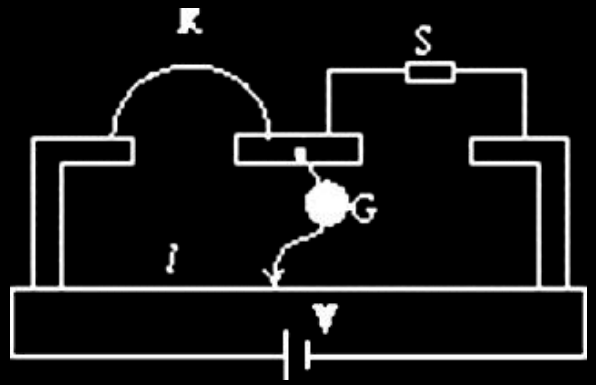
❖ Meter bridge:

$$\frac{x}{y} = \frac{\ell}{100 - \ell}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	1
2020	1	2020	-
2019	4	2019	-
2018	2	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	1	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. In a meter bridge experiment S is a standard resistance. R is a resistance wire. It Is found that balancing length is $l = 25$ cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance l' (in cm) will now be_____.
[JEE-Main 2020]



Ans. (40)

Q. In a meter bridge, as shown in the figure, it is given that resistance Y = 12.5 Ω and that the balance is obtained at a distance 39.5 cm from end A (by Jockey J). After interchanging the resistances X and Y, a new balance point is found at a distance l_2 from end A. What are the values of X and l_2? [JEE-Main 2018]

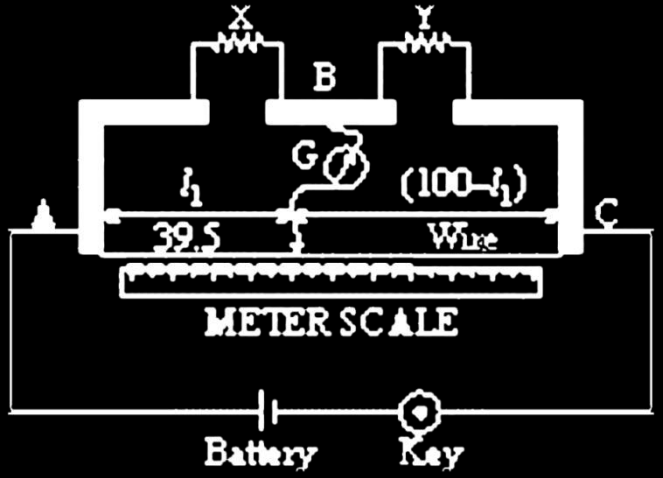
(1) 19.15 Ω and 60.5 cm

(2) 8.16 Ω and 60.5 cm

(3) 8.16 Ω and 39.5 cm

(4) 19.15 Ω and 39.5 cm

Ans. (2)



❖ Wheat stone bridge :

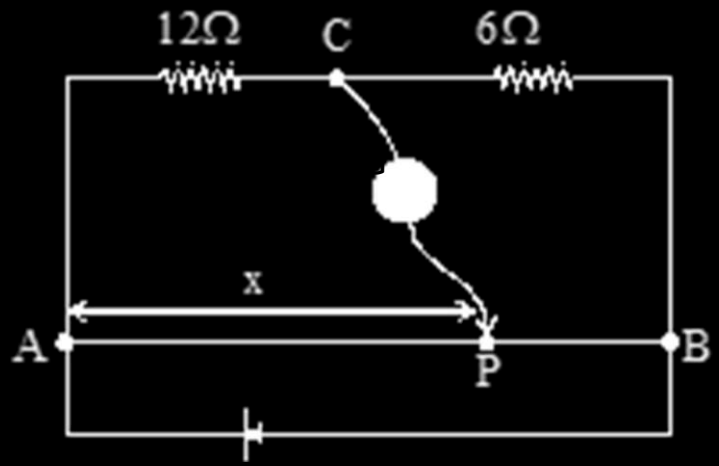
$$\frac{P}{Q} = \frac{R}{S}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1
2011	-	2011	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. Consider a 72 cm long wire AB as shown in the figure. The galvanometer jockey is placed at P on AB at a distance x cm from A. The galvanometer shows zero deflection.

[JEE-Main 2021]



The value of x, to the nearest integer, is

Ans. (48)

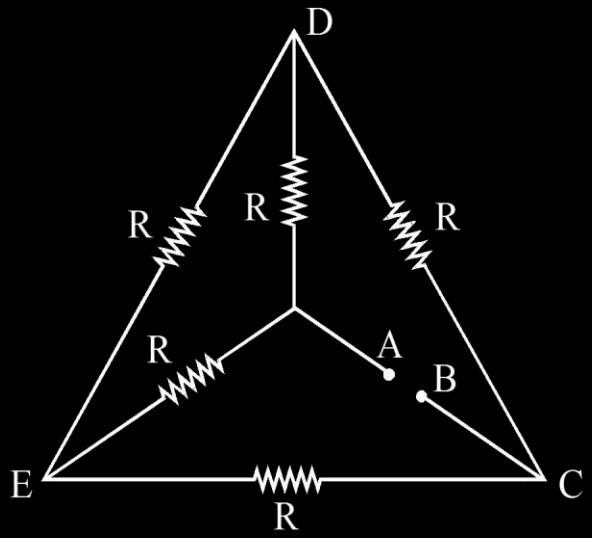
Q. Five equal resistances are connected in a network as shown in figure. The net resistance between the points A and B is : [JEE-Main-2021]

(1) 2R

(2) $\frac{R}{2}$

(3) $\frac{3R}{2}$

(4) R



Ans. (4)

Thanks!

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ELASTICITY & VISCOSITY

❖ Thermal Stress

$$\frac{\text{Thermal Stress}}{\text{Thermal Strain}} = Y$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	2	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. A uniform cylindrical rod of length L and radius r, is made from a material whose Young's modulus of Elasticity equals Y. When this rod is heated by temperature T and simultaneously subjected to a net longitudinal compressional force F, its length remains unchanged. The coefficient of volume expansion, of the material of the rod, is (nearly) equals to : [JEE-Main 2019]

(1) $F/(3\pi r^2 YT)$

(2) $3F/(\pi r^2 YT)$

(3) $6F/(\pi r^2 YT)$

(4) $9F/(\pi r^2 YT)$

Ans. (2)

Q. A steel rod with $y = 2.0 \times 10^{11}\ Nm^{-2}$ and $\alpha = 10^{-5}\ °C^{-1}$ of length 4 m and area of cross-section 10 cm^2 is heated from 0° C to 400°C without being allowed to extend. The tension produced in the rod is $x \times 10^5$ N where the value of x is ..... [JEE-Main 2021]

Ans. 8.00

❖ Series and parallel combination of Young Modulus :

$$y_{eq} = \frac{y_1 + y_2}{2} \text{(Parallel)}$$

$$\frac{1}{y_{eq}} = \frac{1}{y_1} + \frac{1}{y_1} \text{(Series)}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. In an experiment, brass and steel wires of length 1m each with areas of cross section 1 mm^2 are used. the wires are connected in series and one end of the combined wire is connected to a rigid support and other end is subjected to elongation. The stress required to produce a net elongation of 0.2 mm is :

(Given, the Young's Modulus for steel and brass are respectively, 120×10^9 N/m^2 and 60×10^9 N/m^2) [JEE-Main 2019]

(1) 0.2×10^6 N/m^2

(2) 4.0×10^6 N/m^2

(3) 1.8×10^6 N/m^2

(4) 1.2×10^6 N/m^2

Ans. (2)

❖ Young Modulus

$$\frac{\text{longitudinal stress}}{\text{longitudinal strain}} = Y$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	6	2021	-
2020	1	2020	-
2019	6	2019	-
2018	-	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 15 (JEE-Main)

Q. The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by 100°C is :

(For steel Young's modulus is 2×10^{11} N m^{-2} and coefficient of thermal expansion is 1.1×10^{-5} K^{-1}) [JEE-Main 2014]

(1) 2.2×10^{7} Pa

(2) 2.2×10^{6} Pa

(3) 2.2×10^{8} Pa

(4) 2.2×10^{9} Pa

Ans. (3)

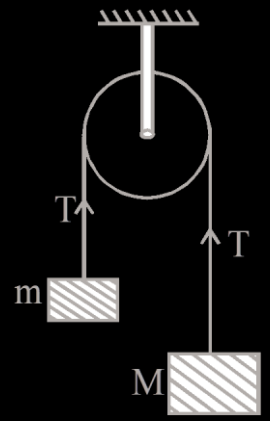
Q. Two blocks of masses m and M are connected by means of a metal wire of cross-sectional area A passing over a frictionless fixed pulley as shown in the figure. The system is then released. If M = 2 m, then the stress produced in the wire is :

(1) $\frac{2mg}{3A}$

(2) $\frac{3mg}{4A}$

(3) $\frac{mg}{A}$

(4) $\frac{4mg}{3A}$



[JEE-Main 2013]

Ans. (4)

❖ Energy density :

$$= \frac{1}{2} \times \text{stress} \times \text{strain}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. Two steel wires having same length are suspended from a ceiling under the same load. If the ratio of their energy stored per unit volume is 1 : 4, the ratio of their diameters is : [JEE-Main 2020]

(1) $1:\sqrt{2}$

(2) 1 : 2

(3) 2 : 1

(4) $\sqrt{2}:1$

Ans. (4)

Q. A boy's catapult is made of rubber cord which is 42 cm long, with 6 mm diameter of cross-section and of negligible mass. The boy keeps a stone weighing 0.02kg on it and stretches the cord by 20 cm by applying a constant force. When released, the stone flies off with a velocity of 20 ms^{-1}. Neglect the change in the area of cross-section of the cord while stretched. The Young's modulus of rubber is closest to: [JEE-Main 2019]

(1) 10^4 Nm^{-2}

(2) 10^8 Nm^{-2}

(3) 10^6 Nm^{-2}

(4) 10^3 Nm^{-2}

Ans. (3)

❖ Poisson's ratio :

$$\sigma = \frac{\text{Lateral strain}(\beta)}{\text{longitudinal strain}(\alpha)}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. In materials like aluminium and copper, the correct order of magnitude of various elastic modulii is :

(1) Bulk modulii < shear moduli < Young's modulii. [JEE-Main 2014]

(2) Young's modulii < shear moduli < bulk modulii.

(3) Bulk modulii < Young's moduli < shear modulii.

(4) Shear modulii < Young's moduli < bulk modulii.

Ans. (4)

❖ Bulk Modulus

$$B = \frac{-\Delta P}{\left(\frac{\Delta V}{V}\right)}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	1
2020	1	2020	-
2019	-	2019	-
2018	1	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 7 (JEE-Main)

Q. When a rubber ball is taken to a depth of _____m in deep sea, its volume decreases by 0.5%. (The bulk modulus of rubber = 9.8×10^8 Nm^{-2} Density of sea water = 10^3 kgm^{-3} , g = 9.8 m/s^2) [JEE-Main 2021]

Ans. 500

Q. An object is located at 2 km beneath the surface of the water. If the fractional compression is 1.36% , the ratio of hydraulic stress to the corresponding hydraulic strain will be _____. [Given : density of water is 1000 kg m^{-3} and g = 9.8 ms^{-2}.]

[JEE-Main 2021]

(1) $1.96 \times 10^7\ Nm^{-2}$

(2) $1.44 \times 10^7\ Nm^{-2}$

(3) $2.26 \times 10^9\ Nm^{-2}$

(4) $1.44 \times 10^9\ Nm^{-2}$

Ans. (4)

❖ Relation between moduli and poisson's ratio

$$K = \frac{Y\eta}{9\eta - 3Y} N/m^2$$

$$Y = 3K(1 - 2\mu)$$

$$Y = 2\eta(1 + \mu)$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. If Y, K and η are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters. **[JEE-Main 2021]**

(1) $Y = \frac{9K\eta}{3K-\eta} N/m^2$

(2) $\eta = \frac{3YK}{9K+Y} N/m^2$

(3) $Y = \frac{9K\eta}{2\eta+3K} N/m^2$

(4) $K = \frac{Y\eta}{9\eta-3Y} N/m^2$

Ans. **(4)**

Thanks!

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ELECTROMAGNETIC WAVES

❖ Velocity of E M Waves :

$$v = \frac{\text{Ang. frequency}}{\text{Wave number}};$$

$$c = f\lambda$$

$$c = \frac{E_0}{B_0}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	-
2020	2	2020	-
2019	3	2019	-
2018	3	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 17 (JEE-Main)

Q. Electric field in a plane electromagnetic wave is given by $E = 50 \sin(500x - 10 \times 10^{10}t)$ V/m.

The velocity of electromagnetic wave in this medium is: [JEE-Main 2021]

(Given C = speed of light in vacuum)

(1) $\frac{3}{2}C$ (2) C (3) $\frac{2}{3}C$ (4) $\frac{C}{2}$

Ans. (3)

Q. An EM wave from air enters a medium. The electric fields are $\vec{E}_1 = E_{01}\hat{x}\cos\left[2\pi\nu\left(\frac{z}{c}-t\right)\right]$ in air and $\vec{E}_2 = E_{02}\hat{x}\cos\left[k\left(2z-ct\right)\right]$ in medium, where the wave number k and frequency v refer to their values in air. The medium is non-magnetic. If $\in_{r_1}$ and $\in_{r_2}$ refer to relative permittivity's of air and medium respectively, which of the following options is correct ? [JEE-Main 2018]

(1) $\frac{\in_{r_1}}{\in_{r_2}} = 2$ (2) $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{4}$ (3) $\frac{\in_{r_1}}{\in_{r_2}} = \frac{1}{2}$ (4) $\frac{\in_{r_1}}{\in_{r_2}} = 4$

Ans. (2)

Q. A plane polarized monochromatic EM wave is traveling in vacuum along z direction such that at $t = t_1$ it is found that the electric field is zero at a spatial point z_1. The next zero that occurs in its neighbourhood is at z_2. The frequency of the electromagnetic wave is : [JEE-Main 2018]

(1) $\dfrac{1}{t_1 + \dfrac{|z_2 - z_1|}{3\times10^8}}$

(2) $\dfrac{3\times10^8}{|z_2 - z_1|}$

(3) $\dfrac{6\times10^8}{|z_2 - z_1|}$

(4) $\dfrac{1.5\times10^8}{|z_2 - z_1|}$

Ans. (4)

❖ **Relation between, Electric field, Magnetic field & Velocity of wave.**

$$\vec{E} = \vec{B} \times \vec{C}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	6	2021	-
2020	7	2020	-
2019	5	2019	-
2018	2	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 23 (JEE-Main)

Q. The electric field of a plane electromagnetic wave propagating along the x direction in vacuum is $\vec{E} = E_0\hat{j}\cos(\omega t - kx)$. The magnetic field $\vec{B}$, at the moment t = 0 is :

[JEE-Main 2020]

(1) $\vec{B} = E_0\sqrt{\mu_0 \in_0}\cos(kx)\hat{j}$

(2) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \in_0}}\cos(kx)\hat{k}$

(3) $\vec{B} = E_0\sqrt{\mu_0 \in_0}\cos(kx)\hat{k}$

(4) $\vec{B} = \frac{E_0}{\sqrt{\mu_0 \in_0}}\cos(kx)\hat{j}$

Ans. (3)

Q. In a plane electromagnetic wave, the directions of electric field and magnetic field are represented by $\hat{k}$ and $2\hat{i}-2\hat{j}$, respectively. What is the unit vector along direction of propagation of the wave. [JEE-Main2020]

(1) $\frac{1}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$

(2) $\frac{1}{\sqrt{5}}\left(\hat{i}+2\hat{j}\right)$

(3) $\frac{1}{\sqrt{5}}\left(2\hat{i}+\hat{j}\right)$

(4) $\frac{1}{\sqrt{2}}\left(\hat{j}+\hat{k}\right)$

Ans. (1)

❖ Energy Density:-

$$\frac{dU}{dV} = \frac{B_0^2}{2\mu_0} = \frac{1}{2}\varepsilon_0 E_0^2$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. A plane electromagnetic wave, has frequency of 2.0×10^{10} Hz and its energy density is 1.02×10^{-8} J/ m^3 in vacuum. The amplitude of the magnetic field of the wave is close to ($\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \frac{Nm^2}{C^2}$ and speed of light = 3×10^8 ms^{-1}) : [JEE-Main 2020]

(1) 180 nT

(2) 160 nT

(3) 150 nT

(4) 190 nT

Ans. (2)

Q. During the propagation of electromagnetic waves in a medium : [JEE-Main 2014]

(1)Electric energy density is equal to the magnetic energy density

(2) Both electric magnetic energy densities are zero

(3) Electric energy density is double of the magnetic energy density

(4) Electric energy density is half of the magnetic energy density.

Ans. (1)

❖ **Intensity:**

$$I = \frac{\text{Power}}{\text{Area}} = \frac{1}{2}\varepsilon_0 E_0^2 C$$

$$= \frac{B_0^2 C}{2\mu_0}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	-	2020	-
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ **Total Questions in last 10 years: 0 (JEE-Advanced) and 7 (JEE-Main)**

Q. Intensity of sunlight is observed as 0.092 Wm^{-2} at a point in free space. What will be the peak value of magnetic field at that point?

($\varepsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$) [JEE-Main 2021]

(1) 2.77×10^{-8} T

(2) 1.96×10^{-8} T

(3) 8.31 T

(4) 5.88 T

Ans. (1)

Q. A 27 mW laser beam has a cross-sectional area of 10 mm^2. The magnitude of the maximum electric field in this electromagnetic wave is given by [Given permittivity of space $\epsilon_0 = 9 \times 10^{-12}$ SI units, Speed of light $c = 3 \times 10^8$ m/s]:- [JEE-Main 2019]

(1) 1 kV/m

(2) 2 kV/m

(3) 1.4 kV/m

(4) 0.7 kV/m

Ans. (3)

Q. An electromagnetic wave of intensity 50 Wm^{-2} enters in a medium of refractive index 'n' without any loss. The ratio of the magnitudes of electrric fields, and the ratio of the magnitudes of magnetic fields of the wave before and after entering into the medium are respectively, given by : [JEE-Main 2019]

(1) $\left(\frac{1}{\sqrt{n}}, \frac{1}{\sqrt{n}}\right)$

(2) $\left(\sqrt{n}, \frac{1}{\sqrt{n}}\right)$

(3) $\left(\sqrt{n}, \sqrt{n}\right)$

(4) $\left(\frac{1}{\sqrt{n}}, \sqrt{n}\right)$

Ans. (2)

❖ Radiation Pressure:

$$P = \frac{2 \times (\text{Intensity})}{C}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. The electric field in a plane electromagnetic wave is given by

$$\vec{E} = 200\cos\left[\left(\frac{0.5\times10^{3}}{m}\right)x - \left(1.5\times10^{11}\,\frac{rad}{s}\times t\right)\right]\frac{V}{m}\hat{j}$$

If this wave falls normally on a perfectly reflecting surface having an area of 100 cm^2. If the radiation pressure exerted by the E.M. wave on the surface during a 10 minute exposure is $\frac{x}{10^9}\frac{N}{m^2}$. Find the value of x. [JEE-Main 2021]

Ans. (354)

Thanks!

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ELECTROSTATICS

❖ Coulomb's Law

$$|\vec{F}| = \frac{K|Q_1Q_2|}{r^2}$$

$$\vec{F}_{21} = \frac{KQ_1Q_2}{|\vec{r}_2 - \vec{r}_1|^3}(\vec{r}_2 - \vec{r}_1)$$

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + ...$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	1	2013	-
2012	-	2012	-

Total Questions in last 10 years in 1 (JEE-Advanced) and 10 (JEE-Main)

Q. Three charges +Q, q, + Q are placed respectively, at distance, 0, d/2 and d from the origin, on the x-axis. If the net force experienced by + Q, placed at x= 0, is zero, then value of q is : [JEE-Main 2019]

(1) +Q/2

(2) –Q/2

(3) –Q/4

(4) +Q/4

Ans. (3)

Q. Two charges,each equal to q, are kept at x = –a and x = a on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (y << a) along the y-axis, the net force acting on the particle is proportional to [JEE-Main 2013]

(1) y

(2) –y

(3) $\frac{1}{y}$

(4) $-\frac{1}{y}$

Ans. (1)

❖ Electric field due to point charge

$$|\vec{E}| = \frac{K|Q|}{r^2}$$

$$\vec{E} = \frac{KQ\vec{r}}{r^3}$$

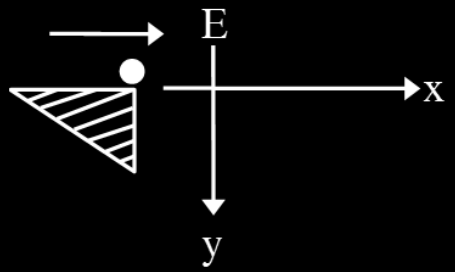
$$\vec{E} = \vec{E}_1 + \vec{E}_2 + ...$$

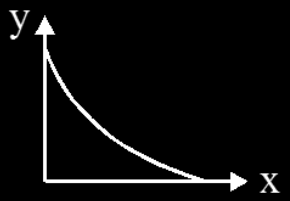
$$\vec{F} = q\vec{E}$$

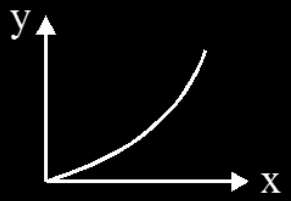
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	-
2020	7	2020	1
2019	3	2019	-
2018	1	2018	2
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	1	2012	1

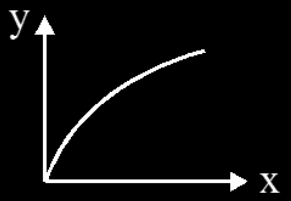
Total Questions in last 10 years in 5 (JEE-Advanced) and 20 (JEE-Main)

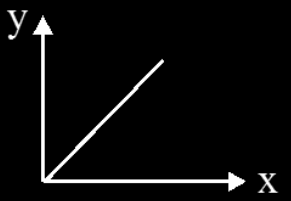
Q. A small point mass carrying some positive charge on it, is released from the edge of a table. There is a uniform electric field in this region in the horizontal direction. Which of the following options then correctly describe the trajectory of the mass ? (Curves are drawn schematically and are not to scale). [JEE-Main 2020]



(1) 

(2) 

(3) 

(4) 

Ans. (4)

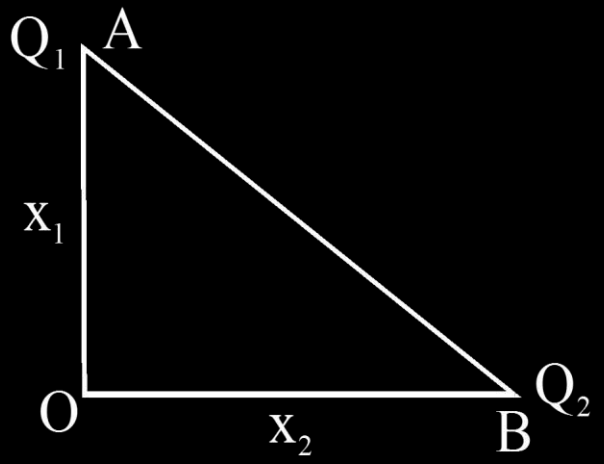
Q. Charges Q_1 and Q_2 arc at points A and B of a right angle triangle OAB (see figure). The resultant electric field at point O is perpendicular to the hypotenuse, then Q_1/Q_2 is proportional to : [JEE-Main 2020]

(1) $\frac{x_2^2}{x_1^2}$

(2) $\frac{x_1^3}{x_2^3}$

(3) $\frac{x_1}{x_2}$

(4) $\frac{x_2}{x_1}$



Ans. (3)

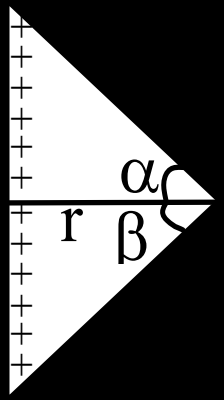
❖ Electric field due to uniforma line charge

$$E_x = \frac{K\lambda}{r}(\sin\alpha + \sin\beta)$$

$$E_y = \frac{K\lambda}{r}(\cos\alpha - \cos\beta)$$

$$E_{\text{infinite wire}} = \frac{2K\lambda}{r}$$

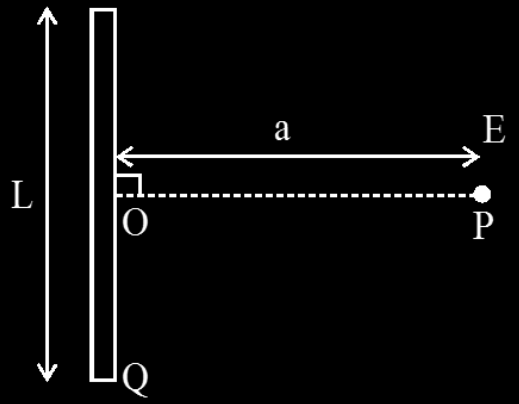
λ – Charge per unit length



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	2
2017	-	2017	-
2016	-	2016	1
2015	-	2015	1
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 5 (JEE-Advanced) and 3 (JEE-Main)

Q. Find the electric field at point P (as shown in figure) on the perpendicular bisector of a uniformly charged thin wire of length L carrying a charge Q. The distance of the point P from the centre of the rod is $a = \frac{\sqrt{3}}{2}L$. [JEE-Main 2021]



(1) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 L^2}$

(2) $\frac{Q}{3\pi\varepsilon_0 L^2}$

(3) $\frac{Q}{2\sqrt{3}\pi\varepsilon_0 L^2}$

(4) $\frac{Q}{4\pi\varepsilon_0 L^2}$

Ans. **(3)**

Q. Find out the surface charge density at the intersection of point x = 3 m plane and x-axis, in the region of uniform line charge of 8 nC/m lying along the z-axis in free space. [JEE Main 2021]

(1) 0.424 nC m^{-2}

(2) 47.88 C/m

(3) 0.07 nC m^{-2}

(4) 4.0 nC m^{-2}

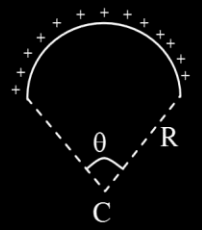
Ans. (1)

❖ Electric field due to uniform charged arc

λ – Charge Per Unit length

$$E = \frac{2K\lambda}{R}\sin\theta/2 \quad \text{along angle bisector}$$

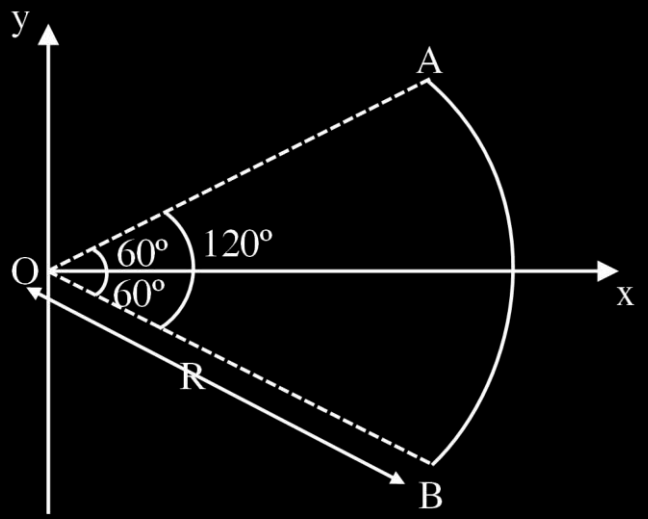
$$E_{\text{semi-circular}} = \frac{2K\lambda}{R}, \quad E_{\text{quarter}} = \frac{\sqrt{2}K\lambda}{R}$$



JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 1 (JEE-Advanced) and 1 (JEE-Main)

Q. Figure shows a rod AB, which is bent in a 120° circular arc of radius R. A charge (–Q) is uniformly distributed over rod AB. What is the electric field $\vec{E}$ at the centre of curvature O ? [JEE-Main 2021]



(1) $\frac{3\sqrt{3}\,Q}{8\pi\varepsilon_0 R^2}\left(\hat{i}\right)$

(2) $\frac{3\sqrt{3}\,Q}{8\pi^2\varepsilon_0 R^2}\left(\hat{i}\right)$

(3) $\frac{3\sqrt{3}\,Q}{16\pi^2\varepsilon_0 R^2}\left(\hat{i}\right)$

(4) $\frac{3\sqrt{3}\,Q}{8\pi^2\varepsilon_0 R^2}\left(-\hat{i}\right)$

Ans. (2)

❖ Electric field due to uniformly charged Hollow sphere or Conducting Hollow or solid sphere.

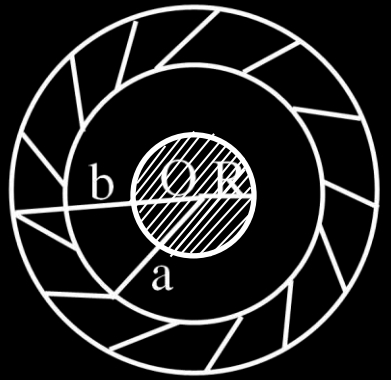
$$E = \frac{KQ}{r^2} \quad ; \quad r \geq R$$

$$= 0 \quad ; \quad r < R$$

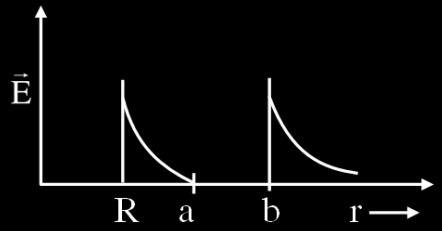
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	1

Total Questions in last 10 years in 1 (JEE-Advanced) and 3 (JEE-Main)

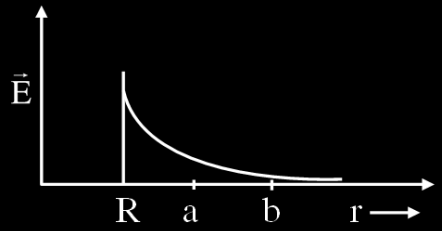
Q. A solid metal sphere of radius R having charge q is enclosed inside the concentric spherical shell of inner radius a and outer radius b as shown in figure. The approximate variation electric field $\vec{E}$ as a function of distance r from centre O is given by [JEE-Main 2021]



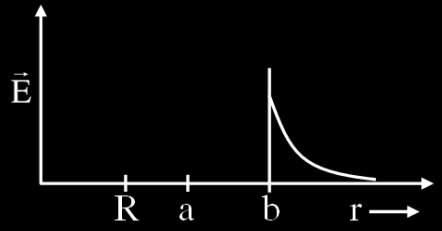
(1)



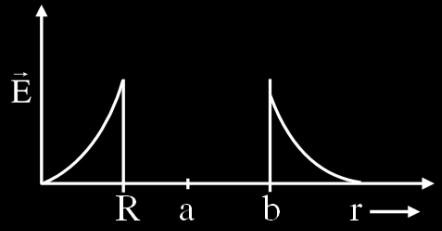
(2)



(3)



(4)



Ans. **(1)**

Q. Consider the force F on a charge 'q' due to a uniformly charged spherical shell of radius R carrying charge Q distributed uniformly over it. Which one of the following statements is true for F, if 'q' is placed at distance r from the centre of the shell ? [JEE-Main 2020]

(1) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$ **for r > R**

(2) $\frac{1}{4\pi\varepsilon_0}\frac{qQ}{R^2} > F > 0$ **for r < R**

(3) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r^2}$ **for all r**

(4) $F = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{R^2}$ **for r < R**

Ans. **(1)**

❖ Electric field due to uniformly charged solid sphere :

$$\vec{E} = \frac{KQ\vec{r}}{r^3} \quad ; \quad r \geq R$$

$$= \frac{KQ\vec{r}}{R^3} \text{ OR } \frac{\rho\vec{r}}{3\epsilon_0} \quad ; \quad r < R$$

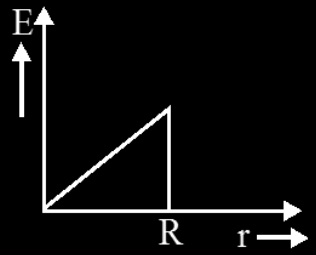
ρ = Volume Charge Density

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	1
2012	1	2012	1

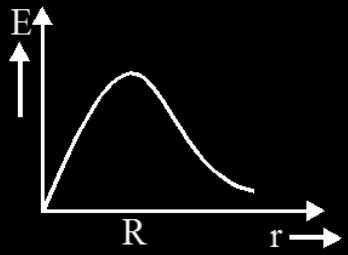
Total Questions in last 10 years in 3 (JEE-Advanced) and 1 (JEE-Main)

Q. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as a function of distance from the centre. The graph which would correspond to the above will be : [JEE-Main 2012]

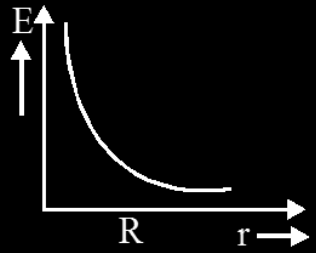
(1)



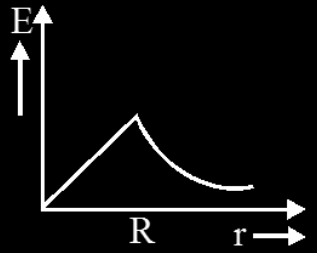
(2)



(3)



(4)



Ans. (4)

❖ Electric field due to uniformly charged disk on axis.

$$E = \frac{\sigma}{2\varepsilon_0}\left(1 - \frac{x}{\sqrt{x^2 + R^2}}\right)$$

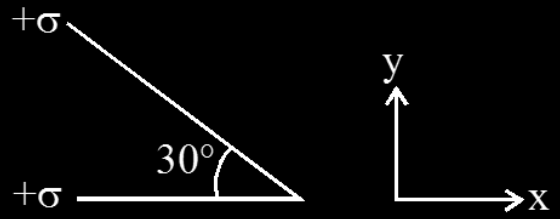
$$E_{\text{infinite disk}} = \frac{\sigma}{2\varepsilon_0} \quad ; R >> x$$

σ – Surface Charge Density

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	1
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 2 (JEE-Advanced) and 3 (JEE-Main)

Q. Two infinite planes each with uniform surface charge density + σ are kept in such a way that the angle between them is 30°. The electric field in the region shown between them is given by : [JEE-Main-2020]



(1) $\frac{\sigma}{\varepsilon_0}\left[\left(1+\frac{\sqrt{3}}{2}\right)\hat{y}+\frac{\hat{x}}{2}\right]$

(2) $\frac{\sigma}{2\varepsilon_0}\left[\left(1-\frac{\sqrt{3}}{2}\right)\hat{y}-\frac{\hat{x}}{2}\right]$

(3) $\frac{\sigma}{2\varepsilon_0}\left[\left(1+\sqrt{3}\right)\hat{y}+\frac{\hat{x}}{2}\right]$

(4) $\frac{\sigma}{2\varepsilon_0}\left[\left(1+\sqrt{3}\right)\hat{y}-\frac{\hat{x}}{2}\right]$

Ans. (2)

Q. A uniformly charged disc of radius R having surface charge density σ is placed in the xy plane with its center at the origin. Find the electric field intensity along the z-axis at a distance Z from origin :- [JEE-Main 2021]

(1) $E = \frac{\sigma}{2\varepsilon_0}\left(1 - \frac{Z}{(Z^2 + R^2)^{1/2}}\right)$

(2) $E = \frac{\sigma}{2\varepsilon_0}\left(1 + \frac{Z}{(Z^2 + R^2)^{1/2}}\right)$

(3) $E = \frac{2\varepsilon_0}{\sigma}\left(\frac{1}{(Z^2 + R^2)^{1/2}} + Z\right)$

(4) $E = \frac{\sigma}{2\varepsilon_0}\left(\frac{1}{(Z^2 + R^2)} + \frac{1}{Z^2}\right)$

Ans. **(1)**

❖ Electric field due to uniformly charged ring on axis

$$E = \frac{KQX}{(R^2 + x^2)^{3/2}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. For a uniformly charged ring of radius R, the electric field on its axis has the largest magnitude at a distance h from its centre. Then value of h is : [JEE-Main 2019]

(1) $\frac{R}{\sqrt{5}}$

(2) R

(3) $\frac{R}{\sqrt{2}}$

(4) $R\sqrt{2}$

Ans. (3)

❖ Electric field due to infinite uniformly charged solid cylinder

$$E = \frac{\rho R^2}{2 r \varepsilon_0} \quad ; r \geq R$$

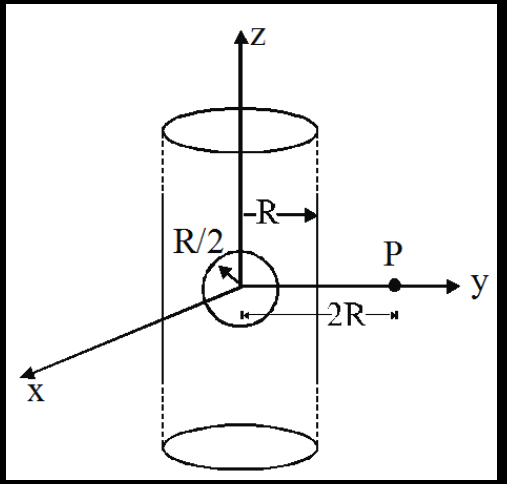
$$= \frac{\rho r}{2 \varepsilon_0} \quad ; r < R$$

ρ = Volume Charge Density

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

Total Questions in last 10 years in 1 (JEE-Advanced) and 0 (JEE-Main)

Q. An infinitely long solid cylinder of radius R has a uniform volume charge density ρ. It has a spherical cavity of radius R/2 with its centre on the axis of the cylinder, as shown in the figure. The magnitude of the electric field at the point P, which is at a distance 2R from the axis of the cylinder, is given by the expression $\frac{23\rho R}{16k\varepsilon_0}$. The value of k is: [JEE Advanced-2012]



Ans. 6

❖ Electric field in spherical cavity of uniformly charged solid sphere.

$$\vec{E} = \frac{\rho \overrightarrow{C_1C_2}}{3\varepsilon_0}$$

ρ = volume charge Density

C_1 = Centre of Solid Sphere

C_2 = Centre of Cavity

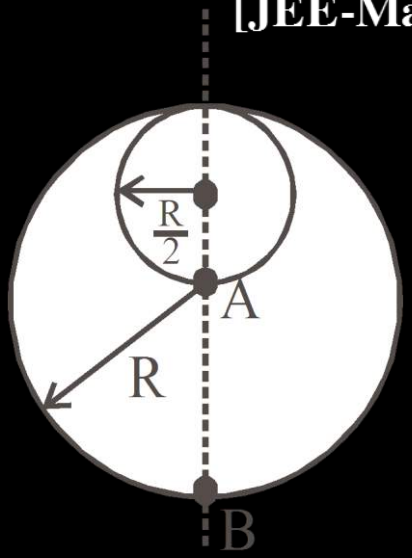
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

Total Questions in last 10 years in 2 (JEE-Advanced) and 1 (JEE-Main)

Q. Consider a sphere of radius R which carries a uniform charge density ρ. If a sphere of radius $\frac{R}{2}$ is carved out of it, as shown, the ratio $\frac{|\vec{E}_A|}{|\vec{E}_B|}$ of magnitude of electric field $\vec{E}_A$ and $\vec{E}_B$, respectively, at points A and B due to the remaining portion is : [JEE-Main 2020]

(1) $\frac{18}{54}$ **(2)** $\frac{21}{34}$

(3) $\frac{17}{54}$ **(4)** $\frac{18}{34}$



Ans. **(4)**

❖ Electric potential due to point charge :

$$V = \frac{KQ}{r}$$

$$V = V_1 + V_2 + \ldots$$

Electrostatic potential Energy

$$U = \frac{Kq_1q_2}{r}$$

$$U = (U_{12} + U_{13} + \ldots\ldots + U_{1n}) + (U_{23} + U_{24} + \ldots\ldots + U_{2n}) + \ldots.$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	1
2020	2	2020	-
2019	2	2019	1
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

Total Questions in last 10 years in 4 (JEE-Advanced) and 4 (JEE-Main)

Q. Ten charges are placed on the circumference of a circle of radius R with constant angular separation between successive charges. Alternate charges 1, 3, 5, 7, 9 have charge (+q) each, while 2, 4, 6, 8, 10 have charge (–q) each. The potential V and the electric field E at the centre of the circle are respectively:

(Take V = 0 at infinity) [JEE-Main 2020]

(1) $V = \frac{10q}{4\pi \in_0 R}; E = \frac{10q}{4\pi \in_0 R^2}$

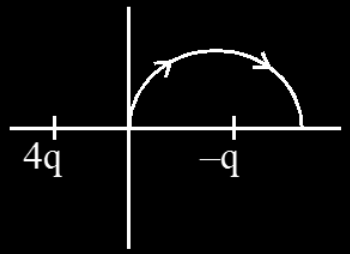
(2) $V = 0, E = \frac{10q}{4\pi \in_0 R^2}$

(3) V = 0, E = 0

(4) $V = \frac{10q}{4\pi \in_0 R}; E = 0$

Ans. (3)

Q. A two point charges 4q and –q are fixed on the x-axis at $x = -\frac{d}{2}$ and $x = \frac{d}{2}$, respectively. If a third point charge 'q' is taken from the origin to x = d along the semicircle as shown in the figure, the energy of the charge will : [JEE-Main 2020]



(1) increase by $\frac{2q^2}{3\pi\varepsilon_0 d}$

(2) increase by $\frac{3q^2}{4\pi\varepsilon_0 d}$

(3) decrease by $\frac{4q^2}{3\pi\varepsilon_0 d}$

(4) decrease by $\frac{q^2}{4\pi\varepsilon_0 d}$

Ans. (3)

❖ Electric potential due to uniformly charge ring on axis :

$$V = \frac{KQ}{\sqrt{r^2 + R^2}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. The two thin coaxial rings, each of radius 'a' and having charges +Q and –Q respectively are separated by a distance of 's'. The potential difference between the centres of the two rings is : [JEE-Main 2021]

(1) $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{a}+\frac{1}{\sqrt{s^2+a^2}}\right]$

(2) $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a}+\frac{1}{\sqrt{s^2+a^2}}\right]$

(3) $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a}-\frac{1}{\sqrt{s^2+a^2}}\right]$

(4) $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{a}-\frac{1}{\sqrt{s^2+a^2}}\right]$

Ans. (4)

❖ Electric potential due to uniformly charged solid sphere :

$$V = \frac{KQ}{r} \quad ; r \geq R$$

$$= \frac{KQ}{2R^3}\left(3R^2 - r^2\right) \quad ; 0 < r < R$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 2 (JEE-Main)

Q. 512 identical drops of mercury are charged to a potential of 2V each. The drops are joined to form a single drop. The potential of this drop is ____ V.

[JEE-Main 2021]

Ans. 128

Q. 20. A uniformally charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials and have radius R_1, R_2, R_3 and R_4 respectively. Then

(1) $R_1 = 0$ and $R_2 < (R_4 - R_3)$ [JEE-Main 2015]

(2) $2R < R_4$

(3) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

(4) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

Ans. (1) or (2)

❖ Electric potential due to uniformly charge hollow sphere or conducting hollow or solid sphere :

$$V = \frac{KQ}{r}; \qquad r \geq R$$

$$= \frac{KQ}{R}; \qquad r < R$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	5	2020	-
2019	2	2019	1
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	1

Total Questions in last 10 years in 2 (JEE-Advanced) and 9 (JEE-Main)

Q. Two isolated conducting spheres S_1 and S_2 of radius $\frac{2}{3}R$ and $\frac{1}{3}R$ have 12 μC and –3 μC charges, respectively, and are at a large distance from each other. They are now connected by a conducting wire. A long time after this is done the charges on S_1 and S_2 are respectively : [JEE-Main 2020]

(1) 6 μC and 3 μC

(2) +4.5 μC and –4.5 μC

(3) 3 μC and 6 μC

(4) 4.5 μC on both

Ans. (1)

Q. Concentric metallic hollow spheres of radii R and 4R hold charges Q_1 and Q_2 respectively. Given that surface charge densities of the concentric spheres are equal, the potential difference V(R) – V(4R) is : [JEE-Main 2020]

(1) $\frac{3Q_1}{16\pi\varepsilon_0 R}$

(2) $\frac{Q_2}{4\pi\varepsilon_0 R}$

(3) $\frac{3Q_1}{4\pi\varepsilon_0 R}$

(4) $\frac{3Q_2}{4\pi\varepsilon_0 R}$

Ans. (1)

❖ Electric field due to dipole :

$$E_{\substack{\text{radial} \\ \text{or axial}}} = \frac{2KP\cos\theta}{r^3}$$

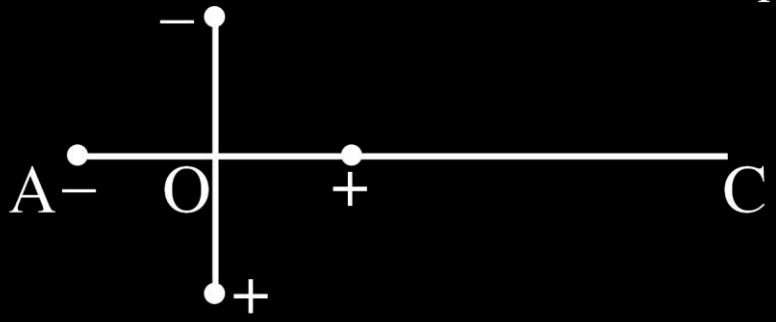
$$E_{\text{equitorial}} = \frac{KP\sin\theta}{r^3}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	1
2018	-	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 2 (JEE-Advanced) and 3 (JEE-Main)

Q. Two ideal electric dipoles A and B, having their dipole moment p_1 and p_2 respectively are placed on a plane with their centres at O as shown in the figure. At point C on the axis of dipole A, the resultant electric field is making an angle of 37° with the axis. The ratio of the dipole moment of A and B, $\frac{p_1}{p_2}$ is : (take $\sin 37° = \frac{3}{5}$)

[JEE-Main 2021]



(1) $\frac{3}{8}$ (2) $\frac{3}{2}$ (3) $\frac{2}{3}$ (4) $\frac{4}{3}$

Ans. (3)

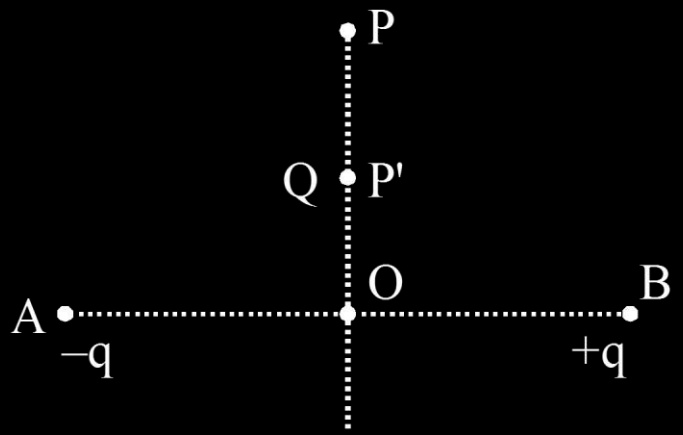
Q. Charges –q and +q located at A and B, respectively, constitute an electric dipole. Distance AB = 2a, O is the mid point of the dipole and OP is perpendicular to AB. A charge Q is placed at P where OP = y and y >> 2a. The charge Q experiences and electrostatic force F. If Q is now moved along the equatorial line to P' such that OP'= $\left(\frac{y}{3}\right)$, the force on Q will be close to : $\left(\frac{y}{3} >> 2a\right)$ [JEE-Main 2019]

(1) $\frac{F}{3}$

(2) 3F

(3) 9F

(4) 27F



Ans. (4)

❖ Electric potential due to dipole :

$$V = \frac{KP\cos\theta}{r^2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	1
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 1 (JEE-Advanced) and 1 (JEE-Main)

Q. Two electric dipoles, A, B with respective dipole moments $\vec{d}_A = -4qa\hat{i}$ and $\vec{d}_B = -2qa\hat{i}$ placed on the x-axis with a separation R, as shown in the figure

The distance from A at which both of them produce the same potential is :

(1) $\frac{\sqrt{2}R}{\sqrt{2}+1}$

(2) $\frac{R}{\sqrt{2}+1}$

[JEE-Main 2019]

(3) $\frac{\sqrt{2}\,R}{\sqrt{2}-1}$

(4) $\frac{R}{\sqrt{2}-1}$

Ans. (3)

❖ Dipole place in uniform electric field :

$$\vec{\tau} = \vec{p} \times \vec{E}$$

$$U = -\vec{P}.\vec{E}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 3 (JEE-Main)

Q. An electric field of 1000 V/m is applied to an electric dipole at angle of 45°. The value of electric dipole moment is 10^{-29} C.m. What is the potential energy of the electric dipole ? [JEE-Main 2019]

(1) -9×10^{-20} J

(2) -7×10^{-27} J

(3) -10×10^{-29} J

(4) -20×10^{-18} J

Ans. (2)

Q. An electric dipole has a fixed dipole moment , which makes angle θ with respect to x-axis. When subjected to an electric field , it experiences a torque . When subjected to another electric field it experiences torque . The angle θ is : [JEE-Main 2017]

(1) 60°
(2) 90°
(3) 30°
(4) 45°

Ans. (1)

❖ Relation between field and potential :

$$\Delta V = -\int_{r_i}^{r_f} \vec{E} \cdot d\vec{r}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	1
2019	1	2019	-
2018	1	2018	-
2017	1	2017	-
2016	-	2016	1
2015	1	2015	-
2014	1	2014	-
2013	-	2013	-
2012	1	2012	-

Total Questions in last 10 years in 2 (JEE-Advanced) and 6 (JEE-Main)

Q. The electric field in a region is given by $\vec{E} = (Ax + B)\hat{i}$, where E is in NC^{-1} and x is in metres. The values of constants are A = 20 SI unit and B = 10 SI unit. If the potential at x = 1 is V_1 and that at x = –5 is V_2, then $V_1 - V_2$ is : [JEE-Main 2019]

(1) –48 V

(2) –520 V

(3) 180 V

(4) 320 V

Ans. (3)

Q. There is a uniform electrostatic field in a region. The potential at various points on a small sphere centred at P, in the region, is found to vary between the limits 589.0 V to 589.8 V. What is the potential at a point on the sphere whose radius vector makes an angle of 60° with the direction of the field ? [JEE-Main 2017]

(1) 589.4 V

(2) 589.5 V

(3) 589.6 V

(4) 589.2 V

Ans. (4)

$$E_x = -\frac{\partial V}{\partial x}$$

$$E_y = -\frac{\partial V}{\partial y}$$

$$E_z = -\frac{\partial V}{\partial z}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	1
2018	-	2018	-
2017	-	2017	1
2016	2	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

Total Questions in last 10 years in 2 (JEE-Advanced) and 5 (JEE-Main)

Q. Within a spherical charge distribution of charge density $\rho(r)$, N equipotential surfaces of potential V_0, $V_0 + \Delta V$, $V_0 + 2\Delta V$, ...$V_0 + N\Delta V$ ($\Delta V > 0$), are drawn and have increasing radii r_0, r_1, r_2,.....r_N, respectively. If the difference in the radii of the surfaces is constant for all values of V_0 and ΔV then :

(1) $\rho(r) \alpha \frac{1}{r^2}$

(2) $\rho(r)$ = constant [JEE-Main2016]

(3) $\rho(r) \alpha \frac{1}{r}$

(4) $\rho(r) \alpha r$

Ans. (3)

Q. The electric potential V(x) in a region around the origin is given by $V(x) = 4x^2$ volts. The electric charge enclosed in a cube of 1m side with its centre at the origin is (in colomb) : [JEE Main 2012]

(1) $8\epsilon_0$

(2) 0

(3) $-8\epsilon_0$

(4) $-4\epsilon_0$

Ans. (3)

❖ Force on dipole :

$$F = p\frac{\partial E}{\partial x}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. An electric dipole is placed on x-axis in proximity to a line charge of linear charge density 3.0×10^{-6} C/m. Line charge is placed on z-axis and positive and negative charge of dipole is at a distance of 10 mm and 12 mm from the origin respectively. If total force of 4 N is exerted on the dipole, find out the amount of positive or negative charge of the dipole. [JEE-Main 2021]

(1) 815.1 nC

(2) 8.8 μC

(3) 0.485 mC

(4) 4.44 μC

Ans. (4)

$$W_{\text{ext. agent}} = \Delta U$$

$$W_{\text{electrostatic field}} = -q(\Delta V)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	1
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 1 (JEE-Advanced) and 3 (JEE-Main)

Q. A uniformly charged ring of radius 3a and total charge q is placed in xy-plane centred at origin. A point charge q is moving towards the ring along the z-axis and has speed u at z = 4a. The minimum value of u such that it crosses the origin is : [JEE-Main 2019]

(1) $\sqrt{\frac{2}{m}}\left(\frac{1}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

(2) $\sqrt{\frac{2}{m}}\left(\frac{2}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

(3) $\sqrt{\frac{2}{m}}\left(\frac{4}{15}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

(4) $\sqrt{\frac{2}{m}}\left(\frac{1}{5}\frac{q^2}{4\pi\varepsilon_0 a}\right)^{1/2}$

Ans. (3)

Q. Four equal point charges Q each are placed in the xy plane at (0, 2), (4, 2), (4, –2) and (0, –2). The work required to put a fifth charge Q at the origin of the coordinate system will be : [JEE-Main 2019]

(1) $\frac{Q^2}{2\sqrt{2}\pi\varepsilon_0}$

(2) $\frac{Q^2}{4\pi\varepsilon_0}\left(1+\frac{1}{\sqrt{5}}\right)$

(3) $\frac{Q^2}{4\pi\varepsilon_0}\left(1+\frac{1}{\sqrt{3}}\right)$

(4) $\frac{Q^2}{4\pi\varepsilon_0}$

Ans. (2)

❖ Self potential energy of unifomly charged hollow sphere or Conducting hollow or solid sphere :

$$U = \frac{Q^2}{8\pi\varepsilon_0 R}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 2 (JEE-Main)

Q. 27 similar drops of mercury are maintained at 10V each. All these spherical drops combine into a single big drop. The potential energy of the bigger drop is ..... times that of a smaller drop.

[JEE-Main 2021]

Ans. 243

Q. The energy stored in the electric field produced by a metal sphere is 4.5 J. If the sphere contains 4 μC charge, its radius will be : [JEE-Main 2017]

[Take = $= 9 \times 10^9$ N – m^2 / C^2]

(1) 32 mm

(2) 20 mm

(3) 16 mm

(4) 28 mm

Ans. (3)

❖ Interaction force between uniformly charged solid sphere or hollow sphere :

$$F_{interaction} = \frac{KQ_1Q_2}{r^2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Two identical conducting spheres with negligible volume have 2.1 nC and –0.1 nC charges, respectively. They are brought into contact and then separated by a distance of 0.5 m. The electrostatic force acting between the spheres is_____$\times 10^{-9}$ N. [JEE Main 2021]

[Given : $4\pi\varepsilon_0 = \frac{1}{9\times10^9}$ SI unit]

Ans. 36

Q. Two identical conducting spheres A and B, carry equal charge. They are separated by a distance much larger than their diameters, and the force between them is F. A third identical conducting sphere, C, is uncharged. Sphere C is first touched to A, then to B, and then removed. As a result, the force between A and B would be equal to :-

[JEE-Main 2018]

(1) $\frac{3F}{8}$

(2) $\frac{F}{2}$

(3) $\frac{3F}{4}$

(4) F

Ans. (1)

❖ Electric field lines :

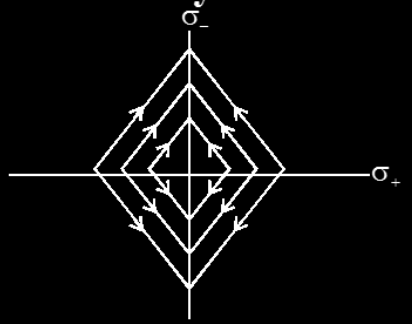
1. Line of force originates out from a positive charge and terminates on a negative charge.
2. Two lines of force never intersect each other.
3. Electric lines of force produced by static charges do not form closed loop.
4. The Number of lines per unit area (line density) represents the magnitude of electric field.
5. Number of lines originating (terminating) at a charge is proportional to the magnitude of charge.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

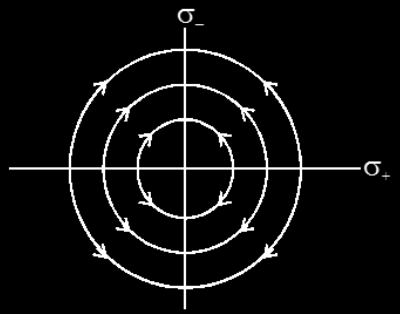
Total Questions in last 10 years in 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Two charged thin infinite plane sheets of uniform surface charge density σ_+ and σ_- where $|\sigma_+| > |\sigma_-|$ intersect at right angle. Which of the following best represents the electric field lines for this system : [JEE Main 2020]

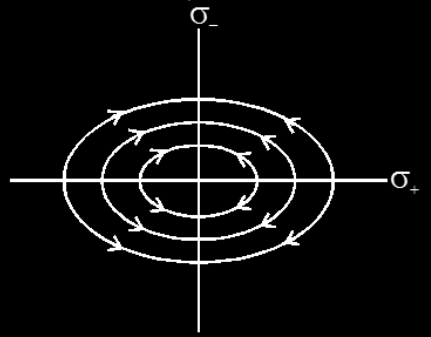
(1)



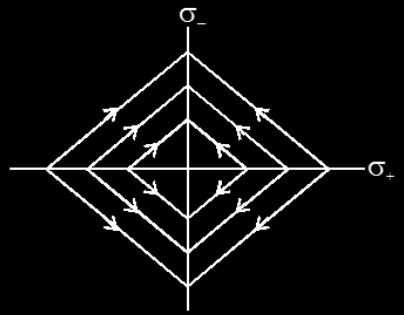
(2)



(3)

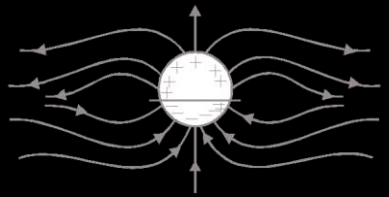


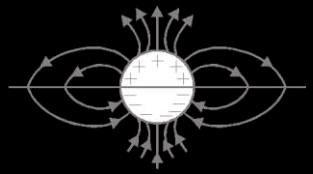
(4)

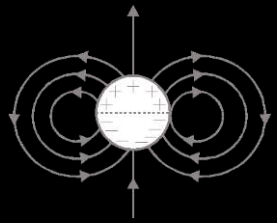


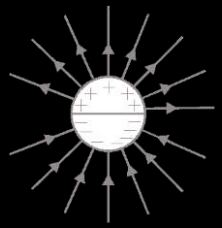
Ans. (1)

Q. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge $-\sigma$ in the lower half. The electric field lines around the cylinder will look like figure given in : (figures are schematic and not drawn to scale) [JEE-Main 2015]

(1) 

(2) 

(3) 

(4) 

Ans. (3)

❖ Conductor :

1. Inside a conductor, electrostatic field is zero
2. The interior of a conductor can have no excess charge in the static situation
3. At the surface of a charged conductor, electrostatic field must be normal to the surface at every point:
4. Electrostatic potential is constant throughout the volume of the conductor and has the same value (as inside) on its surface i.e conductor is an equipotential body:
5. Electric field at the surface of a charged conductor

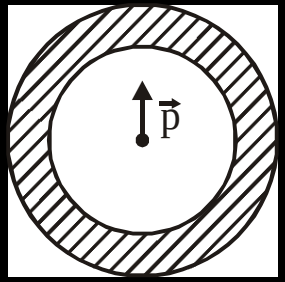
$$E = \frac{\sigma}{\varepsilon_0}\hat{n}$$

σ is the surface charge density.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Shown in the figure is a shell made of a conductor. It has inner radius a and outer radius b, and carries charge Q. At its centre is a dipole $\vec{p}$ as shown. In this case : [JEE Main 2015]



(1) Electric field outside the shell is the same as that of a point charge at the centre of the shell.

(2) Surface charge density on the inner surface of the shell is zero everywhere.

(3) Surface charge density on the inner surface is uniform and equal to $\frac{(Q/2)}{4\pi a^2}$.

(4) Surface charge density on the outer surface depends on $\vec{p}$

Ans. (1)

❖ Gauss law :

$$\text{Electric flux} = \int \vec{E} \cdot d\vec{A}$$

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{en.}}{\varepsilon_0}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	6	2021	-
2020	2	2020	1
2019	1	2019	1
2018	2	2018	1
2017	1	2017	1
2016	1	2016	-
2015	-	2015	1
2014	3	2014	-
2013	-	2013	-
2012	-	2012	1

Total Questions in last 10 years in 6 (JEE-Advanced) and 16 (JEE-Main)

Q. Choose the incorrect statement :

(a) The electric lines of force entering into a Gaussian surface provide negative flux.

(b) A charge 'q' is placed at the centre of a cube. The flux through all the faces will be the same.

(c) In a uniform electric field net flux through a closed Gaussian surface containing no net charge, is zero.

(d) When electric field is parallel to a Gaussian surface, it provides a finite non-zero flux.

Choose the most appropriate answer from the options given below [JEE Main 2021]

(1) (c) and (d) only

(2) (b) and (d) only

(3) (d) only

(4) (a) and (c) only

Ans. (3)

Q. The electric field in a region is given by $\vec{E} = \frac{2}{5}E_0\hat{i} + \frac{3}{5}E_0\hat{j}$ with $E_0 = 4.0 \times 10^3 \frac{N}{C}$.

The flux of this field through a rectangular surface area 0.4 m^2 parallel to the Y – Z plane is _____ Nm^2C^{-1}. [JEE Main 2021]

Ans. 640

Thanks!

PHYSICS FORMULA RACE

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ELECTROMAGNETIC FIELD

❖ Magnetic field at perpendicular point due to current carrying line segment:

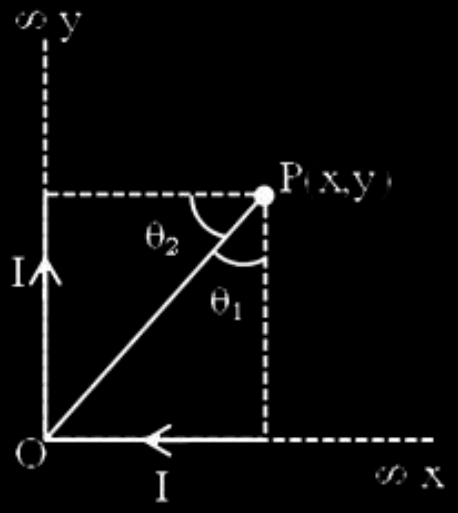
$$B_{\perp} = \frac{\mu_0 I}{4\pi d}[\sin\theta_1 + \sin\theta_2]$$

$$B_{ll} = \frac{\mu_0 I}{4\pi d}[\cos\theta_2 - \cos\theta_1]$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	3	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 10 (JEE-Main)

Q. There are two infinitely long straight current carrying conductors and they are held at right angles to each other so that their common ends meet at the origin as shown in the figure given below. The ratio of current in both conductor is 1 : 1. The magnetic field at point P is ____. [JEE-Main 2021]



(1) $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}+(x+y)\right]$

(2) $\frac{\mu_0 I}{4\pi xy}\left[\sqrt{x^2+y^2}-(x+y)\right]$

(3) $\frac{\mu_0 Ixy}{4\pi}\left[\sqrt{x^2+y^2}-(x+y)\right]$

(4) $\frac{\mu_0 Ixy}{4\pi}\left[\sqrt{x^2+y^2}+(x+y)\right]$

Ans. (A)

Q. A current of 1.5 A is flowing through a triangle, of side 9 cm each. The magnetic field at the centroid of the triangle is : [JEE-Main 2020]

(Assume that the current is flowing in the clockwise direction.)

(1) 3×10^{-7} T, outside the plane of triangle

(2) $2\sqrt{3} \times 10^{-7}$ T, outside the plane of triangle

(3) $2\sqrt{3} \times 10^{-5}$ T, inside the plane of triangle

(4) 3×10^{-5} T, inside the plane of triangle

Ans. (4)

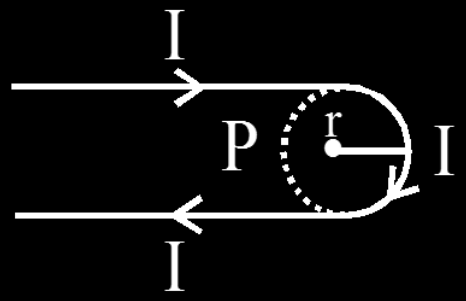
❖ Magnetic field at perpendicular point due to current carrying Infinite line :

$$B = \frac{\mu_0 i}{2\pi d}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	1
2020	1	2020	-
2019	1	2019	-
2018	-	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	1
2012	-	2012	1

☛Total Questions in last 10 years: 5 (JEE-Advanced) and 4 (JEE-Main)

Q. A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point P which lies on the centre of the semicircle ? [JEE-Main 2021]



(1) $\frac{\mu_0 I}{4\pi r}(2-\pi)$ **(2)** $\frac{\mu_0 I}{4\pi r}(2+\pi)$ **(3)** $\frac{\mu_0 I}{2\pi r}(2+\pi)$ **(4)** $\frac{\mu_0 I}{2\pi r}(2-\pi)$

Ans. (2)

❖ Magnetic field at the axis of circular coil:

$$B = \frac{\mu_0 i \cdot R^2}{2(R^2 + x^2)^{3/2}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 3 (JEE-Main)

Q. The fractional change in the magnetic field intensity at a distance 'r' from centre on the axis of current carrying coil of radius 'a' to the magnetic field intensity at the centre of the same coil is : (Take $r < a$) [JEE-Main 2021]

(1) $\frac{3}{2}\frac{a^2}{r^2}$

(2) $\frac{2}{3}\frac{a^2}{r^2}$

(3) $\frac{2}{3}\frac{r^2}{a^2}$

(4) $\frac{3}{2}\frac{r^2}{a^2}$

Ans. (4)

Q. Magnetic fields at two points on the axis of a circular coil at a distance of 0.05 m and 0.2 m from the centre are in the ratio 8 : 1. The radius of coil is ____. [JEE-Main 2021]

(1) 0.2 m

(2) 0.1 m

(3) 0.15 m

(4) 1.0 m

Ans. (2)

❖ Magnetic field at centre of circular coil :

$$B = \frac{\mu_0 i}{2R}$$

$$B_{arc} = \frac{\mu_0 i \cdot \theta}{4\pi R}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	1
2020	-	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 5 (JEE-Main)

Q. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii 'a' and 'b' respectively. Find the magnetic field at centre, when a current I passes through coil :

[JEE-Main 2021]

(1) $\frac{\mu_0 IN}{2(b-a)} \log_e\left(\frac{b}{a}\right)$

(2) $\frac{\mu_0 I}{8}\left[\frac{a+b}{a-b}\right]$

(3) $\frac{\mu_0 I}{4(a-b)}\left[\frac{1}{a}-\frac{1}{b}\right]$

(4) $\frac{\mu_0 I}{8}\left(\frac{a-b}{a+b}\right)$

Ans. (1)

Q. A thin ring of 10 cm radius carries a uniformly distributed charge. The ring rotates at a constant angular speed of 40 π rad s^{-1} about its axis, perpendicular to its plane. If the magnetic field at its centre is 3.8×10^{-9} T, then the charge carried by the ring is close to ($\mu_0 = 4\pi \times 10^{-7}$ N/A^2) : [JEE-Main 2019]

(1) 2×10^{-6} C

(2) 3×10^{-5} C

(3) 4×10^{-5} C

(4) 7×10^{-6} C

Ans. (2)

❖ Magnetic Field inside a long solenoid:

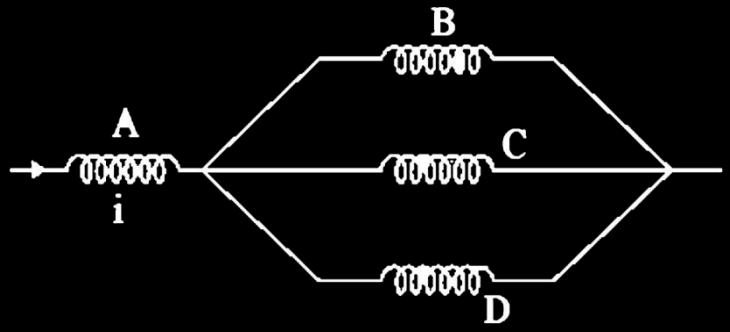
$$B = \mu_0 n i$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Four identical long solenoids A, B, C and D are connected to each other as shown in the figure. If the magnetic field at the center of A is 3T, the field at the center of C would be : (Assume that the magnetic field is confined with in the volume of respective solenoid).

[JEE Main-2021]



(1) 12T (2) 6T (3) 9T (4) 1T

Ans. (4)

Q. A solenoid of 1000 turns per meter has a core with relative permeability 500. Insulated windings of the solenoid carry an electric current of 5A. The magnetic flux density produced by the solenoid is : [JEE-Main 2021]

(permeability of free space = $4\pi \times 10^{-7}$ H/m)

(1) πT

(2) $2 \times 10^{-3}\ \pi$T

(3) $\frac{\pi}{5}$ T

(4) $10^{-4}\pi$T

Ans. (1)

❖ Force on a moving charge in magnetic field :

$$\vec{F} = q\,\vec{v} \times \vec{B}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	6	2020	-
2019	4	2019	-
2018	1	2018	-
2017	1	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 16 (JEE-Main)

Q. The magnetic field vector of an electromagnetic wave is given by $B = B_o \frac{\hat{i}+\hat{j}}{\sqrt{2}} \cos(kz - \omega t)$; where $\hat{i}, \hat{j}$ represents unit vector along x and y-axis respectively. At t = 0 s, two electric charges q_1 of 4π coulomb and q_2 of 2π coulomb located at $\left(0,0,\frac{\pi}{k}\right)$ and $\left(0,0,\frac{3\pi}{k}\right)$, respectively, have the same velocity of 0.5 c $\hat{i}$, (where c is the velocity of light). The ratio of the force acting on charge q_1 to q_2 is :- [JEE-Main 2021]

(1) $2\sqrt{2} : 1$ (2) $1 : \sqrt{2}$ (3) 2 : 1 (4) $\sqrt{2} : 1$

Ans. (3)

Q. A charge Q is moving $\vec{dl}$ distance in the magnetic field $\vec{B}$. Find the value of work done by $\vec{B}$. [JEE-Main 2021]

(1) 1

(2) Infinite

(3) Zero

(4) –1

Ans. (3)

❖ Magnetic force on a current carrying wire :

$$\vec{F} = i\vec{\ell} \times \vec{B}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 3 (JEE-Main)

Q. A square loop of side 2a and carrying current I is kept in xz plane with its centre at origin. A long wire carrying the same current I is placed parallel to z-axis and passing through point (0, b, 0), (b >> a). The magnitude of torque on the loop about z-ax is will be : [JEE-Main 2020]

(1) $\frac{2\mu_0 I^2 a^2 b}{\pi(a^2+b^2)}$

(2) $\frac{\mu_0 I^2 a^2 b}{2\pi(a^2+b^2)}$

(3) $\frac{\mu_0 I^2 a^2}{2\pi b}$

(4) $\frac{2\mu_0 I^2 a^2}{\pi b}$

Ans. **(1)**

Q. A thin strip 10 cm long is on a U shaped wire of negligible resistance and it is connected to a spring of spring constant 0.5 Nm^{-1} (see figure). The assembly is kept in a uniform magnetic field of 0.1 T. If the strip is pulled from its equilibrium position and released, the number of oscillation it performs before its amplitude decreases by a factor of e is N. If the mass of the strip is 50 grams, its resistance 10Ω and air drag negligible, N will be close to :

[JEE-Main 2019]

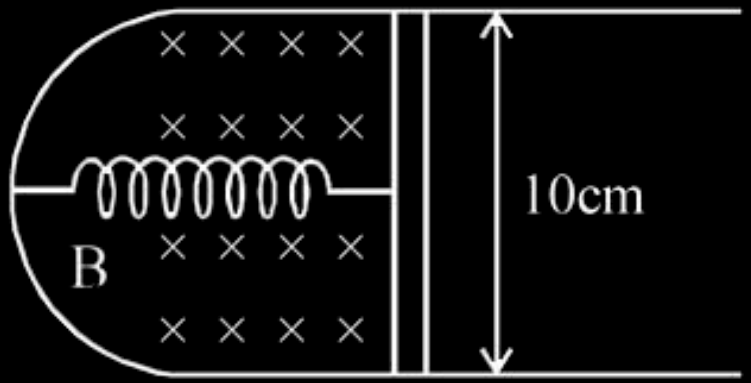
(1) 50000

(2) 5000

(3) 10000

(4) 1000

Ans. (3)



❖ **Radius of circular path of a moving charge in magnetic field :**

$$r = \frac{m\ v}{q\ B}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	1
2020	3	2020	-
2019	2	2019	-
2018	1	2018	1
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	1	2012	-

☛Total Questions in last 10 years: 4 (JEE-Advanced) and 11 (JEE-Main)

Q. Two ions of masses 4 amu and 16 amu have charges +2e and +3e respectively. These ions pass through the region of constant perpendicular magnetic field. The kinetic energy of both ions is same. Then : [JEE-Main 2021]

(1) lighter ion will be deflected less than heavier ion

(2) lighter ion will be deflected more than heavier ion

(3) both ions will be deflected equally

(4) no ion will be deflected.

Ans. (2)

Q. Two ions having same mass have charges in the ratio 1 : 2. They are projected normally in a uniform magnetic field with their speeds in the ratio 2 : 3. The ratio of the radii of their circular trajectories is : [JEE-Main 2021]

(1) 1 : 4

(2) 4 : 3

(3) 3 : 1

(4) 2 : 3

Ans. (2)

❖ Pitch of helical path :

$$\text{Pitch} = \frac{2\pi m}{qB} v\cos\theta$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A beam of protons with speed 4×10^5 ms^{-1} enters a uniform magnetic field of 0.3 T at an angle of 60° to the magnetic field. The pitch of the resulting helical path of protons is close to: (Mass of the proton = 1.67×10^{-27} kg, charge of the proton = 1.69×10^{-19} C

[JEE-Main-2020]

(1) 12 cm

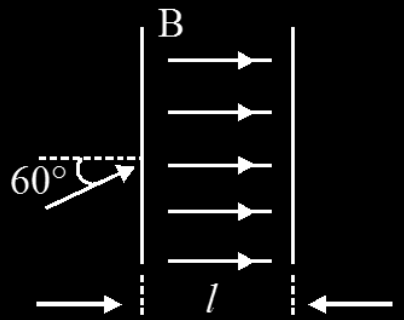
(2) 4 cm

(3) 5 cm

(4) 2 cm

Ans. (2)

Q. The figure shows a region of length 'l' with a uniform magnetic field of 0.3 T in it and a proton entering the region with velocity 4×10^5 ms^{-1} making an angle 60° with the field. If the proton completes 10 revolution by the time it cross the region shown, 'l' is close to (mass of proton = 1.67×10^{-27} kg, charge of the proton = 1.6×10^{-19} C) [JEE-Main 2020]



(1) 0.11 m
(2) 0.22 m
(3) 0.44 m
(4) 0.88 m

Ans. (3)

❖ Magnetic Dipole moment :

$$M = N i A$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	4	2020	-
2019	2	2019	-
2018	2	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 9 (JEE-Main)

Q. A charged particle going around in a circle can be considered to be a current loop. A particle of mass m carrying charge q is moving in a plane with speed v under the influence of magnetic field $\vec{B}$. The magnetic moment of this moving particle : [JEE-Main 2020]

(1) $-\frac{mv^2\vec{B}}{B^2}$

(2) $-\frac{mv^2\vec{B}}{2\pi B^2}$

(3) $\frac{mv^2\vec{B}}{2B^2}$

(4) $-\frac{mv^2\vec{B}}{2B^2}$

Ans. (4)

Q. An iron rod of volume 10^{-3} m^3 and relative permeability 1000 is placed as core in a solenoid with 10 turns/cm. If a current of 0.5 A is passed through the solenoid, then the magnetic moment of the rod will be : [JEE-Main 2020]

(1) 0.5×10^2 Am^2

(2) 50×10^2 Am^2

(3) 500×10^2 Am^2

(4) 5×10^2 Am^2

Ans. (4)

❖ Torque acting on current carrying coil placed in mag. Field.

$$\vec{\tau} = \vec{M} \times \vec{B}$$

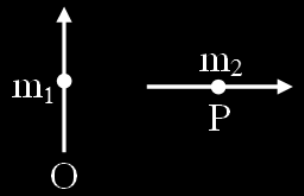
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	3	2020	1
2019	2	2019	-
2018	1	2018	1
2017	-	2017	-
2016	1	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. A coil in the shape of an equilateral triangle of side 10 cm lies in a vertical plane between the pole pieces of permanent magnet producing a horizontal magnetic field 20 mT. The torque acting on the coil when a current of 0.2 A is passed through it and its plane becomes parallel to the magnetic field will be $\sqrt{x} \times 10^{-5}$ Nm. The value of x is..... [JEE-Main 2021]

Ans. (3)

Q. Two short magnetic dipoles m_1 and m_2 each having magnetic moment of 1 Am^2 are placed at point O and P respectively. The distance between OP is 1 meter. The torque experienced by the magnetic dipole m_2 due to the presence of m_1 is ..... $\times 10^{-7}$ Nm. [JEE-Main 2021]



Ans. (1)

❖ Potential energy of a current carrying coil placed in uniform magnetic Field:

$$U = -\vec{M} \cdot \vec{B}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. A circular coil has moment of inertia 0.8 kg m^2 around any diameter and is carrying current to produce a magnetic moment of 20 Am^2. The coil is kept initially in a vertical position and it can rotate freely around a horizontal diameter. When a uniform magnetic field of 4T is applied along the vertical, it starts rotating around its horizontal diameter. The angular speed the coil acquires after rotating by 60° will be : [JEE-Main-2020]

(1) 10 rad s^{-1}

(2) 20 π rad s^{-1}

(3) 10 π rad s^{-1}

(4) 20 rad s^{-1}

Ans. (1)

Q. A magnet of total magnetic moment 10^{-2}A-m^2 is placed in a time varying magnetic field, B(costωt) where B = l Tesla and ω = 0.125 rad/s. The work done for reversing the direction of the magnetic moment at t = 1 second, is [JEE-Main2019]

(1) 0.007 J

(2) 0.014 J

(3) 0.01 J

(4) 0.028 J

Ans. (4)

❖ Ampere's Circuital Law:

$$\oint \vec{B} \cdot \vec{d}\ell = \mu_0 ni$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 2 (JEE-Main)

Q. A coaxial cable consists of an inner wire of radius 'a' surrounded by an outer shell of inner and outer radii 'b' and 'c' respectively. The inner wire carries an electric current i_0, which is distributed uniformly across cross-sectional area. The outer shell carries an equal current in opposite direction and distributed uniformly. What will be the ratio of the magnetic field at a distance x from the axis when (i) $x < a$ and (ii) $a < x < b$? [JEE-Main 2021]

(1) $\frac{x^2}{a^2}$

(2) $\frac{a^2}{x^2}$

(3) $\frac{x^2}{b^2 - a^2}$

(4) $\frac{b^2 - a^2}{x^2}$

Ans. (1)

Q. A long, straight wire of radius a carries a current distributed uniformly over its cross-section. The ratio of the magnetic fields due to the wire at distance a/3 and 2a, respectively from the axis of the wire is: [JEE-Main 2020]

(1) 2

(2) 1/2

(3) 3/2

(4) 2/3

Ans. (4)

❖ Time period of oscillation of current carrying loop in mag. Field:-

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. In a uniform magnetic field, the magnetic needle has a magnetic moment 9.85×10^{-2} A/m^2 and moment of inertia 5×10^{-6} kg m^2. If it performs 10 complete oscillations in 5 seconds then the magnitude of the magnetic field is _____ mT. [Take π^2 as 9.85]

[JEE-Main 2021]

Ans. (8)

Q. A hoop and a solid cylinder of same mass and radius are made of a permanent magnetic material with their magnetic moment parallel to their respective axes. But the magnetic moment of hoop is twice of solid cylinder. They are placed in a uniform magnetic field in such a manner that their magnetic moments make a small angle with the field. If the oscillation periods of hoop and cylinder are T_h and T_c respectively, then : [JEE-Main 2019]

(1) $T_h = 0.5\ T_c$

(2) $T_h = 2\ T_c$

(3) $T_h = 1.5\ T_c$

(4) $T_h = T_c$

Ans. (4)

Thanks!

PHYSICS FORMULA RACE

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ELECTROMAGNETIC INDUCTION

❖ Flux :

$$\phi = \vec{B} \cdot \vec{A}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	1

☛ Total Questions in last 10 years : 2 (JEE-Advanced) and 3 (JEE-Main)

Q. Consider a circular coil of wire carrying constant current I_x, forming magnetic dipole. The magnetic flux through an infinite plane that contains the circular coil and excluding the circular coil area is given by ϕ_r. The magnetic flux through the area of the circular coil area is given by ϕ_0. Which of the following option is correct ?

[JEE-Main 2020]

(1) $\phi_r = \phi_0$

(2) $\phi_r > \phi_0$

(3) $\phi_r < \phi_0$

(4) $\phi_r = -\phi_0$

Ans. (4)

Q. A loop ABCDEFA of straight edges has six corner points A(0,0,0), B(5,0,0), C(5,5,0), D(0, 5, 0), E(0, 5, 5) and F(0, 0, 5). The magnetic field in this region is $\vec{B} = \left(3\hat{i} + 4\hat{k}\right)T$. The quantity of flux through the loop ABCDEFA (in Wb) is _____. [JEE-Main 2020]

Ans. (175)

ELECTROMAGNETIC INDUCTION

❖ Emf induced :

$$e = -\frac{d\phi}{dt}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	6	2020	-
2019	-	2019	-
2018	2	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	2	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years : 1 (JEE-Advanced) and 12 (JEE-Main)

Q. A uniform magnetic field B exists in a direction perpendicular to the plane of a square loop made of a metal wire. The wire has a diameter of 4 mm and a total length of 30 cm. The magnetic field changes with time at a steady rate $dB/dt=0.032\ Ts^{-1}$. The induced current in the loop is close to (Resistivity of the metal wire is $1.23\times10^{-8}\Omega m$) [JEE-Main 2021]

(1) 0.43 A

(2) 0.61 A

(3) 0.34A

(4) 0.53A

Ans. (2)

Q. A planar loop of wire rotates in a uniform magnetic field. Initially, at t = 0, the plane of the loop is perpendicular to the magnetic field. If it rotates with a period of 10 s about an axis in its plane then the magnitude of induced emf will be maximum and minimum, respectively at

[JEE-Main 2020]

(1) 2.5 s and 7.5 s

(2) 5.0 s and 7.5s

(3) 5.0 s and 10.0 s

(4) 2.5s and 5.0 s

Ans. (2)

❖ **Average EMF Induced :**

$$e = -\frac{\Delta \phi}{\Delta t}$$

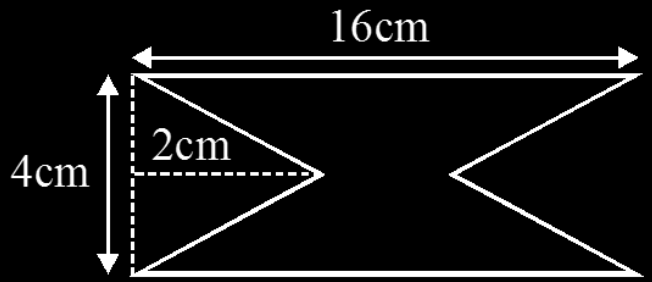
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ **Total Questions in last 10 years : 0 (JEE-Advanced) and 2 (JEE-Main)**

Q. A circular coil of radius 10 cm is placed in a uniform magnetic field of 3.0×10^{-5}T with its plane perpendicular to the field initially. It is rotated at constant angluar speed about an axis along the diameter of coil and perpendicular to magnetic field so that it undergoes half of rotation in 0.2s. The maximum value of EMF induced (in μV) in the coil will be close to the integer_____. [JEE-Main2021]

Ans. (15 μV)

Q. At time t = 0 magnetic field of 1000 Gauss is passing perpendicularly through the area defined by the closed loop shown in the figure. If the magnetic field reduces linearly to 500 Gauss, in the next 5s, then induced EMF in the loop is : [JEE-Main 2020]



(1) 36 μV (2) 48 μV (3) 56 μV (4) 28 μV

Ans. (3)

❖ Emf induced in loop inside a solenoid having varying current :

$$e = \mu_0 n \pi R^2 \frac{di}{dt}$$

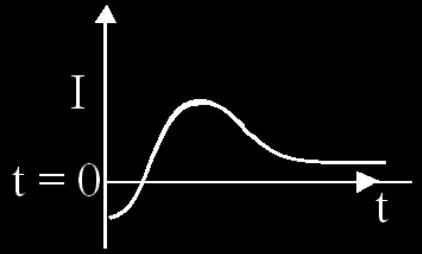
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years : 0 (JEE-Advanced) and 2 (JEE-Main)

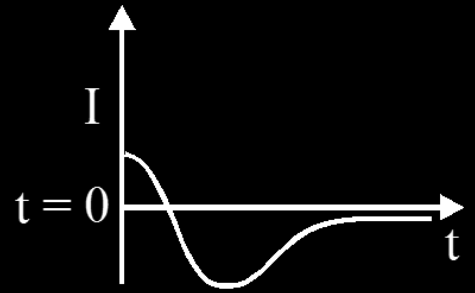
Q. A very long solenoid of radius R is carrying current $I(t) = kte^{-\alpha t}$ $(k>0)$, as a function of time $(t \geq 0)$. Counter clockwise current is taken to be positive. A circular conducting coil of radius 2R is placed in the equatorial plane of the solenoid and concentric with the solenoid. The current induced in the outer coil is correctly depicted, as a function of time, by.

[JEE-Main 2019]

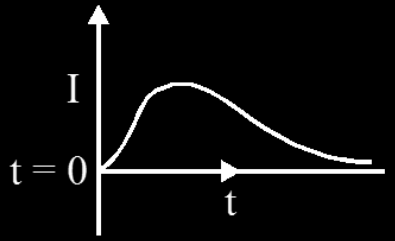
(1)



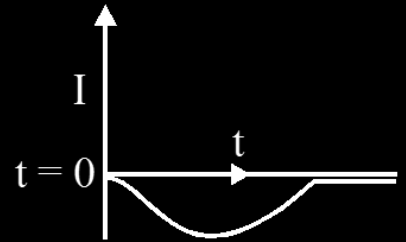
(2)



(3)



(4)



Ans. (1)

❖ Charge flowing in conductor, placed in time varing magnetic field :

$$\Delta Q = \frac{1}{R}\Delta\phi$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A conducting circular loop made of a thin wire, has area $3.5 \times 10^{-3} m^2$ and resistance 10Ω. It is placed perpendicular to a time dependent magnetic field $B(t) = (0.4T) \sin(50\pi t)$. The the net charge flowing through the loop during $t = 0$ s and $t = 10$ ms is close to. [JEE-Main 2019]

(1) 0.14 mC

(2) 7mC

(3) 21mC

(4) 6mC

Ans. (1)

❖ Change in flux in time varying current carrying coil :

$$\Delta\phi = R\int i dt$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

Total Questions in last 10 years : 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Magnetic flux through a coil of resistance 10 Ω is changed by $\Delta\phi$ in 0.1s. The resulting current in the coil varies with time as shown in the figure. Then $\Delta\phi$ is equal to (in weber) :-

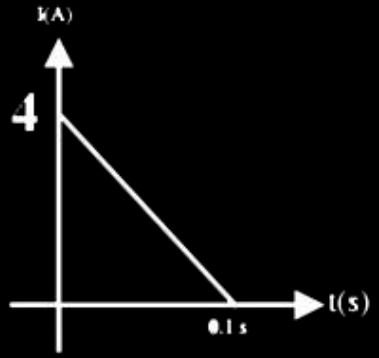
[JEE-Main 2012]

(1) 6

(2) 4

(3) 2

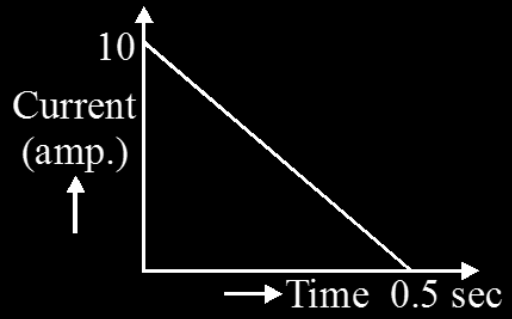
(4) 8



Ans. (3)

Q. In a coil of resistance 100 Ω, a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is :-

[JEE-Main 2017]



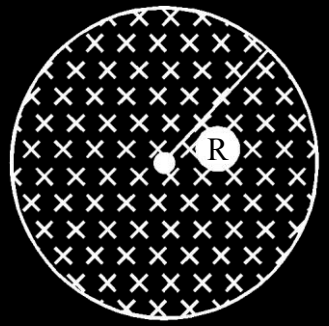
(1) 250 Wb (2) 275 Wb (3) 200 Wb (4) 225 Wb

Ans. (1)

❖ Induced electric field time varying magnetic field :

$$E_{in} = \frac{r}{2}\frac{dB}{dt}$$

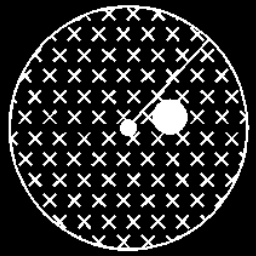
$$E_{out} = \frac{R^2}{2r}\frac{dB}{dt}$$

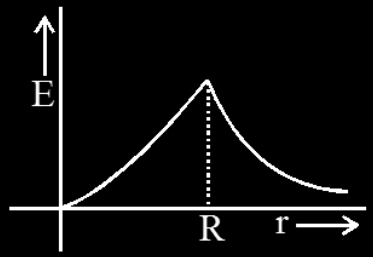


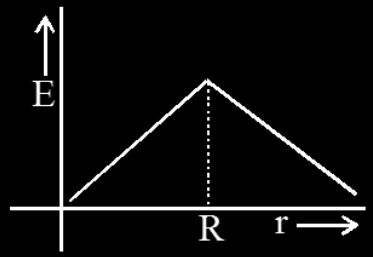
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

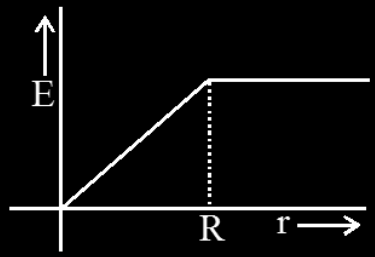
Total Questions in last 10 years : 0 (JEE-Advanced) and 1 (JEE-Main)

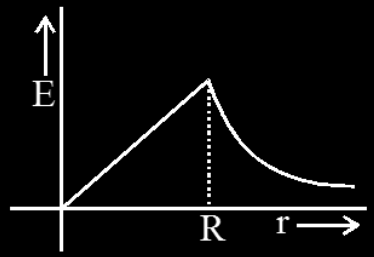
Q. Figure shows a circular area of radius R where a uniform magnetic field $\vec{B}$ is going into the plane of paper and increasing in magnitude at a constant rate. In that case, which of the following graphs, drawn schematically, correctly shows the variation of the induced electric field E(r)? [JEE-Main 2014]



(1) 

(2) 

(3) 

(4) 

Ans. (4)

❖ Motional emf :

$$e = Bv\ell$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	2	2019	2
2018	-	2018	1
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	2	2011	-

Total Questions in last 10 years : 3 (JEE-Advanced) and 5 (JEE-Main)

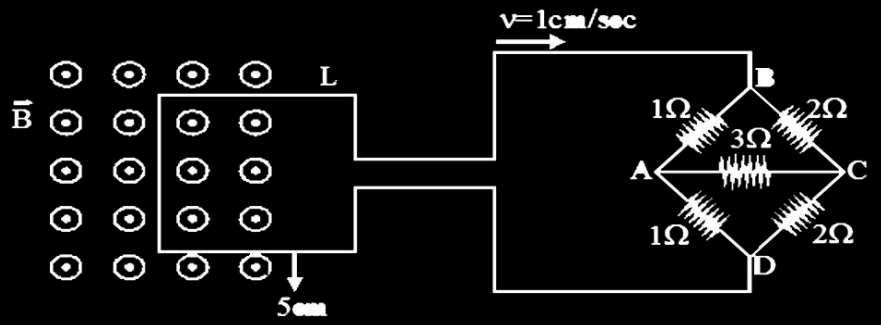
Q. The figure shows a square loop L of side 5 cm which is connected to a network of resistances. The whole setup is moving towards right with a constant speed of 1 cms^{-1}. At some instant, a part of L is in a uniform magnetic field of 1T, perpendicular to the plane of the loop. If the resistance of L is 1.7 Ω, the current in the loop at that instant will be close to [JEE-Main 2022]

(1) 115 μA

(2) 170 μA

(3) 60 μA

(4) 150 μA



Ans. (2)

Q. A 10 m long horizontal wire extends from North East to South West. It is falling with a speed of 5.0 ms^{-1}, at right angles to the horizontal component of the earth's magnetic field of 3×10^{-4} Wb/m^2. The value of the induced emf in wire is : [JEE-Main2019]

(1) 1.5×10^{-3} V

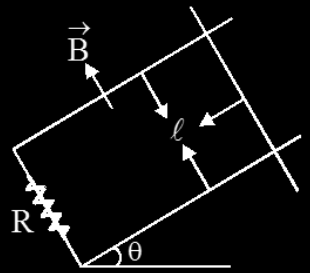
(2) 1.1×10^{-3} V

(3) 2.5×10^{-3} V

(4) 0.3×10^{-3} V

Ans. (1)

Q. A copper rod of mass m slides under gravity on two smooth parallel rails, with separation ℓ and set at an angle of θ with the horizontal. At the bottom, rails are joined by a resistance R. There is a uniform magnetic field B normal to the plane of the rails, as shown in the figure. The terminal speed of the copper rod is : [JEE Main-2018]



(1) $\frac{mgR\sin\theta}{B^2\ell^2}$ (2) $\frac{mgR\cot\theta}{B^2\ell^2}$ (3) $\frac{mgR\tan\theta}{B^2\ell^2}$ (4) $\frac{mgR\cos\theta}{B^2\ell^2}$

Ans. (1)

ELECTROMAGNETIC INDUCTION

❖ Emf induced in rotating rod :

$$e = \int_{x_i}^{x_f} B(\omega x)dx$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

Total Questions in last 10 years : 0 (JEE-Advanced) and 1 (JEE-Main)

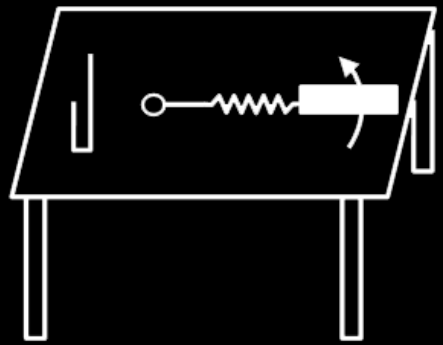
Q. A metallic rod of length 'ℓ' is tied to a string of length 2 ℓ and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is. [JEE-Main 2013]

(1) $\frac{2B\omega\ell^2}{2}$

(2) $\frac{3B\omega\ell^2}{2}$

(3) $\frac{4B\omega\ell^2}{2}$

(4) $\frac{5B\omega\ell^2}{2}$



Ans. (4)

❖ Self Inductance of coil :

$$e = -L\frac{di}{dt}$$

$$L = \frac{\mu_0 N^2 A}{\ell}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years : 0 (JEE-Advanced) and 6 (JEE-Main)

Q. In a fluorescent lamp choke (a small transformer) 100 V of reverse voltage is produced when the choke current changes uniformly from 0.25A to 0 in a duration of 0.025 ms. The self-inductance of the choke (in mH) is estimated to be_____. [JEE-Main 2021]

Ans. (10)

Q. The total number of turns and cross-section area in a solenoid is fixed. However, its length l, is varied by adjusting the separation between windings. The inductance of solenoid will be proportional to : [JEE-Main 2019]

(1) l

(2) l^2

(3) $1/l^2$

(4) $1/l$

Ans. (4)

❖ Mutual Inductance of coils :

$$\phi = Mi$$

$$M = \mu_0 n_1 n_2 \pi r_1^2$$

JEE-Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

☛ Total Questions in last 10 years : 1 (JEE-Advanced) and 2 (JEE-Main)

Q. Two coils 'P' and 'Q' are separated by some distance. When a current of 3 A flows through coil 'P', a magnetic flux of 10^{-3} Wb passes through 'Q'. No current is passed through 'Q'. When no current passes through 'P' and a current of 2 A passes through 'Q', the flux through 'P' is : [JEE-Main 2021]

(1) 6.67×10^{-4} Wb

(2) 6.67×10^{-3} Wb

(3) 3.67×10^{-4} Wb

(4) 3.67×10^{-3} Wb

Ans. (1)

Q. There are two long co-axial solenoids of same length ℓ. The inner and outer coils have radii r_1 and r_2 and number of turns per unit length n_1 and n_2 respectively. The ratio of mutual inductance to the self-inductance of the inner-coil is: [JEE-Main 2019]

(1) $\frac{n_1}{n_2}$ **(2)** $\frac{n_2}{n_1}\frac{r_1}{r_2}$ **(3)** $\frac{n_2}{n_1}\frac{r_2^2}{r_1^2}$ **(4)** $\frac{n_2}{n_1}$

Ans. (4)

ELECTROMAGNETIC INDUCTION

❖ An Ideal Inductor in d.c. circuit behaves as a connecting wire after a long time of switch on.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Total Questions in last 10 years : 1 (JEE-Advanced) and 3 (JEE-Main)

Q. Figure shows a circuit that contains four identical resistors with resistance R = 2.0 Ω, two identical inductors with inductance L = 2.0 mH and an ideal battery with *emf* E = 9 V. The current '*i*' just after the switch 'S' is closed will be : [JEE-Main-2021]

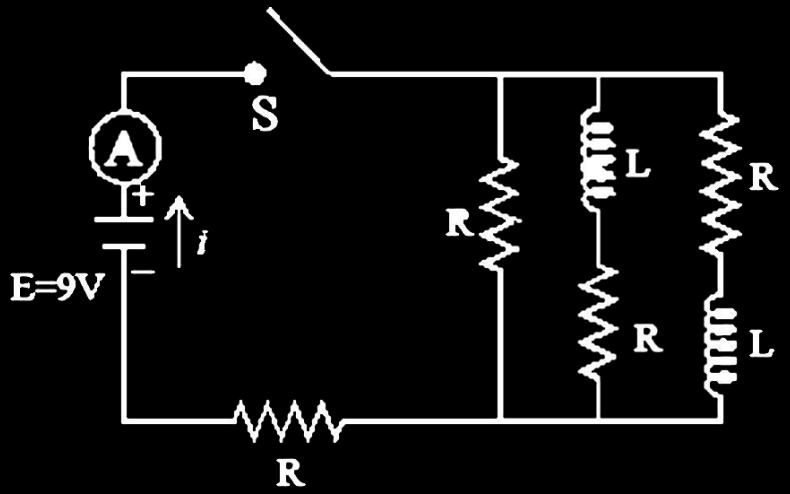
(1) 2.25 A

(2) 3.0 A

(3) 3.37 A

(4) 9 A

Ans. (1)



Q. In the figure shown, a circuit contains two identical resistors with resistance R = 5Ω and an inductance with L = 2mH. An ideal battery of 15 V is connected in the circuit. What will be the current through the battery long after the switch is closed?

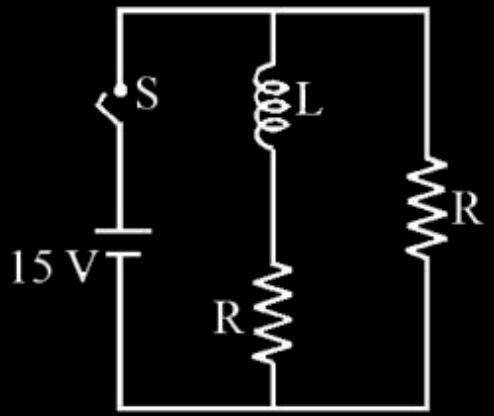
[JEE-Main 2019]

(1) 6A

(2) 7.5A

(3) 5.5A

(4) 3A



Ans. (1)

Thanks!

PHYSICS FORMULA RACE

FLUID MECHANICS & SURFACE TENSION

❖ Archimedes principle : $F_{buoyant} = \rho_{(liquid)} V_{(displaced\ by\ liquid)} g$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	1
2020	5	2020	-
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	1
2013	1	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 4 (JEE-Advanced) and 9 (JEE-Main)

Q. A hollow spherical shell at outer radius R floats just submerged under the water surface. The inner radius of the shell is r. If the specific gravity of the shell material is $\frac{27}{8}$ w.r.t. water, the value of r is : [JEE-Main 2020]

(1) $\frac{4}{9}R$

(2) $\frac{8}{9}R$

(3) $\frac{1}{3}R$

(4) $\frac{2}{3}R$

Ans. (2)

Q. A cubical block of side 0.5 m floats on water with 30% of its volume under water. What is the maximum weight that can be put on the block without fully submerging it under water? [JEE-Main 2019]

(Take density of water = 10^3 kg/m^3)

(1) 65.4 kg

(2) 87.5 kg

(3) 30.1 kg

(4) 46.3 kg

Ans. (2)

❖ Equation of continuity :

AV = constant

$A \rightarrow$ Area

$V \rightarrow$ Velocity

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	2	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	2
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 6 (JEE-Main)

Q. An ideal fluid flows (laminar flow) through a pipe of non-uniform diameter. The maximum and minimum diameters of the pipes are 6.4 cm and 4.8 cm, respectively. The ratio of the minimum and the maximum velocities of fluid in this pipe is : [JEE-Main 2020]

(1) $\frac{\sqrt{3}}{2}$

(2) $\frac{3}{4}$

(3) $\frac{81}{256}$

(4) $\frac{9}{16}$

Ans. (4)

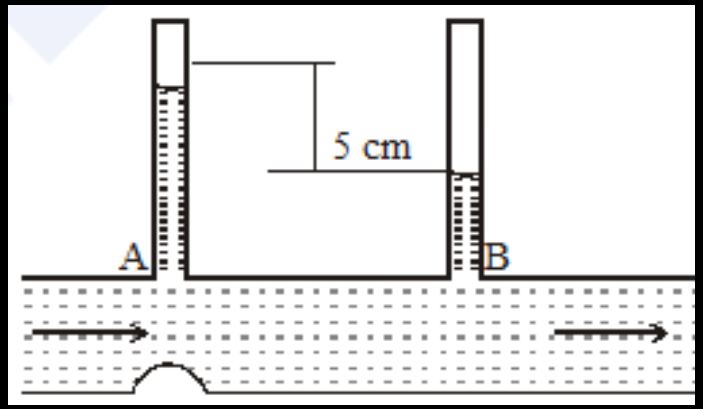
Q. In the diagram shown, the difference in the two tubes of the manometer is 5 cm, the cross section of the tube at A and B is 6 mm^2 and 10 mm^2 respectively. The rate at which water flows through the tube is ($g = 10\ ms^{-2}$) [JEE-Main 2014]

(1) 10.0 cc/s

(2) 7.5 cc/s

(3) 8.0 cc/s

(4) 12.5 cc/s



Ans. (2)

❖ Bernoulli's theorem :

$$\rho + \frac{\rho V^2}{2} + \rho g h = \text{constant}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	1
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. A fluid is flowing through a horizontal pipe of varying cross-section, with speed v ms^{-1} at a point where the pressure is P Pascal. P At another point where pressure is $\frac{P}{2}$ Pascal its speed is V ms^{-1}. If the density of the fluid is ρ kg m^{-3} and the flow is streamline, then V is equal to : [JEE-Main 2020]

(1) $\sqrt{\frac{P}{2\rho}+v^2}$

(2) $\sqrt{\frac{P}{\rho}+v^2}$

(3) $\sqrt{\frac{2P}{\rho}+v^2}$

(4) $\sqrt{\frac{P}{\rho}+v}$

Ans. (2)

Q. Water from a tap emerges vertically downwards with an initial speed of 1.0 ms^{-1}. The cross-sectional area of the tap is 10^{-4} m^2. Assume that the pressure is constant throughout the stream of water and that the flow is streamlined. The cross-sectional area of the stream, 0.15 m below the tap would be : (Take g = 10 ms^{-2}) [JEE-Main 2019]

(1) 1×10^{-5} m^2

(2) 5×10^{-5} m^2

(3) 2×10^{-5} m^2

(4) 5×10^{-4} m^2

Ans. (2)

❖ Speed of Efflux :

$$v = \sqrt{2gh}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to : [JEE-Main 2019]

(1) 9.6 m

(2) 4.8 m

(3) 2.9 m

(4) 6.0 m

Ans. (2)

Q. In a cylindrical water tank, there are two small holes A and B on the wall at a depth of h_1, from the surface of water and at a height of h_2 from the bottom of water tank.

Surface of water is at height H from the bottom of water tank. Water coming out from both holes strikes the ground at the same point S. The ratio of h_1 and h_2 is :- [JEE-Main 2012]

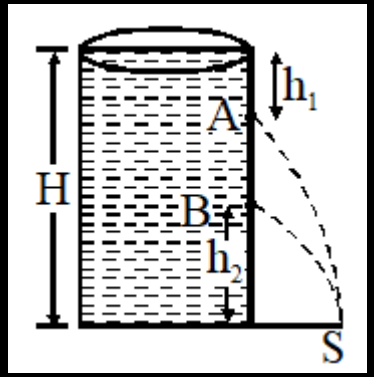
(1) Depends on H

(2) 1 : 2

(3) 2 : 1

(4) 1 : 1

Ans. (4)



❖ Terminal velocity :

$$V_T = \frac{2}{9}\frac{r^2(\rho - \sigma)g}{\eta}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. In an experiment to verify Stokes law, a small spherical ball of radius r and density ρ falls under gravity through a distance h in air before entering a tank of water. If the terminal velocity of the ball inside water is same as its velocity just before entering the water surface, then the value of h is proportional to : (ignore viscosity of air) [JEE-Main 2012]

(1) r (2) r^4 (3) r^3 (4) r^2

Ans. (2)

Q. The terminal velocity of a small sphere of radius a in a viscous liquid is proportional to

[JEE-Main 2012]

(1) a^3

(2) a^2

(3) a

(4) a^{-1}

Ans. (2)

❖ Stoke's law :

$$F = 6\pi\eta rv$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. In an experiment, a small steel ball falls through a liquid at a constant speed of 10 cm/s. If the steel ball is pulled upward with a force equal to twice its effective weight, how fast will it move upward ? [JEE-Main 2013]

(1) 10 cm/s
(2) 5 cm/s
(3) 20 cm/s
(4) Zero

Ans. (1)

❖ Capillarity :

$$h = \frac{2T\cos\theta}{\rho g r}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	2	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. When a long glass capillary tube of radius 0.015 cm is dipped in a liquid, the liquid rises to a height of 15 cm within it. If the contact angle between the liquid and glass to close to 0°, the surface tension of the liquid, in milliNewton m^{-1}, is [$\rho_{(liquid)}$ = 900 kgm^{-3}, g = 10 ms^{-2}] (Give answer in closest integer)_____. [JEE-Main 2020]

Ans. 101

Q. A capillary tube made of glass of radius 0.15 mm is dipped vertically in a beaker filled with methylene iodide (surface tension = 0.05 Nm^{-1}, density = 667 kg m^{-3}) which rises to height h in the tube. It is observed that the two tangents drawn from liquid-glass interfaces (from opp. sides of the capillary) make an angle of 60° with one another. Then h is close to ($g = 10\ ms^{-2}$). [JEE-Main 2020]

(1) 0.137 m

(2) 0.172 m

(3) 0.087 m

(4) 0.049 m

Ans. (3)

❖ Excess pressure inside :

$$P_{drop} = \frac{2T}{R}$$

$$P_{bubble} = \frac{4T}{R}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. Pressure inside two soap bubbles are 1.01 and 1.02 atmosphere, respectively. The ratio of their volumes is : [Main-2020]

(1) 8 : 1

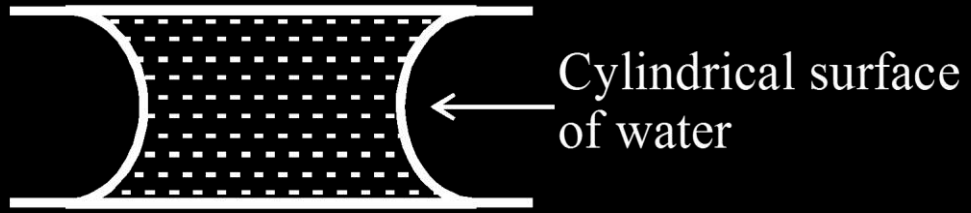
(2) 0.8 : 1

(3) 2 : 1

(4) 4 : 1

Ans. (1)

Q. If two glass plates have water between them and are separated by very small distance (see figure), it is very difficult to pull them apart. It is because the water in between forms cylindrical surface on the side that gives rise to lower pressure in the water in comparison to atmosphere. If the radius of the cylindrical surface is R and surface tension of water is T then the pressure in water between the plates is lower by : [JEE-Main 2021]



(1) $\frac{2T}{R}$ (2) $\frac{4T}{R}$ (3) $\frac{T}{4R}$ (4) $\frac{T}{2R}$

Ans. (Bonus)

❖ Contact angle :

$$\cos\theta = \frac{T_{SA} - T_{SL}}{T_{LA}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Wax is coated on the inner wall of acapillary tube and the tube is then dippedin water. Then, compared to the unwaxedcapillary, the angle of contact θ and theheight h upto which water rises change. [JEE-Main 2013]

These changes are :

(1) θ decreases and h also decreases

(2) θ increases and h decreases

(3) θ increases and h also increases

(4) θ decreases and h increases

Ans. (1)

❖ Surface energy :

$E = \text{Surface tension} * (\text{change in area})$

$E = T\Delta A$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 5 (JEE-Main)

Q. Work done in increasing the size of a soap bubble from a radius of 3 cm to 5cm is nearly (Surface tension of soap solution = 0.03 Nm^{-1}) :- [JEE-Main 2013]

(1) 2π mJ

(2) $0.4\ \pi$ mJ

(3) 4π mJ

(4) $0.2\ \pi$ mJ

Ans. (2)

Q. Two merucry drops (each of radius 'r') merge to form a bigger drop. The surface energy of the bigger drop, ifs T is the surface tension, is : [JEE-Main 2021]

(1) $\pi r^2 T$

(2) $4\pi r^2 T$

(3) $2\pi r^2 T$

(4) $\pi r^2 T$

Ans. (4)

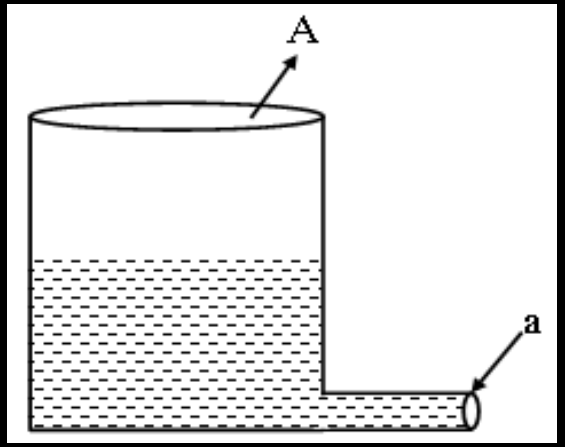
❖ Accelerating Fluids :

$$F = \rho a v^2$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	1
2020	-	2020	1
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 2 (JEE-Main)

Q. A light cylindrical vessel is kept on a horizontal surface. Area of base is A. A hole of cross-sectional area 'a' is made just at its bottom side. The minimum coefficient of friction necessary to prevent sliding the vessel due to the impact force of the emerging liquid is (a << A) : [JEE-Main 2021]



(1) $\frac{A}{2a}$

(2) None of these

(3) $\frac{2a}{A}$

(4) $\frac{a}{A}$

Ans. (3)

Q. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% looses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be : [JEE-Main 2021]

(1) pv^2 **(2)** $\frac{3}{4}pv^2$ **(3)** $\frac{1}{2}pv^2$ **(4)** $\frac{1}{4}pv^2$

Ans. (2)

❖ Coefficient of viscosity :

$$\eta = \frac{F_{viscous}}{A\left(\frac{dv}{dy}\right)}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. The velocity of water in a river is 18 km/hr near the surface. If the river is 5 m deep , find the shearing stress between the horizontal layers of water. The co-efficient of viscosity of water = 10^{-2} poise. [JEE-Main 2014]

(1) 10^{-1} N/m^2

(2) 10^{-4} N/m^2

(3) 10^{-2} N/m^2

(4) 10^{-3} N/m^2

Ans. (4)

❖ Gauge Pressure

$$P = \rho g h$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	1
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 3 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. A submarine experiences a pressure of 5.05×10^6 Pa at a depth of d_1 in a sea. When it goes further to a depth of d_2, it experiences a pressure of 8.08×10^6 Pa. Then $d_2 - d_1$ is approximately (density of water = 10^3 kg/m^3 and acceleration due to gravity = 10 ms^{-2}) [JEE-Main 2019]

(1) 500 m

(2) 400 m

(3) 300 m

(4) 600 m

Ans. (3)

Q. The pressure acting on a submarine is 3×10^5 Pa at a certain depth. If the depth is doubled, the percentage increase in the pressure acting on the submarine would be : (Assume that atmospheric pressure is 1×10^5 Pa density of water is 10^3 kg m^{-3}, g = 10 ms^{-2}) [JEE-Main 2021]

(1) $\frac{200}{3}\%$

(2) $\frac{200}{5}\%$

(3) $\frac{5}{200}\%$

(4) $\frac{3}{200}\%$

Ans. (1)

❖ Pascal's Law:

$$\frac{F}{A} = \text{constant}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A hydraulic press can lift 100 kg when a mass 'm' is placed on the smaller piston. It can lift _____kg when the diameter of the larger piston is increased by 4 times and that of the smaller piston is decreased by 4 times keeping the same mass 'm' on the smaller piston. [JEE-Main 2021]

Ans. 25600

❖ Radius of curvature of interface formed by two bubbles:

$$\frac{1}{r} = \frac{1}{r_1} - \frac{1}{r_2}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A small soap bubble of radius 4 cm is trapped inside another bubble of radius 6 cm without any contact. Let P_2 be the pressure inside the inner bubble and P_0, the pressure outside the outer bubble. Radius of another bubble with pressure difference $P_2 - P_0$ between its inside the outside would be : [JEE-Main 2018]

(1) 12 cm

(2) 4.8 cm

(3) 2.4 cm

(4) 6 cm

Ans. (3)

Q. When two soap bubbles of radii a and b (b > a) coalesce, the radius of curvature of common surface is : [JEE-Main 2021]

(1) $\frac{ab}{b-a}$

(2) $\frac{a+b}{ab}$

(3) $\frac{b-a}{ab}$

(4) $\frac{ab}{a+b}$

Ans. (1)

❖ Reynold's number :

$$N_a = \frac{D v \rho}{\eta}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. Water from a pipe is coming at a rate of 100 litres per minute. If the radius of the pipe is 5 cm, the Reynolds number for the flow is of the order of : (density of water = 1000 kg/m^3, coefficient of viscosity of water = 1mPas)

(1) 10^6 (2) 10^3 [JEE-Main 2019]

(3) 10^4 (4) 10^2

Ans. (3)

Q. If it takes 5 minutes to fill a 15 litre bucket from a water tap of diameter $\frac{2}{\sqrt{\pi}}$ cm then the Raynolds number for the flow is (density of water = 10^3 kg/m^3 and viscosity of water = 10^{-3} Pa.s) close to : [JEE-Main 2015]

(1) 11000

(2) 5500

(3) 550

(4) 1100

Ans. (2)

Thanks!

PHYSICS FORMULA RACE

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❖ Mirror Formula

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	1	2020	-
2019	3	2019	-
2018	-	2018	-
2017	1	2017	-
2016	2	2016	-
2015	-	2015	1
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. What is the sign of focal length of convex mirror?

Options: [JEE-Main-2021]

(1) +ve

(2) –ve

(3) Can be +ve or –ve

(4) None of these

Ans. (1)

Q. A short straight object of height 100cm lies before the central axis of a spherical mirror whose focal length has absolute value $|f| = 40$ cm. The image of object produced by the mirror is of height 25 cm and has the same orientation of the object. One may conclude from the information: [JEE-Main-2021]

(1) Image is virtual, opposite side of concave mirror.
(2) Image is real, same side of convex mirror.
(3) Image is real, same side of concave mirror.
(4) Image is virtual, opposite side of convex mirror.

Ans. (4)

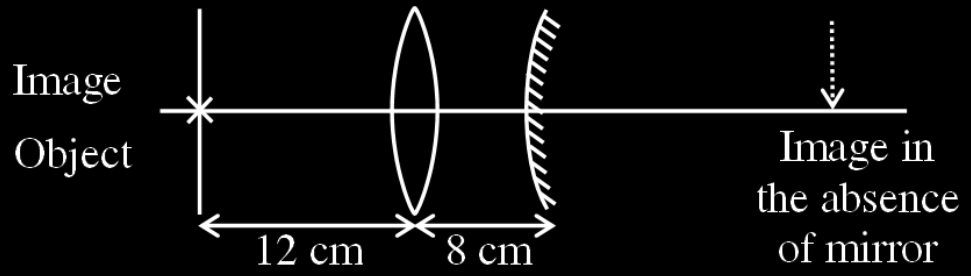
❖ Lens Formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	2	2020	-
2019	3	2019	1
2018	1	2018	-
2017	2	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 10 (JEE-Main)

Q. An object is placed at a distance of 12 cm from a convex lens. A convex mirror of focal length 15 cm is placed on other side of lens at 8 cm as shown in the figure. Image of object coincides with the object. When the convex mirror is removed, a real and inverted image is formed at a position. The distance of the image from the object will be___(cm). [JEE-Main-2021]



Ans. 50

Q. A diverging lens with magnitude of focal length 25 cm is placed at a distance of 15cm from a converging lens of magnitude of focal length 20cm. A beam of parallel light falls on the diverging lens. The final image formed is: [JEE-Main-2017]

(1) real and at a distance of 6 cm from the convergent lens.

(2) real and at a distance of 40 cm from convergent lens.

(3) virtual and at a distance of 40 cm from convergent lens.

(4) real and at a distance of 40 cm from the divergent lens.

Ans. (2)

❖ Lens Makers Formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	1
2020	3	2020	-
2019	4	2019	1
2018	1	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	1
2014	1	2014	1
2013	1	2013	1
2012	-	2012	1

☛ Total Questions in last 10 years: 7 (JEE-Advanced) and 12 (JEE-Main)

Q. The refractive index of converging lens is 1.4. What will be the focal length of this if it is placed in a medium of same refractive index? Assume the radii of curvature of the faces of lens are R_1 and R_2 respectively. [JEE-Main-2021]

(1) 1 (2) $\frac{R_1R_2}{R_1-R_2}$ (3) Infinite (4) Zero

Ans. (3)

Q. A thin lens made of glass (refractive index = 1.5) of focal length f = 16 cm is immersed in a liquid of refractive index 1.42. If its focal length in liquid is f_ℓ, then the ratio f_ℓ /f is closest to the integer: [JEE-Main-2020]

(1) 17 (2) 1 (3) 9 (4) 5

Ans. (3)

❖ Total Internal Reflection

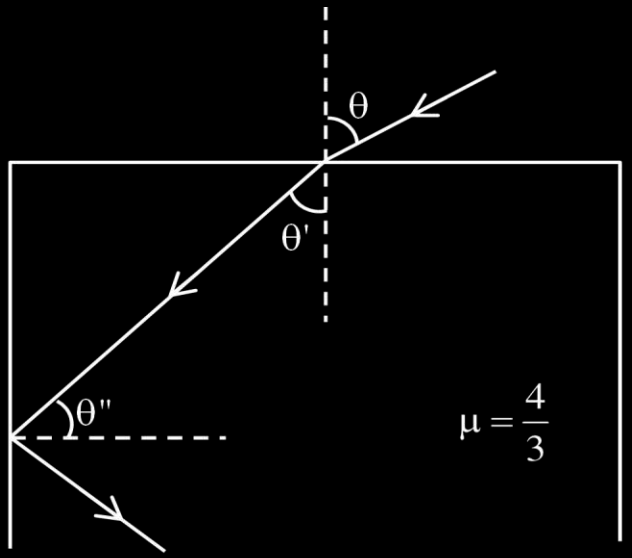
$$\theta_c = \sin^{-1}\left(\frac{1}{\mu}\right)$$

θ_c = Critical Angle

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	3	2021	2
2020	1	2020	1
2019	1	2019	2
2018	-	2018	-
2017	1	2017	2
2016	-	2016	2
2015	1	2015	2
2014	1	2014	1
2013	-	2013	1
2012	1	2012	-

☛ Total Questions in last 10 years: 13 (JEE-Advanced) and 8 (JEE-Main)

Q. A ray of light entering from air into a denser medium of refractive index $\frac{4}{3}$, as shown in figure. The light ray suffers total internal reflection at the adjacent surface as shown. The maximum value of angle θ should be equal to: [JEE-Main-2021]



(1) $\sin^{-1}\frac{\sqrt{7}}{3}$

(2) $\sin^{-1}\frac{\sqrt{5}}{4}$

(3) $\sin^{-1}\frac{\sqrt{7}}{4}$

(4) $\sin^{-1}\frac{\sqrt{5}}{3}$

Ans. (1)

Q. A ray of laser of a wavelength 630 nm is incident at an angle of 30° at the diamond-air interface. It is going from diamond to air. The refractive index of diamond is 2.42 and that of air is 1. Choose the correct option. [JEE-Main-2021]

(1) angle of refraction is 24.41°

(2) angle of refraction is 30°

(3) refraction is not possible

(4) angle of refraction is 53.4°

Ans. (3)

❖ Snell's Law

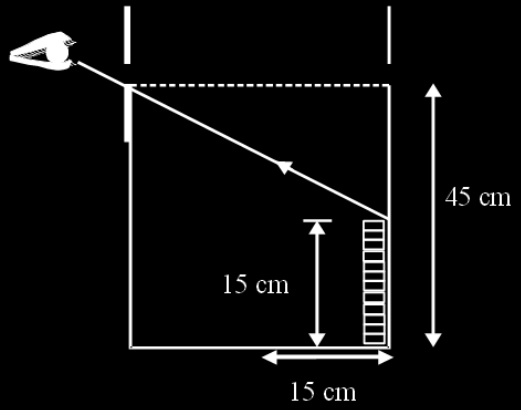
$$n_1 \sin i_1 = n_2 \sin i_2$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	2
2020	3	2020	1
2019	2	2019	2
2018	-	2018	-
2017	1	2017	2
2016	-	2016	2
2015	1	2015	2
2014	1	2014	1
2013	-	2013	1
2012	1	2012	-

☛ Total Questions in last 10 years: 13 (JEE-Advanced) and 10 (JEE-Main)

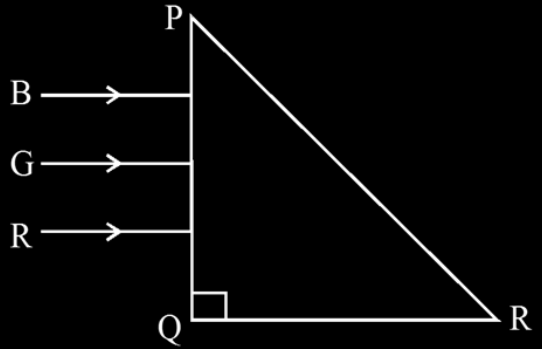
Q. An observer can see through a small hole on the side of a jar (radius 15 cm) at a point at height of 15 cm from the bottom (see figure). The hole is at a height of 45 cm. When the jar is filled with a liquid up to a height of 30 cm the same observer can see the edge at the bottom of the jar. If the refractive index of the liquid is N / 100, where N is an integer, the value of N is_____.

[JEE-Main-2020]



Ans. 158

Q. Three rays of light, red (R), green (G) and blue (B) are incident on the face PQ of a right angled prism PQR as shown in the figure.



The refractive indices of material of the prism for red, green and blue wavelength are 1.27, 1.42 and 1.49 respectively. The colour of ray(s) emerging out of the face PR is [JEE-Main-2021]

(1) red (2) blue and green (3) green (4) blue

Ans. (1)

❖ Apparent Height/Depth

$$d_{app} = \frac{d_{actual}}{\mu}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	2	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	2	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. A vessel of depth 2h is half filled with a liquid of refractive index $2\sqrt{2}$ and the upper half with another liquid of refractive index $\sqrt{2}$. The liquids are immiscible. The apparent depth of the inner surface of the bottom of vessel will be [JEE-Main-2020]

(1) $\frac{h}{\sqrt{2}}$

(2) $\frac{h}{2(\sqrt{2}+1)}$

(3) $\frac{3}{4}h\sqrt{2}$

(4) $\frac{h}{3\sqrt{2}}$

Ans. **(3)**

Q. A glass tumbler having inner depth of 17.5 cm is kept on a table. A student starts pouring water ($\mu = 4/3$) into it while looking at the surface of water from the above. When he feels that the tumbler is half filled, he stops pouring water. Up to what height, the tumbler is actually filled ?

[JEE-Main 2021]

(1) 11.7 cm

(2) 10 cm

(3) 7.5 cm

(4) 8.75 cm

Ans. (2)

Q. A glass tumbler having inner depth of 17.5 cm is kept on a table. A student starts pouring water ($\mu = 4/3$) into it while looking at the surface of water from the above. When he feels that the tumbler is half filled, he stops pouring water. Up to what height, the tumbler is actually filled ?

[JEE-Main 2021]

(1) 11.7 cm

(2) 10 cm

(3) 7.5 cm

(4) 8.75 cm

Ans. (2)

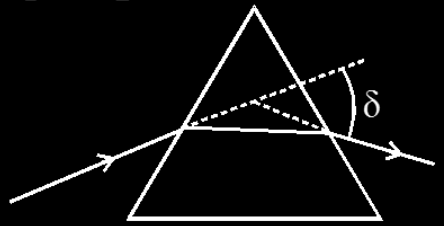
❖ Minimum deviation

$$\mu = \frac{\sin\left[\frac{\delta_{min} + A}{2}\right]}{\sin\left[\frac{A}{2}\right]}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	4	2021	1
2020	2	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 9 (JEE-Main)

Q. The angle of deviation through a prism is minimum when [JEE-Main 2021]

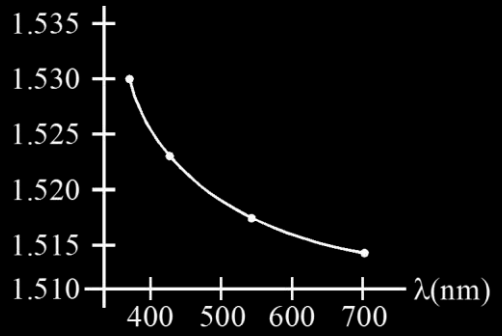


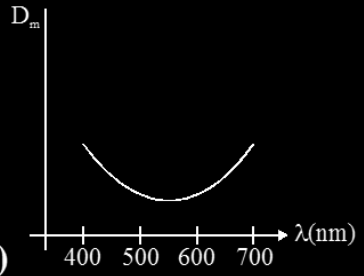
(A) Incident ray and emergent ray are symmetric to the prism
(B) The refracted ray inside the prism becomes parallel to its base
(C) Angle if incidence is equal to that of the angle of emergence
(D) When angle of emergence is double the angle of incidence

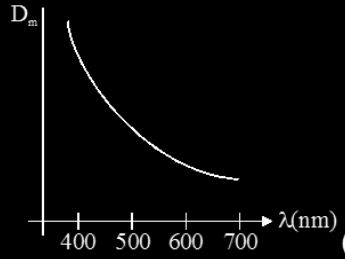
Choose the correct answer from the options given below :
(1) Statements (B) and (C) are true
(2) Statements (A), (B) and (C) are true
(3) Only statement (D) is true
(4) Only statements (A) and (B) are true

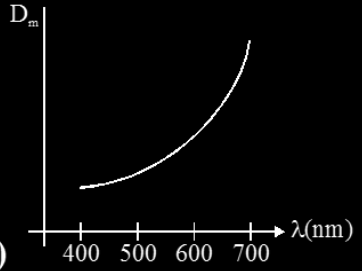
Ans. (2)

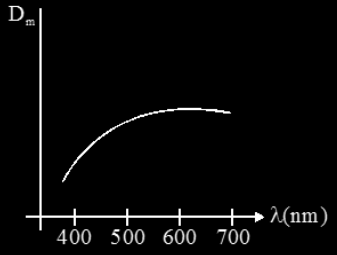
Q. The variation of refractive index of a crown glass thin prism with wavelength of the incident light is shown. Which of the following, graph is the correct one, if D_m is the angle of minimum deviation? [JEE-Main 2019]



(A)


(B)


(C)


(D)


Ans. (B)

❖ Magnification by Mirror

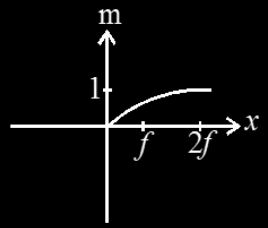
$$m = \frac{-v}{u}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021		2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

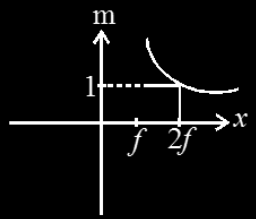
☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. An object is gradually moving away from the focal point of a concave mirror along the axis of the mirror. The graphical representation of the magnitude of linear magnification (m) versus distance of the object from the mirror (x) is correctly given by (Graphs are drawn schematically and are not to scale) [JEE-Main2020]

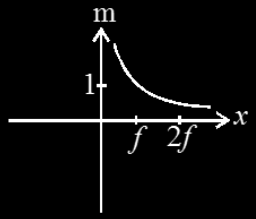
(1)



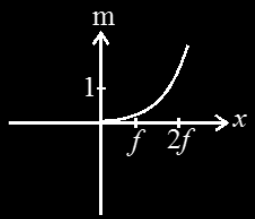
(2)



(3)



(4)



Ans. (2)

❖ Laws of Reflection

$$\hat{r} = \hat{i} - 2(\hat{i} \cdot \hat{n})\hat{n}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. The incident ray, reflected ray and the outward drawn normal are denoted by the unit vectors $\vec{a}$, $\vec{b}$ and $\vec{c}$ respectively. Then choose the correct relation for these vectors. [JEE-Main 2021]

(1) $\vec{b} = \vec{a} + 2\vec{c}$ **(2)** $\vec{b} = 2\vec{a} + \vec{c}$ **(3)** $\vec{b} = \vec{a} - 2(\vec{a}.\vec{c})\vec{c}$ **(4)** $\vec{b} = \vec{a} - \vec{c}$

Ans. **(3)**

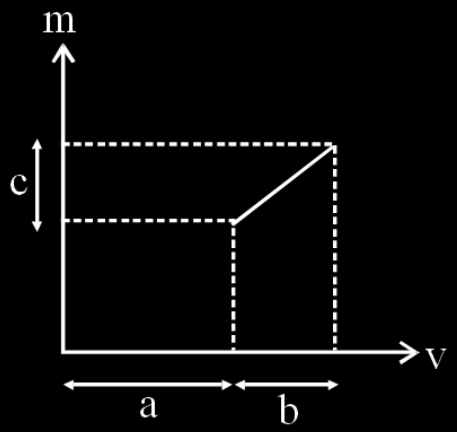
❖ Magnification by Lens

$$m = \frac{v}{u}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	1
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 4 (JEE-Main)

Q. The graph shows how the magnification m produced by a thin lens varies with image distance v. What is the focal length of the lens used? [JEE-Main 2019]



(1) $\frac{b^2}{ac}$ (2) $\frac{a}{c}$ (3) $\frac{b^2c}{a}$ (4) $\frac{b}{c}$

Ans. (4)

Q. A convex lens of focal length 20 cm produces images of the same magnification 2 when an objects is kept at two distances x_1 and x_2 ($x_1 > x_2$) from the lens. The ratio of x_1 and x_2 is: [JEE-Main 2019]

(1) 5 : 3

(2) 2 : 1

(3) 4 : 3

(4) 3 : 1

Ans. (4)

❖ Velocity Formula for a Spherical mirrors

$$V_{image/M} = -m^2 V_{object/M}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Car B overtakes another car A at a relative speed of 40 ms^{-1}. How fast will the image of car B appear to move in the mirror of focal length 10cm fitted in car A, when the car B is 1.9 m away from the car A?

[JEE Main 2021]

(1) 0.1ms^{-1} (2) 0.2ms^{-1}

(3) 4ms^{-1} (4) 40 ms^{-1}

Ans. (1)

Q. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm from the mirror. If the object is moved with a speed of 9 cm s^{-1}, the speed (in cm s^{-1}) with which image moves at that instant is_____

[JEE-Main 2020]

Ans. 1

❖ Velocity Formula for a Spherical Lens

$$V_{Image/L} = m^2 V_{object/L}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. An object is at a distance of 20 m from a convex lens of focal length 0.3 m. The lens forms an image of the object. If the object moves away from the lens at a speed of 5 m/s, the speed and direction of the image will be:

(1) 2.26×10^{-3} m/s away from the lens [JEE Main 2019]

(2) 0.92×10^{-3} m/s away from the lens

(3) 3.22×10^{-3} m/s towards the lens

(4) 1.16×10^{-3} m/s towards the lens

Ans. (4)

❖ Refraction at Spherical Interface

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 5 (JEE-Main)

Q. The image of an object placed in air formed by a convex refracting surface is at a distance of 10 m behind the surface. The image is real and is at $\frac{2}{3}$ of the distance of the object from the surface. The wavelength of light inside the surface is $\frac{2}{3}$ times the wavelength in air. The radius of the curved surface is $\frac{x}{13}$m. The value of 'x' is-------. [JEE-Main 2021]

Ans. 30

Q. The eye can be regarded as a single refracting surface. The radius of curvature of this surface is equal to that of cornea (7.8 mm). This surface separates two media of refractive indices 1 and 1.34. Calculate the distance from the refracting surface at which a parallel beam of light will come to focus. [JEE-Main 2020]

(1) 1 cm (2) 2 cm (3) 4.0 cm (4) 3.1 cm

Ans. (1)

❖ Normal Shift (glass-slab)

$$x = t_{(\text{thickness})}\left[1 - \frac{1}{\mu}\right]$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. An object 2.4 m in front of a lens forms a sharp image on a film 12 cm behind the lens. A glass plate 1cm thick, of refractive index 1.50 is interposed between lens and film with its plane faces parallel to film. At what distance (from lens) should object be shifted to be in sharp focus on film?

(1) 7.2 m [JEE-Main 2012]

(2) 2.4 m

(3) 3.2 m

(4) 5.6 m

Ans. (4)

Q. A convex lens is put 10 cm from a light source and it makes a sharp image on a screen, kept 10 cm from the lens. Now a glass block (refractive index 1.5) of 1.5 cm thickness is placed in contact with the light source. To get the sharp image again, the screen is shifted by a distance d. Then d is :

(1) 1.1 cm away from the lens [JEE-Main 2019]

(2) 0

(3) 0.55 cm towards the lens

(4) 0.55 cm away from the lens

Ans. (4)

❖ Combination of Lens

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	-	2020	-
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 6 (JEE-Main)

Q. A plano-convex lens (focal length f_2, refractive index μ_2, radius of curvature R) fits exactly into a plano-concave lens (focal length f_1, refractive index μ_1, radius of curvature R). Their plane surfaces are parallel to each other. Then, the focal length of the combination will be :

(1) $f_1 - f_2$ [JEE-Main 2019]

(2) $\frac{R}{\mu_2 - \mu_1}$

(3) $\frac{2f_1f_2}{f_1 + f_2}$

(4) $f_1 + f_2$

Ans. (2)

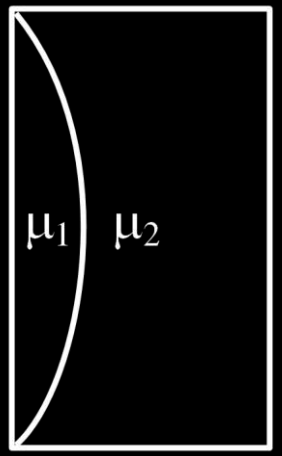
Q. Curved surfaces of a plano-convex lens of refractive index μ_1 and a plano-concave lens of refractive index μ_2 have equal radius of curvature as shown in figure. Find the ratio of radius of curvature to the focal length of the combined lenses. [JEE-Main 2021]

(1) $\frac{1}{\mu_2 - \mu_1}$

(2) $\mu_1 - \mu_2$

(3) $\frac{1}{\mu_1 - \mu_2}$

(4) $\mu_2 - \mu_1$



Ans. (2)

❖ Combination of Mirror and Lens

$$\frac{1}{f_{eq}} = \frac{1}{f_{mirror}} - \frac{2}{f_{lens}}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

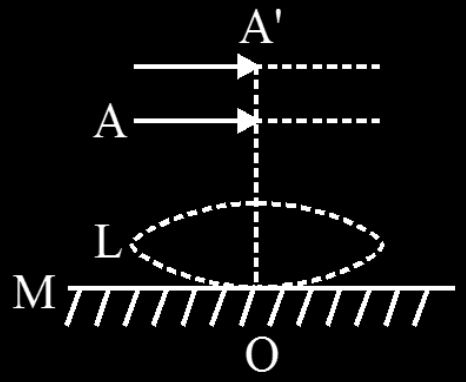
☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A convergent doublet of separated lenses, corrected for spherical aberration, has resultant focal length of 10 cm. The separation between the two lenses is 2 cm. I he focal lengths of the component lenses are [JEE-Main-2018]

(1) 10 cm, 12 cm
(2) 16 cm, 18 cm
(3) 12 cm, 14 cm
(4) 18 cm, 20 cm

Ans. (4)

Q. A thin convex lens L (refractive index = 15) is placed on a plane mirror M. When a pin is placed at A, such that OA = 18 cm, its real inverted image is formed at A itself, as shown in figure. When a liquid of refractive index μ_1 is put between the lens and the mirror, the pin has to be moved to A. such that OA' = 27cm, to get its inverted real image at A' itself. The value of m will be : [JEE-Main 2019]



(1) $\sqrt{2}$ (2) $\frac{4}{3}$ (3) $\sqrt{3}$ (4) $\frac{3}{2}$

Ans. (2)

❖ Resolving Power of Microscope

$$R.P. = \frac{2\mu \sin \beta}{1.22\lambda}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. The value of numerical aperature of the objective lens of a microscope is 1.25. If light of wavelength 5000 A is used, the minimum separation between two points, to be seen as distinct, will be :

(1) 0.48 μm (2) 0.38 μm [JEE-Main 2021]

(3) 0.24 μm (4) 0.12 μm

Ans. (3)

Q. Assuming human pupil to have a radius of 0.25 cm and a comfortable viewing distance of 25 cm, the minimum separation between two objects that human eye can resolve at 500 nm wavelength is:

(1) 30 μm (2) 100 μm [JEE-Main 2019]

(3) 300 μm (4) 1 μm

Ans. (1)

❖ Resolving Power of Telescope

$$R.P. = \frac{D}{1.22\lambda}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. The aperture diameter of a telescope is 5m. The separation between the moon and the earth is 4×10^5 km. With light of wavelength of 5500 A, the minimum separation between objects on the surface of moon, so that they are just resolved, is close to: [JEE-Main 2020]

(1) 200 m (2) 600 m

(3) 60 m (4) 20 m

Ans. (3)

Q. Diameter of the objective lens of a telescope is 250 cm. For light of wavelength 600 Coming from a distant object, the limit of resolution of the telescope is close to:- [JEE-Main 2019]

(1) 1.5×10^{-7} rad (2) 2.0×10^{-7} rad

(3) 3.0×10^{-7} rad (4) 4.5×10^{-7} rad

Ans. (3)

❖ Magnifying Power of Compound Microscope

$$M = \frac{v_0}{u_0}\left[\frac{D}{u_e}\right]$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	3	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. If we need a magnification of 375 from a compound microscope of tube length 150 mm and an objective of focal length 5 mm, the focal length of ithe eye piece should be close to

(1) 22 mm (2) 33 m [JEE-Main 2020]

(3) 12 m (4) 2 mm

Ans. (1)

Q. In a compound microsope, the magnified virtual image is formed at a distance of 25 cm from the eye-piece. The focal length of its objective lens is 1 cm. If the magnification is 100 and the tube length of the microscope is 20 cm, then the focal length of the eye-piece lens (in cm) is_____. [JEE-Main 2020]

Ans. 2.25

❖ Magnifying Power of Astronomical Telescope

$$M = \frac{-f_0}{u_e}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. The magnifying power of a telescope with tube length 60 cm is 5. What is the focal length of its eye piece? [JEE-Main 2020]

(1) 40 cm
(2) 10 cm
(3) 20 cm
(4) 30 cm

Ans. (2)

Q. An observer looks at a distant tree of height 10 m with a telescope of magnifying power of 20. To the observer the tree appears : [JEE Main 2016]

(1) 10 times nearer
(2) 20 times taller
(3) 20 times nearer
(4) 10 times taller

Ans. (3)

❖ Distance Formula for Focal Length

$$f = \frac{D^2 - d^2}{4D}$$

D = Distance b/w object & screen
d = Distance b/w two positions

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. The distance between an object and a screen is 100 cm. A lens can produce real image of the object on the screen for two different positions between the screen and the object. The distance between these two positions is 40 cm. If the power of the lens is close to $\left(\frac{N}{100}\right)^{D}$ where N is an integer, the value of N is.... [JEE-Main 2020]

Ans. 5

❖ Simple Microscope

$$M = 1 + \frac{D}{f}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	3	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. An object viewed from a near point distance of 25 cm, using a microscopic lens with magnification '6', gives an unresolved image. A resolved image is observed at infinite distance with a total magnification double the earlier using an eyepiece along with the given lens and a tube of length 0.6 m, if the focal length of the eyepiece is equal to _____ cm. [JEE-Main 2021]

Ans. 25

Q. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : For a simple microscope, the angular size of the object equals the angular size of the image.

Reason R : Magnification is achieved as the small object can be kept much closer to the eye than 25 cm and hence it subtends a large angle.

In the light of the above statements, choose the most appropriate answer from the options given below : [JEE Main-2021]

(1) A is true but R is false

(2) Both A and R are true but R is NOT the correct explanation of A.

(3) Both A and R are true and R is the correct explanation of A

(4) A is false but R is true

Ans. (2)

- **Eye Defect**
  - Myopia
  - Hypermetropia
  - Presbyopia
  - Astigmatism

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	3	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. Your friend is having eye sight problem. She is not able lo see clearly a distant uniform window mesh and it appears to her as non-uniform and distorted. The doctor diagnosed the problem as : [JEE-Main 2021]

(1) Astigmatism

(2) Myopia with Astigmatism

(3) Presbyopia with Astigmatism

(4) Myopia and hypermetropia

Ans. (2)

❖ **Dispersive Power**

$$\omega = \left(\frac{\mu_V - \mu_R}{\mu_y - 1} \right)$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	3	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-
2011	-	2011	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. A deviation of 2° is produced in the yellow ray when prism of crown and flint glass are achromatically combined. Taking dispersive powers of crown and flint glass are 0.02 and 0.03 respectively and refractive index for yellow light for these glasses are 1.5 and 1.6 respectively. The refracting angles for crown glass prism will be _____° (in degree)

(Round off to the Nearest Integer) [JEE-Main 2021]

Ans. 12

Thanks!

PHYSICS FORMULA RACE

GRAVITATION

❖ Force between two point masses :

$$F = \frac{Gm_1m_2}{r^2} \; ; \; G = 6.67 \times 10^{-11} \frac{N - m^2}{(Kg)^2}$$

$$\vec{F}_{21} = \frac{-Gm_1m_2}{\left|\vec{r}_2 - \vec{r}_1\right|^3}\left(\vec{r}_2 - \vec{r}_1\right)$$

$\vec{F}_{21}$ = Force exerted on body '2' by body '1'

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	-	2020	-
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 7 (JEE-Main)

Q. Two identical particles of mass 1 kg each go round a circle of radius R, under the action of their mutual gravitational attraction. The angular speed of each particle is : [JEE-Main 2021]

(1) $\sqrt{\frac{G}{2R^3}}$

(2) $\frac{1}{2}\sqrt{\frac{G}{R^3}}$

(3) $\frac{1}{2R}\sqrt{\frac{1}{G}}$

(4) $\sqrt{\frac{2G}{R^3}}$

Ans. (2)

Q. Four identical particles of equal masses 1kg made to move along the circumference of a circle of radius 1 m under the action of their own mutual gravitational attraction. The speed of each particle will be : [JEE Main 2021]

(1) $\sqrt{\frac{G}{2}(1+2\sqrt{2})}$ **(2)** $\sqrt{G(1+2\sqrt{2})}$

(3) $\sqrt{\frac{G}{2}(2\sqrt{2}-1)}$ **(4)** $\frac{1}{2}\sqrt{G(1+2\sqrt{2})}$

Ans. **(4)**

❖ Gravitational Field due to uniform surface mass density Hollow Sphere :

$$\vec{E} = \frac{-GM\vec{r}}{r^3} \quad ; \quad r \geq R$$

$$= 0 \quad ; \quad r < R$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	2	2020	-
2019	1	2019	1
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 5 (JEE-Main)

Q. Inside a uniform spherical shell : [JEE-Main 2021]

(a) the gravitational field is zero

(b) the gravitational potential is zero

(c) the gravitational field is same everywhere

(d) the gravitation potential is same everywhere

(e) all of the above

Choose the most appropriate answer from the options given below :

(1) (a), (c) and (d) only

(2) (e) only

(3) (a), (b) and (c) only

(4) (b), (c) and (d) only

Ans. (1)

Q. The mass density of a planet of radius R varies with the distance r from its centre as $\rho(r) = \rho_0\left(1 - \frac{r^2}{R^2}\right)$. Then the gravitational field is maximum at : [JEE-Main 2020]

(1) $r = \frac{1}{\sqrt{3}}R$

(2) $r = \sqrt{\frac{5}{9}}R$

(3) $r = \sqrt{\frac{3}{4}}R$

(4) $r = R$

Ans. (2)

❖ Gravitational Field Due to Uniform Mass Density Solid Sphere :

$$\vec{E} = \frac{-GM\vec{r}}{r^3} \; ; \quad r \geq R$$

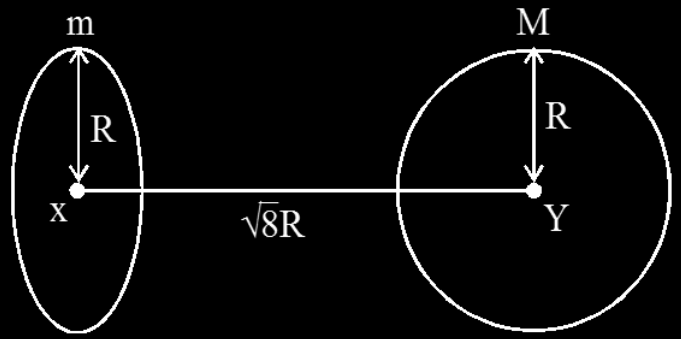
$$= \frac{-GM\vec{r}}{R^3} \; ; \quad r < R$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	10	2021	-
2020	3	2020	-
2019	5	2019	-
2018	2	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	2
2014	-	2014	1
2013	-	2013	-
2012	2	2012	-

☛ Total Questions in last 10 years: 4 (JEE-Advanced) and 22 (JEE-Main)

Q. Find the gravitational force of attraction between the ring and sphere as shown in the diagram, where the plane of the ring is perpendicular to the line joining the centres. If $\sqrt{8}\,R$ is the distance between the centres of a ring (of mass 'm') and a sphere (mass 'M') where both have equal radius 'R'.

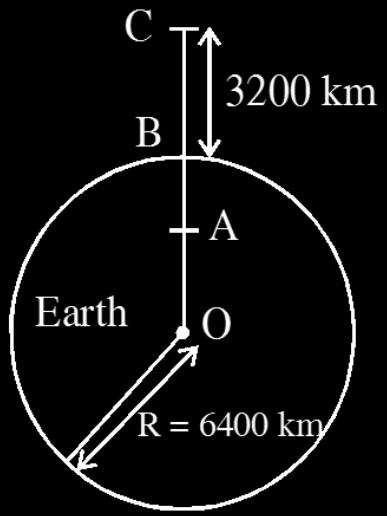
[JEE-Main 2021]



(1) $\frac{\sqrt{8}}{9}\cdot\frac{GmM}{R}$ **(2)** $\frac{2\sqrt{2}}{3}\cdot\frac{GMm}{R^2}$ **(3)** $\frac{1}{3\sqrt{8}}\cdot\frac{GMm}{R^2}$ **(4)** $\frac{\sqrt{8}}{27}\cdot\frac{GmM}{R^2}$

Ans. **(4)**

Q. In the reported figure of earth, the value of acceleration due to gravity is same at point A and C but it is smaller than that of its value at point B (surface of the earth). The value of OA : AB will be x : y. The value of x is ..... [JEE-Main 2021]



Ans. (4)

❖ Gravitational potential due to uniform mass density solid sphere :

$$V = \frac{-GM}{r} \quad ; \quad r \geq R$$

$$= \frac{-GM}{2R^3}(3R^2 - r^2) \quad ; \quad r < R$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	4	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	2	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 13 (JEE-Main)

Q. The masses and radii of the earth and moon are (M_1, R_1) and (M_2, R_2) respectively. Their centres are at a distance 'r' apart. Find the minimum escape velocity for a particle of mass 'm' to be projected from the middle of these two masses : [JEE-Main 2021]

(1) $V = \frac{1}{2}\sqrt{\frac{4G(M_1+M_2)}{r}}$

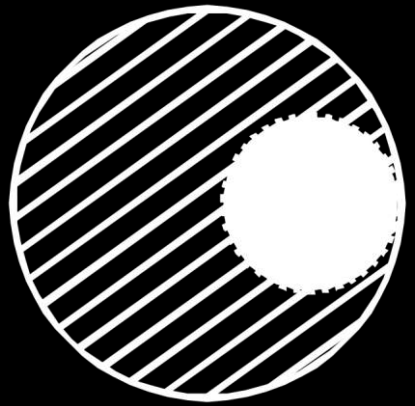
(2) $V = \sqrt{\frac{4G(M_1+M_2)}{r}}$

(3) $V = \frac{1}{2}\sqrt{\frac{2G(M_1+M_2)}{r}}$

(4) $V = \frac{\sqrt{2G}(M_1+M_2)}{r}$

Ans. 2

Q. From a solid sphere of mass M and radius R, a spherical portion of radius $\frac{R}{2}$ is removed, as shown in the figure. Taking gravitational potential V = 0 at r = ∞, the potential at the centre of the cavity thus formed is : (G = *gravitational constant*) [JEE-Main 2015]



(1) $\frac{-2GM}{3R}$

(2) $\frac{-2GM}{R}$

(3) $\frac{-GM}{2R}$

(4) $\frac{-GM}{R}$

Ans. (4)

❖ Gravitational potential energy of a system for two Masses :

$$U = \frac{-Gm_1m_2}{r}$$

For more than two masses

$$U = \left(U_{12} + U_{13} + ... + U_{1n}\right) + \left(U_{23} + U_{24} + ... + U_{2n}\right) + ...$$

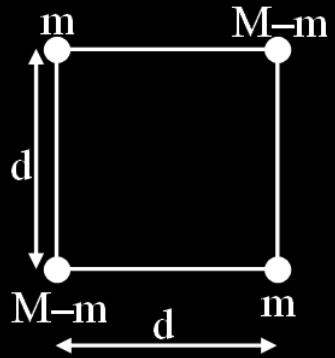
$U = mV$

V = Potential

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 1 (JEE-Main)

Q. A body of mass (2M) splits into four masses {m, M – m, m, M – m}, which are rearranged to form a square as shown in the figure. The ratio of $\frac{M}{m}$ for which, the gravitational potential energy of the system becomes maximum is x : 1. The value of x is ..... . [JEE-Main 2021]



Ans. 2

❖ Effect of Rotation of Earth :

$$g' = g\left(1 - \frac{\omega^2 R_e}{g}\right)$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. If the angular velocity of earth's spin is increased such that the bodies at the equator start floating, the duration of the day would be approximately :

(Take : $g = 10\ ms^{-2}$, the radius of earth, $R = 6400 \times 10^3$ m, Take $\pi = 3.14$)

(1) 60 minutes [JEE-Main 2021]

(2) does not change

(3) 1200 minutes

(4) 84 minutes

Ans. (4)

Q. A box weighs 196 N on a spring balance at the north pole. Its weight recorded on the same balance if it is shifted to the equator is close to (Take g = 10 ms^{-2} at the north pole and the radius of the earth = 6400 km) : [JEE-Main 2020]

(1) 195.66 N

(2) 194.66 N

(3) 194.32 N

(4) 195.32 N

Ans. (4)

❖ Variation of Acceleration Due to gravity of Earth :

(i) Effect of Height From Surface

$$g_h = g\left(1 - \frac{2h}{R_e}\right); \quad h < R_e$$

(ii) Effect if Depth From Surface

$$g_d = g\left(1 - \frac{d}{R_e}\right)$$

d = Depth from Surface

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A satellite is revolving in a circular orbit at a height 'h' from the earth's surface (radius of earth R ; h << R). The minimum increase in its orbital velocity required, so that the satellite could escape from the earth's gravitational field, is close to : (Neglect the effect of atmosphere). [JEE-Main 2016]

(1) $\sqrt{gR}\left(\sqrt{2}-1\right)$

(2) $\sqrt{2gR}$

(3) $\sqrt{gR}$

(4) $\sqrt{gR/2}$

Ans. (1)

Q. The acceleration due to gravity on the earth's surface at the poles is g and angular velocity of the earth about the axis passing through the pole is ω. An object is weighed at the equator and at a height h above the poles by using a spring balance. If the weights are found to be same, then h is : (h<<R, where R is the radius of the earth) [JEE-Main 2020]

(1) $\frac{R^2\omega^2}{8g}$

(2) $\frac{R^2\omega^2}{4g}$

(3) $\frac{R^2\omega^2}{g}$

(4) $\frac{R^2\omega^2}{2g}$

Ans. (4)

❖ Escape Speed for the Surface of Planet :

$$V = \sqrt{\frac{2GM}{R}}$$

For Earth

$$V_e = \sqrt{\frac{2GM_e}{R_e}} = 11.2\,km/sec$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	2	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 8 (JEE-Main)

Q. The initial velocity v_i required to project a body vertically upward from the surface of the earth to reach a height of 10R, where R is the radius of the earth, may be described in terms of escape velocity v_e such that $v_i = \sqrt{\frac{x}{y}} \times v_e$.

The value of x will be _____. [JEE-Main 2021]

Ans. 10

Q. The radius in kilometer to which the present radius of earth (R = 6400 km) to be compressed so that the escape velocity is increased 10 time is _____.

[JEE-Main 2021]

Ans. 64

❖ Kepler's Law for Planetary Motion :

(1) Kepler's Law of orbit :-

Each Planed moves around the sun in elliptical path with sun is at Focus

(2) Kepler's Law of Area:

Line joining and planet to the sun Sweeps equal area in equal time.

$$\frac{dA}{dt} = \frac{L_{planet/sun}}{2m} = \text{constant}$$

$L_{Planet/\ Sun}$ →Angular Momentum of Planet about the Sun.

(3) Kepler's Law of Time Period :

$T^2 \propto a^3$

T = Period of Revolution

a = Semi-major axis

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. The angular momentum of a planet of mass M moving around the sun in an elliptical orbit is $\vec{L}$. The magnitude of the areal velocity of the planet is : [JEE-Main 2021]

(1) $\frac{4L}{M}$

(2) $\frac{L}{M}$

(3) $\frac{2L}{M}$

(4) $\frac{L}{2M}$

Ans. (4)

Q. A planet revolving in elliptical orbit has :

(A) a constant velocity of revolution.

(B) has the least velocity when it is nearest to the sun.

(C) its areal velocity is directly proportional to its velocity.

(D) areal velocity is inversely proportional to its velocity.

(E) to follow a trajectory such that the areal velocity is constant.

Choose the correct answer from the options given below :

(1) A only (2) D only [JEE-Main 2021]

(3) C only (4) E only

Ans. (4)

❖ Self Gravitational Potential Energy of Uniform mass Solid Sphere :

$$U_{Self} = \frac{-3GM^2}{5R}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. If one wants to remove all the mass of the earth to infinity in order to break it up completely. The amount of energy that needs to be supplied will be $\frac{x}{5}\frac{GM^2}{R}$ where x is ____

(Round off to the Nearest Integer)

(M is the mass of earth, R is the radius of earth, G is the gravitational constant)

[JEE-Main 2021]

Ans. 3

❖ Attraction Force between two Uniform mass Hollow or Solid Sphere :

$$F_{attraction} = \frac{Gm_1m_2}{r^2}$$

r = Distance between center of Sphere

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	1
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 3 (JEE-Main)

Q. The planet Mars has two moons, if one of them has a period 7 hours, 30 minutes and an orbital radius of 9.0×10^3 km. Find the mass of Mars.

$\left\{\text{Given } \frac{4\pi^2}{G} = 6 \times 10^{11}\ N^{-1}\ m^{-2}\ kg^2\right\}$ [JEE-Main 2021]

(1) 5.96×10^{19} kg

(2) 3.25×10^{21} kg

(3) 7.02×10^{25} kg

(4) 6.00×10^{23} kg

Ans. (4)

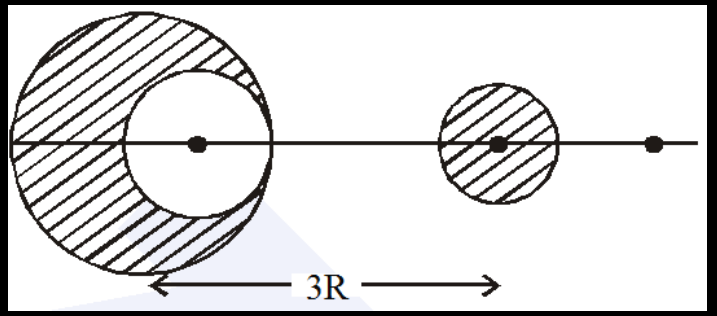
Q. From a sphere of mass M and radius R, a smaller sphere of radius $\frac{R}{2}$ is carved out such that the cavity made in the original sphere is between its centre and the periphery. (See figure). For the configuration in the figure where the distance between the centre of the original sphere and the removed sphere is 3R, the gravitational force between the two spheres is : [JEE-Main 2014]

(1) $\frac{59\,GM^2}{450\,R^2}$

(2) $\frac{GM^2}{225\,R^2}$

(3) $\frac{41GM^2}{450\,R^2}$

(4) $\frac{41GM^2}{3600\,R^2}$



Ans. (4)

Thanks!

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HEAT TRANSFER , CALORIMETRY & THERMAL EXPANSION

❖ **Change in temperature of material when heat supplied or, removed :**

$\Delta Q = ms\Delta T$; $\Delta Q = mL$

S = Specific heat

L = Latent heat of vaporization or, fusion.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	6	2020	-
2019	8	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛**Total Questions in last 10 years: 2 (JEE-Advanced) and 16 (JEE-Main)**

Q. The temperature of equal masses of three different liquids x,y and z are 10°C, 20°C and 30°C respectively. The temperature of mixture when x is mixed with y is 16°C and that when y is mixed with z is 26°C. The temperature of mixture when x and z are mixed will be

[JEE-Main 2021]

(1) 28.32° C

(2) 25.62° C

(3) 23.84°C

(4) 20.28°C

Ans. (3)

Q. Two different metal bodies A and B of equal mass are heated at a uniform rate under similar conditions. The variation of temperature of the bodies is graphically represented as shown in the figure. The ratio of specific heat capacities is :

[JEE-Main 2021]

(1) $\frac{8}{3}$

(2) $\frac{3}{8}$

(3) $\frac{3}{4}$

(4) $\frac{4}{3}$

Ans. (2)

❖ Relation between coefficient of linear (α) & volume (γ) expansion:

$$\ell^1 = \ell_0(1+\alpha\Delta T)$$

$$V^1 = V_0(1+\gamma\Delta T)$$

$$\gamma = 3d$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	4	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 9 (JEE-Main)

Q. Each side of a box made of metal sheet in cubic shape is 'a' at room temperature 'T', the coefficient of linear expansion of the metal sheet is 'α'. The metal sheet is heated uniformly, by a small temperature ΔT, so that its new temperature is $T + \Delta T$. Calculate the increase in the volume of the metal box. [JEE-Main 2021]

(1) $3a^3\alpha\Delta T$

(2) $4a^3\alpha\Delta T$

(3) $4\pi a^3\alpha\Delta T$

(4) $\frac{4}{3}\pi a^3\alpha\Delta T$

Ans. (1)

Q. Two different wires having lengths L_1 and L_2, and respective temperature coefficient of linear expansion α_1 and α_2, are joined end-to-end. Then the effective temperature coefficient of linear expansion is : [JEE-Main 2020]

(1) $4\dfrac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}\dfrac{L_2L_1}{(L_2+L_1)^2}$

(2) $2\sqrt{\alpha_1\alpha_2}$

(3) $\dfrac{\alpha_1+\alpha_2}{2}$

(4) $\dfrac{\alpha_1L_1+\alpha_2L_2}{L_1+L_2}$

Ans. (4)

❖ **For linear scale graduated thermometer :**

$$\frac{\Delta T}{\Delta \text{Reading}} = \text{constant}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A thermometer graduated according to a linear scale reads a value x_0 when in contact with boiling water, and $x_0/3$ when in contact with ice.

What is the temperature of an object in 0 °C, if this thermometer in the contact with the object reads $x_0/2$? [JEE-Main 2019]

(1) 35

(2) 25

(3) 60

(4) 40

Ans. (2)

❖ Thermal Resistance

$$R = \int \frac{dx}{K(\text{Area})} = \frac{\ell}{KA}$$

$K = \text{Thermal Conductivity}$

$$R_{eq} = R_1 + R_2 + \ldots\ldots[\text{In series}]$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots[\text{In parallel}]$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 4 (JEE-Main)

Q. Two thin metallic spherical shells of radii r_1 and r_2 ($r_1 < r_2$) are placed with their centres coinciding. A material of thermal conductivity K is filled in the space between the shells. The inner shell is maintained at temperature θ_1 and the outer shell at temperature $\theta_2(\theta_1<\theta_2)$. The rate at which heat flows radially through the material is :- [JEE-Main 2021]

(1) $\frac{4\pi K r_1 r_2(\theta_2-\theta_1)}{r_2-r_1}$

(2) $\frac{\pi r_1 r_2(\theta_2-\theta_1)}{r_2-r_1}$

(3) $\frac{K(\theta_2-\theta_1)}{r_2-r_1}$

(4) $\frac{K(\theta_2-\theta_1)(r_2-r_1)}{4\pi r_1 r_2}$

Ans. (1)

Q. Two identical metal wires of thermal conductivities K_1 and K_2 respectively are connected in series. The effective thermal conductivity of the combination is : [JEE-Main 2021]

(1) $\frac{2K_1K_2}{K_1+K_2}$

(2) $\frac{K_1+K_2}{2K_1K_2}$

(3) $\frac{K_1+K_2}{K_1K_2}$

(4) $\frac{K_1K_2}{K_1+K_2}$

Ans. (1)

❖ Heat current:

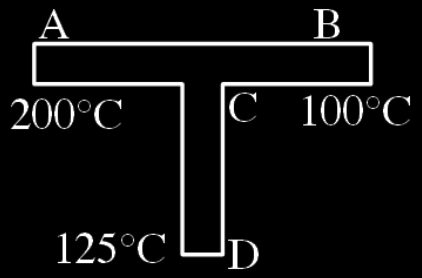
$$\frac{dQ}{dt} = \frac{\text{Temp. Difference}}{\text{Thermal Resistance}}$$

$$= \frac{\Delta T}{R_{eq.}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

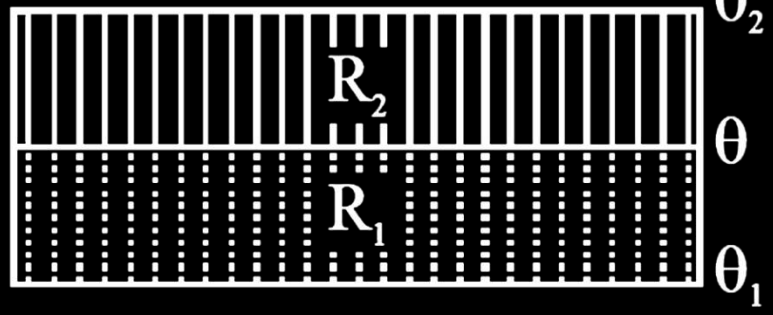
☛Total Questions in last 10 years: 1 (JEE-Advanced) and 1 (JEE-Main)

Q. A rod CD of thermal resistance 10.0 KW^{-1} is joined at the middle of an identical rod AB as shown in figure, The end A, B and D are maintained at 200°C, 100°C and 125°C respectively. The heat current in CD is P watt. The value of P is ..... . [JEE-Main 2021]



Ans. (2)

Q. The temperature θ at the junction of two insulating sheets, having thermal resistances R_1 and R_2 as well as top and bottom temperatures θ_1 and θ_2 (as shown in figure) is given by : [JEE-Main 2021]



(1) $\frac{\theta_2 R_2 - \theta_1 R_1}{R_2 - R_1}$

(2) $\frac{\theta_1 R_2 - \theta_2 R_1}{R_2 - R_1}$

(3) $\frac{\theta_1 R_2 + \theta_2 R_1}{R_1 + R_2}$

(4) $\frac{\theta_1 R_1 + \theta_2 R_2}{R_1 + R_2}$

Ans. (3)

❖ Newton's law of cooling

$$\frac{\Delta T}{\Delta t} = K\left(T_t - T_s\right)$$

T_t = avg. temp.

T_S = surrounding temp.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. A body takes 4 min. to cool from 61° C to 59°C. If the temperature of the surroundings is 30°C, the time taken by the body to cool from 51°C to 49° C is : [JEE-Main 2021]

(1) 4 min.

(2) 3 min.

(3) 8 min.

(4) 6 min.

Ans. (4)

Q. In 5 minutes, a body cools from 75°C to 65°C at room temperature of 25°C. The temperature of body at the end of next 5 minutes is _____°C. [JEE-Main 2021]

Ans. (57)

❖ Rate of heat transfer due to radiation:

*Stefan's Law :

$$\frac{dQ}{dt} = e\sigma A\left(T^4 - T_0^4\right)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	1
2020	-	2020	2
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 6 (JEE-Advanced) and 0 (JEE-Main)

❖ Wien's Law:

$$\lambda \ \alpha \ \frac{1}{T}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 0 (JEE-Main)

Thanks!

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KINEMATICS

❖ Basic concept :

Average speed = $\frac{S}{\Delta t}$; Instantaneous speed = $\frac{ds}{dt}$

Average velocity = $\frac{\Delta \vec{r}}{\Delta t}$; Instantaneous velocity = $\frac{d\vec{r}}{dt}$

Average acceleration = $\frac{\Delta \vec{v}}{\Delta t}$

Instantaneous acceleration = $\frac{d\vec{v}}{dt}$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 4 (JEE-Main)

Q. The position vector of a particle changes with time according to the relation $\vec{r}(t) = 15t^2\hat{i} + (4 - 20t^2)\hat{j}$. What is the magnitude of the acceleration at t = 1 ? [JEE-Main 2019]

(1) 40

(2) 100

(3) 25

(4) 50

Ans. (4)

Q. The relation between time t and distance x for a moving body is given as $t = mx^2 + nx$, where m and n are constants. The retardation of the motion is : (When v stands for velocity) [JEE-Main 2021]

(1) $2mv^3$

(2) $2mnv^3$

(3) $2nv^3$

(4) $2n^2v^3$

Ans. (1)

❖ Uniformly accelerated motion in one-dimension :

$$V = u + at$$

$$S = ut + \frac{1}{2}at^2 = \left(\frac{v+u}{2}\right)t = vt - \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$v_{avg.} = \frac{v+u}{2}$$

$$S_{n^{th}} = u + \frac{a}{2}(2n-1)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	10	2021	-
2020	5	2020	-
2019	3	2019	-
2018	1	2018	-
2017	1	2017	-
2016	-	2016	-
2015	1	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 22 (JEE-Main)

Q. An engine of a train, moving with uniform acceleration, passes the signal-post with velocity u and the last compartment with velocity v. The velocity with which middle point of the train passes the signal post is :

[JEE-Main 2021]

(1) $\sqrt{\frac{v^2+u^2}{2}}$

(2) $\frac{v-u}{2}$

(3) $\frac{u+v}{2}$

(4) $\sqrt{\frac{v^2-u^2}{2}}$

Ans. (1)

Q. An automobile, travelling at 40 km/h, can be stopped at a distance of 40 m by applying brakes. If the same automobile is travelling at 80 km/h, the minimum stopping distance, in meters, is (assume no skidding)

[JEE-Main 2018]

(1) 100 m
(2) 75 m
(3) 160 m
(4) 150 m

Ans. (3)

❖ Motion with variable acceleration in one dimension:

$$\Delta x = \int_{t_1}^{t_2} v\,dt \quad ; \quad \text{distance} = \int_{t_1}^{t_2} |v|\,dt$$

$$\Delta v = \int_{t_1}^{t_2} a\,dt$$

$$\int_{v_1}^{v_2} v\,dv = \int_{x_1}^{x_2} a\,dx$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	1	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 6 (JEE-Main)

Q. The instantaneous velocity of a particle moving in a straight line is given as $v = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1s and 2s is : [JEE-Main 2021]

(1) $3\alpha + 7\beta$

(2) $\frac{3}{2}\alpha + \frac{7}{3}\beta$

(3) $\frac{\alpha}{2} + \frac{\beta}{3}$

(4) $\frac{3}{2}\alpha + \frac{7}{2}\beta$

Ans. (2)

Q. The velocity of a particle is $v = v_0 + gt + Ft^2$. Its position is $x = 0$ at $t = 0$; then its displacement after time ($t = 1$) is : [JEE-Main 2021]

(1) $v_0 + g + F$

(2) $v_0 + \frac{g}{2} + \frac{F}{3}$

(3) $v_0 + \frac{g}{2} + F$

(4) $v_0 + 2g + 3F$

Ans. (2)

❖ Graph :

⇒ Slope of x – t graph gives velocity

⇒ Slope of v – t graph gives acceleration

⇒ Algebraic area of v – t graph gives displacement

⇒ Area of v – t graph gives distance

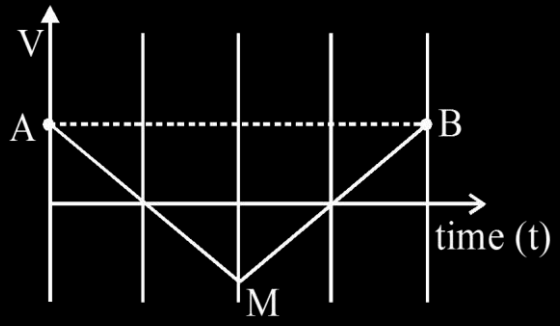
⇒ Algebraic area of a – t graph gives change in velocity

⇒ Slope of v^2 – x graph gives two times of acceleration

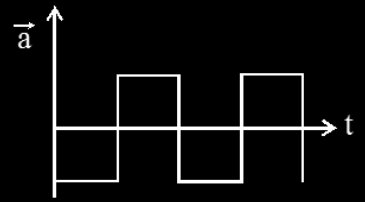
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	7	2021	-
2020	2	2020	-
2019	3	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	2	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 15 (JEE-Main)

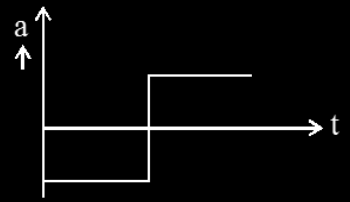
Q. If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph?
[JEE-Main 2021]



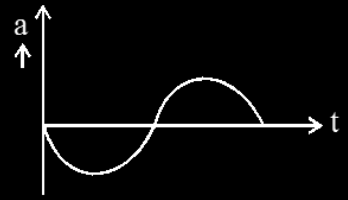
(1)



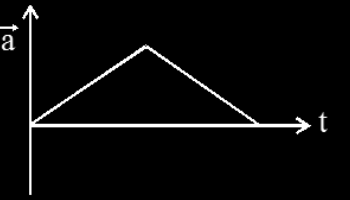
(2)



(3)

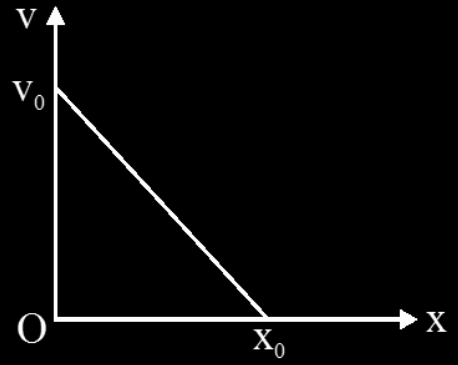


(4)

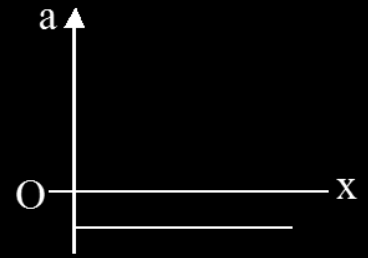


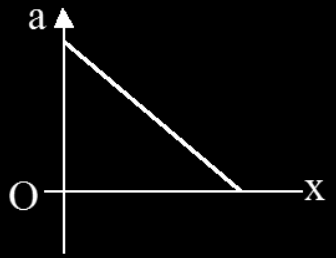
Ans. (2)

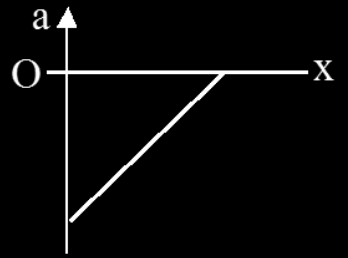
5. The velocity-displacement graph of a particle is shown in the figure. [JEE-Main 2021]

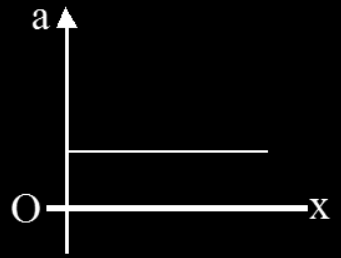


The acceleration-displacement graph of the same particle is represented by :

(1)


(2)


(3)


(4)


Ans. (3)

❖ Relative motion in one dimension :

$$v_{AB} = v_A - v_B$$

$$a_{AB} = a_A - a_B$$

If a_{rel} is uniform

$$v_{rel} = u_{rel} + a_{rel}t$$

$$S_{rel} = u_{rel}t + \frac{1}{2}a_{rel}t^2$$

$$v_{rel}^2 = u_{rel}^2 + 2a_{rel}s_{rel}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	2
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 2 (JEE-Advanced) and 4 (JEE-Main)

6. Train A and train B are running on parallel tracks in the opposite directions with speeds of 36 km/hour and 72 km/hour, respectively. A person is walking in train A in the direction opposite to its motion with a speed of 1.8 km/hr. Speed (in ms^{-1}) of this person as observed from train B will be close to : (take the distance between the tracks as negligible) [JEE-Main 2020]

(1) 30.5 ms^{-1}

(2) 29.5 ms^{-1}

(3) 31.5 ms^{-1}

(4) 28.5 ms^{-1}

Ans. (2)

Q. A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time t_1. If he remains stationary on a moving escalator then the escalator takes him up in time t_2. The time taken by him to walk up on the moving escalator will be : [JEE-Main 2021]

(1) $\frac{t_1 t_2}{t_2 - t_1}$

(2) $\frac{t_1 + t_2}{2}$

(3) $\frac{t_1 t_2}{t_2 + t_1}$

(4) $t_2 - t_1$

Ans. (3)

❖ Projectile motion :

$$T = \frac{2u\sin\theta}{g} = \frac{2u_y}{g}$$

$$R = \frac{u^2\sin 2\theta}{g} = \frac{2u_x u_y}{g}$$

$$R_{max} = \frac{u^2}{g} \text{ at } \theta = 45°$$

$$H_{max} = \frac{u^2\sin^2\theta}{2g} = \frac{u_y^2}{2g}$$

$$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta} = x\tan\theta\left(1 - \frac{x}{R}\right)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	1	2020	1
2019	5	2019	1
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	2	2014	-
2013	3	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years in 2 (JEE-Advanced) and 15 (JEE-Main)

Q. The trajectory of a projectile in a vertical plane is $y = \alpha x - \beta x^2$, where α and β are constants and x & y are respectively the horizontal and vertical distances of the projectile from the point of projection. The angle of projection θ and the maximum height attained H are respectively given by [JEE-Main 2021]

(1) $\tan^{-1}\alpha, \frac{\alpha^2}{4\beta}$

(2) $\tan^{-1}\beta, \frac{\alpha^2}{2\beta}$

(3) $\tan^{-1}\alpha, \frac{4\alpha^2}{\beta}$

(4) $\tan^{-1}\left(\frac{\beta}{\alpha}\right), \frac{\alpha^2}{\beta}$

Ans. (1)

Q. A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product t_1t_2 is : [JEE-Main 2019]

(1) R/g

(2) R/4g

(3) 2R/g

(4) R/2g

Ans. (3)

❖ Projectile on Inclined plane :

$$T = \frac{2u\sin\alpha}{g\cos\beta} = \frac{2u_{\perp}}{g_{\perp}}$$

$$H_{max} = \frac{u^2\sin^2\alpha}{2g\cos\beta} = \frac{u_{\perp}^2}{2g_{\perp}}$$

$$R = \frac{2u^2\sin\alpha\cos(\alpha+\beta)}{g\cos\beta}$$

Here $\alpha \rightarrow$ angle of projection with the incline

$\beta \rightarrow$ angle of incline with the horizontal

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A plane is inclined at an angle $\alpha = 30^\circ$ with a respect to the horizontal. A particle is projected with a speed $u = 2\ ms^{-1}$ from the base of the plane, making an angle $\theta = 15^\circ$ with respect to the plane as shown in the figure. The distance from the base, at which the particle hits the plane is close to : [JEE-Main 2019]

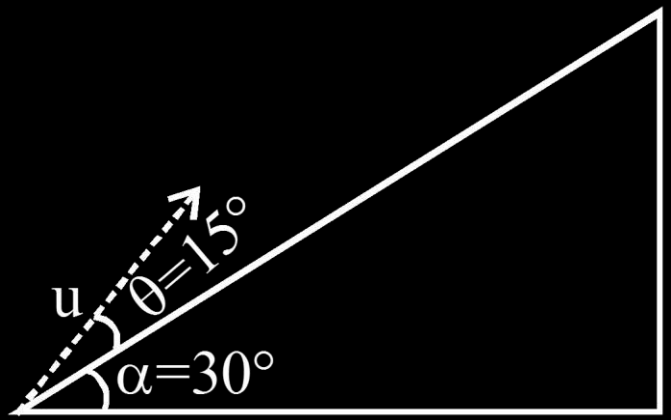
(Take $g = 10\ ms^{-2}$)

(1) 14 cm

(2) 20 cm

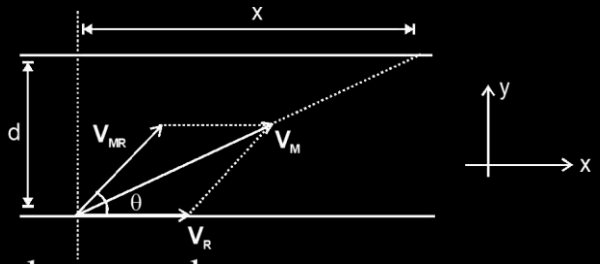
(3) 18 cm

(4) 26 cm



Ans. (2)

❖ **River problem :**



$$t = \frac{d}{v_y} = \frac{d}{v_{MR}\sin\theta}$$

$$x = (v_{MR}\cos\theta + v_R) \times \frac{d}{v_{MR}\sin\theta}$$

Time to cross the river along the shortest path

$$t = \frac{d}{v_{MR}\sin\theta} = \frac{d}{\sqrt{v_{MR}^2 - V_R^2}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ **Total Questions in last 10 years in 0 (JEE-Advanced) and 4 (JEE-Main)**

Q. A person is swimming with a speed of 10 m/s at an angle of 120° with the flow and reaches to a point directly opposite on the other side of the river. The speed of the flow is 'x' m/s. The value of 'x' to the nearest integer is _____.

[JEE-Main 2021]

Ans. 5.00

Q. A swimmer can swim with velocity of 12 km/h in still water. Water flowing in a river has velocity 6 km/h. The direction with respect to the direction of flow of river water he should swim in order to reach the point on the other bank just opposite to his starting point is _____°. (Round off to the Nearest Integer) (find the angle in degree)

[JEE-Main 2021]

Ans. 120

❖ Wind Airplane Problems :

$$\vec{V}_{aw} = \vec{V}_a - \vec{V}_w$$

where, $\vec{V}_a$ = velocity of aeroplane w.r.t. ground

$\vec{V}_w$ = velocity of wind.

$\vec{V}_{aw}$ = velocity of air plane w.r.t ground

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A butterfly is flying with a velocity $4\sqrt{2}$ m/s in North-East direction. Wind is slowly blowing at 1 m/s from North to South. The resultant displacement of the butterfly in 3 seconds is : [JEE-Main 2021]

(1) 3 m

(2) 20 m

(3) $12\sqrt{2}$ m

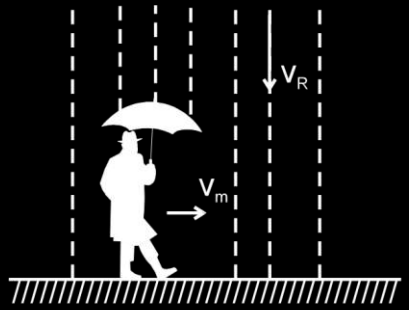
(4) 15 m

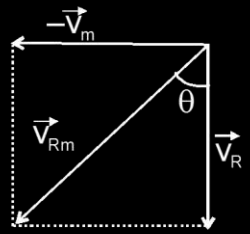
Ans. (4)

❖ Rain Problems :

$$\vec{v}_{Rm} = \vec{V}_R - \vec{V}_m \qquad \text{or} \qquad v_{Rm} = \sqrt{V_R^2 + V_m^2}$$

and direction $\theta = \tan^{-1}\left(\frac{V_m}{V_R}\right)$ with the vertical as shown in figure.





JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. When a car is at rest, its driver sees rain drops falling on it vertically. When driving the car with speed v, he sees that rain drops are coming at an angle 60° from the horizontal. On further increasing the speed of the car to $(1 + \beta)v$, this angle changes to 45°. The value of β is close to : [JEE-Main 2020]

(1) 0.41
(2) 0.50
(3) 0.37
(4) 0.73

Ans. (4)

❖ **Minimum distance Problems :**

If the initial position of two particles are $\vec{r}_1$ and $\vec{r}_2$ and their velocities are $\vec{v}_1$ and $\vec{v}_2$ then shortest distance between the particles.

$$d_{shortest} = \frac{|\vec{r}_{12} \times \vec{v}_{12}|}{|\vec{v}_{12}|}$$

Time after which this situation will occur

$$t = -\frac{\vec{r}_{12} \cdot \vec{v}_{12}}{|\vec{v}_{12}|^2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years in 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Ship A is sailing towards north-east with velocity $\vec{v} = 30\hat{i} + 50\hat{j}$ km/hr where $\hat{i}$ points east and $\hat{j}$, north. Ship B is at a distance of 80 km east and 150 km north of Ship A and is sailing towards west at 10 km/hr. A will be at minimum distance from B in : [JEE-Main 2019]

(1) 4.2 hrs.

(2) 2.2 hrs.

(3) 3.2 hrs.

(4) 2.6 hrs.

Ans. (4)

Thanks!

PHYSICS FORMULA RACE

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KTG & THERMODYNAMICS

❖ Translational K.E. of gas

$$\text{K.E.} = \frac{3}{2} K_B T$$

$$K_B = \text{Boltzmann's Constant}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	5	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 8 (JEE-Main)

Q. The average translational kinetic energy of N_2 gas molecules at .....°C becomes equal to the K.E. of an electron accelerated from rest through a potential difference of 0.1 volt.

(Given $k_B = 1.38 \times 10^{-23}$ J/K) [JEE-Main 2021]

(Fill the nearest integer).

Ans. (500)

Q. The number of molecules in one litre of an ideal gas at 300 K and 2 atmospheric pressure with mean kinetic energy 2×10^{-9} J per molecules is : [JEE-Main 2021]

(1) 0.75×10^{11}

(2) 3×10^{11}

(3) 1.5×10^{11}

(4) 6×10^{11}

Ans. (3)

❖ Mean free path (λ) & Average collision time (τ)

$$\lambda = \frac{1}{\sqrt{2}\pi d^2 n}; \tau = \frac{\lambda}{v_{avg.}}$$

$$n = \frac{\text{no. of molecules}}{\text{Volume}}$$

d = Diameter of Molecule

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	5	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. A system consists of two types of gas molecules A and B having same number density $2 \times 10^{25} / m^3$. The diameter of A and B are 10 Å and 5 Å respectively. They suffer collision at room temperature. The ratio of average distance covered by the molecule A to that of B between two successive collision is _____ $\times 10^{-2}$. [JEE-Main 2021]

Ans. (25)

Q. Calculate the value of mean free path (λ) for oxygen molecules at temperature 27°C and pressure 1.01×10^5 Pa. Assume the molecular diameter 0.3 nm and the gas is ideal.

($k = 1.38 \times 10^{-23}$ JK^{-1}) [JEE-Main 2021]

(1) 58 nm

(2) 32 nm

(3) 86 nm

(4) 102 nm

Ans. (4)

❖ RMS & Avg. speed of gas molecule:

$$V_{rms} = \sqrt{\frac{3KT}{m}} = \sqrt{\frac{3RT}{M_w}}$$

$$V_{avg.} = \sqrt{\frac{8RT}{\pi M}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	5	2021	-
2020	1	2020	-
2019	4	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. If the rms speed of oxygen molecules at 0°C is 160 m/s, find the rms speed of hydrogen molecules at 0°C. [JEE-Main 2021]

(1) 640 m/s

(2) 40 m/s

(3) 80 m/s

(4) 332 m/s

Ans. 1

Q. The rms speeds of the molecules of Hydrogen, Oxygen and Carbondioxide at the same temperature are V_H, V_O and V_C respectively then : [JEE-Main 2021]

(1) $V_H > V_O > V_C$

(2) $V_C > V_O > V_H$

(3) $V_H = V_O > V_C$

(4) $V_H = V_O = V_C$

Ans. (1)

Q. Consider a sample of oxygen behaving like an ideal gas. At 300 K, the ratio of root mean square (rms) velocity to the average velocity of gas molecule would be :
(Molecular weight of oxygen is 32 g/mol; R = 8.3 J K^{-1} mol^{-1}) [JEE-Main 2021]

(1) $\sqrt{\frac{3}{3}}$

(2) $\sqrt{\frac{8}{3}}$

(3) $\sqrt{\frac{3\pi}{8}}$

(4) $\sqrt{\frac{8\pi}{3}}$

Ans. (3)

❖ Relation between degree of freedom(f) & ratio of specific heat (γ)

$$\gamma = \frac{2}{f} + 1$$

$$\gamma = \frac{C_p}{C_v}; C_P = \frac{f+2}{2}R; C_V = \frac{f}{2}R$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	5	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. The correct relation between the degrees of freedom f and the ratio of specific heat γ is :

[JEE-Main2021]

(1) $f = \frac{2}{\gamma - 1}$

(2) $f = \frac{2}{\gamma + 1}$

(3) $f = \frac{\gamma + 1}{2}$

(4) $f = \frac{1}{\gamma + 1}$

Ans. (1)

Q. If one mole of the polyatomic gas is having two vibrational modes and β is the ratio of molar specific heats for polyatomic gas $\left(\beta = \frac{C_P}{C_V}\right)$ then the value of β is : [JEE-Main 2021]

(1) 1.02

(2) 1.2

(3) 1.25

(4) 1.35

Ans. (2)

❖ Specific heat of mixture of two gases

$$(C_P)_{mix.} = \frac{n_1 C_{p_1} + n_2 C_{p_2}}{n_1 + n_2}$$

$$(C_V)_{mix.} = \frac{n_1 C_{v_1} + n_2 C_{v_2}}{n_1 + n_2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	2	2020	-
2019	1	2019	1
2018	1	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 5 (JEE-Main)

Q. Consider a mixture of n moles of helium gas and 2 n moles of oxygen gas (molecules taken to be rigid) as an ideal gas. Its C_P/C_V value will be : [JEE-Main 2020]

(1) 67/45

(2) 19/13

(3) 23/15

(4) 40/27

Ans. (3)

❖ Ideal gas equation

$$PV = nRT$$

$$P = \frac{\rho RT}{M}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	6	2021	-
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	2	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 12 (JEE-Main)

Q. A mixture of hydrogen and oxygen has volume 500 cm^3, temperature 300 K, pressure 400 kPa and mass 0.76 g. The ratio of masses of oxygen to hydrogen will be :-

[JEE-Main-2021]

(1) 3 : 8

(2) 3 : 16

(3) 16 : 3

(4) 8 : 3

Ans. (3)

Q. A balloon carries a total load of 185 kg at normal pressure and temperature of 27°C. What load will the balloon carry on rising to a height at which the barometric pressure is 45 cm of Hg and the temperature is –7°C. Assuming the volume constant ? [JEE-Main 2021]

(1) 181.46 kg

(2) 214.15 kg.

(3) 219.07 kg

(4) 123.54 kg

Ans. (4)

❖ 1st law of thermodynamics:

$$\Delta Q = \Delta U + W$$

$$\Delta U = nC_v\Delta T = n\frac{f}{2}R\Delta T$$

$$W = \int P(dV)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	1
2020	3	2020	-
2019	5	2019	1
2018	-	2018	1
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 5 (JEE-Advanced) and 16 (JEE-Main)

Q. The temperature of 3.00 mol of an ideal diatomic gas is increased by 40.0 °C without changing the pressure of the gas. The molecules in the gas rotate but do not oscillate. If the ratio of change in internal energy of the gas to the amount of workdone by the gas is $\frac{x}{10}$. Then the value of x (round off to the nearest integer) is _____. [JEE-Main 2021]

(Given $R = 8.31\ J\ mol^{-1}\ K^{-1}$)

Ans. (25)

Q. An electric appliance supplies 6000 J/min heat to the system. If the system delivers a power of 90W. How long it would take to increase the internal energy by 2.5×10^3 J ?

[JEE-Main 2021]

(1) 2.5×10^2 s

(2) 4.1×10^1s

(3) 2.4×10^3 s

(4) 2.5×10^1s

Ans. (1)

❖ Adiabatic Process:-

$$Pv^{\gamma} = \text{constt}; \qquad \Delta Q = O$$

$$W = \frac{P_2V_2}{1-\gamma} = \frac{nR(T_2 - T_1)}{1-\gamma}$$

$$= -\Delta U$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	6	2021	1
2020	3	2020	2
2019	1	2019	-
2018	1	2018	1
2017	-	2017	-
2016	-	2016	1
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 5 (JEE-Advanced) and 11 (JEE-Main)

Q. A sample of gas with $\gamma = 1.5$ is taken through an adiabatic process in which the volume is compressed from 1200 cm^3 to 300 cm^3. If the initial pressure is 200 kPa. The absolute value of the workdone by the gas in the process =_____J. [JEE-Main 2021]

Ans. (480)

Q. One mole of an ideal gas is taken through an adiabatic process where the temperature rises from 27°C to 37°C. If the ideal gas is composed of polyatomic molecule that has 4 vibrational modes, which of the following is true? [R = 8.314 J mol^{-1} k^{-1}] [JEE-Main 2021]

(1) work done by the gas is close to 332 J

(2) work done on the gas is close to 582 J

(3) work done by the gas is close to 582 J

(4) work done on the gas is close to 332 J

Ans. (2)

❖ Isothermal Process:

$$PV = \text{Constt.}$$

$$W = nRT\ell n\frac{V_2}{V_1}$$

$$= nRT\ell n\frac{P_1}{P_2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	5	2021	2
2020	-	2020	-
2019	-	2019	-
2018	1	2018	1
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 7 (JEE-Main)

Q. Two spherical soap bubbles of radii r_1 and r_2 in vacuum combine under isothermal conditions. The resulting bubble has a radius equal to : [JEE-Main 2021]

(1) $\frac{r_1 r_2}{r_1 + r_2}$

(2) $\sqrt{r_1 r_2}$

(3) $\sqrt{r_1^2 + r_2^2}$

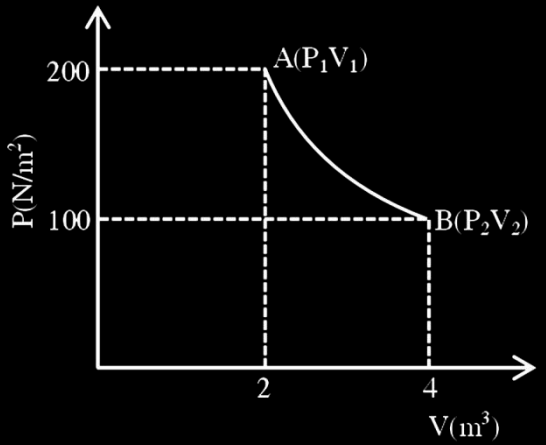
(4) $\frac{r_1 + r_2}{2}$

Ans. (3)

Q. One mole of an ideal gas at 27°C is taken from A to B as shown in the given PV indicator diagram. The work done by the system will be____ $\times 10^{-1}$ J. [JEE-Main 2021]

[Given : R = 8.3 J / mole K, ln2 = 0.6931]

(Round off to the nearest integer)



Ans. 17258

❖ Isobaric Process:

$$P = \text{Constant}$$

$$\Delta Q = nC_P\Delta T$$

$$W = P(\Delta V)$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	2	2020	-
2019	3	2019	1
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	1
2012	-	2012	-

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 6 (JEE-Main)

Q. Starting at temperature 300 K, one mole of an ideal diatomic gas ($\gamma = 1.4$) is first compressed adiabatically from volume V_1 to V_2 = . It is then allowed to expand isobarically to volume $2V_2$. If all the processes are the quasi-static then the final temperature of the gas (in °K) is (to the nearest integer) _____. [JEE-Main 2020]

Ans. (Correct answer is between 1818 to 1819)

Q. A diatomic gas with rigid molecules does 10 J of work when expanded at constant pressure. What would be the heat energy absorbed by the gas, in this process ? [JEE-Main 2019]

(1) 35 J

(2) 40 J

(3) 25 J

(4) 30 J

Ans. (1)

❖ Isochoric Process:

$$V = \text{constant}; \; W = 0$$

$$\Delta Q = \Delta U = nC_V \Delta T$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	3	2019	-
2018	-	2018	-
2017	1	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	1
2012	1	2012	-

☛Total Questions in last 10 years: 3 (JEE-Advanced) and 6 (JEE-Main)

Q. When heat Q is supplied to a diatomic gas of rigid molecules, at constant volume its temperature increases by ΔT. The heat required to produce the same change in temperature, at a constant pressure is : [JEE-Main 2019]

(1) $\frac{7}{5}Q$ **(2)** $\frac{3}{2}Q$

(3) $\frac{5}{3}Q$ **(4)** $\frac{2}{3}Q$

Ans. **(1)**

Q. A cylinder with fixed capacity of 67.2 lit contains helium gas at STP. The amount of heat needed to raise the temperature of the gas by 20°C is : [Given that R = 8.31 J mol^{-1} K^{-1}]

[JEE-Main 2021]

(1) 748 J

(2) 374 J

(3) 350 J

(4) 700 J

Ans. (1)

❖ Polytropic Porcess

$$PV^{x} = \text{constt.}$$

$$W = \frac{P_2V_2 - P_1V_1}{1 - x} = \frac{nR\left(T_2 - T_1\right)}{1 - x}$$

$$\text{Specific heat, } C = \frac{R}{1 - x} + C_V$$

$$\Delta Q = nC\Delta T.$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. An ideal gas is expanding such that PT^3 = constant. The coefficient of volume expansion of the gas is : [JEE-Main 2021]

(1) $\frac{1}{T}$ (2) $\frac{2}{T}$

(3) $\frac{4}{T}$ (4) $\frac{3}{T}$

Ans. 3

Q. In a certain thermodynamical process, the pressure of a gas depends on its volume as kV^3. The work done when the temperature changes from 100°C to 300°C will be ___ nR, where n denotes number of moles of a gas. [JEE-Main 2021]

Ans. 50

❖ Cyclic Process

$$\Delta U = 0$$

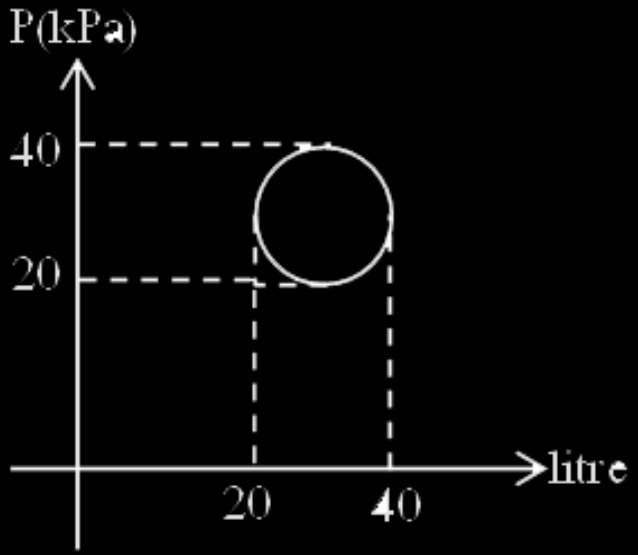
$$\Delta Q = W = \text{Area under loop}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	2	2019	1
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	1
2013	1	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 2 (JEE-Advanced) and 8 (JEE-Main)

Q. An engine operates by taking a monatomic ideal gas through the cycle shown in the figure.

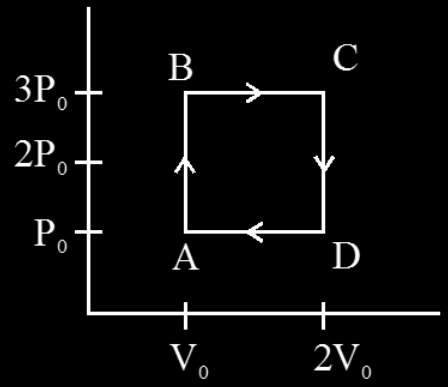
The percentage efficiency of the engine is close to _____ . [JEE-Main 2020]



Ans. (19.00)

Q. An engine operates by taking a monatomic ideal gas through the cycle shown in the figure.

The percentage efficiency of the engine is close to _____ . [JEE-Main 2020]



Ans. (19.00)

❖ Carnot engine:

$$\text{Efficiency}(\eta) = \frac{W}{Q_{in}} = 1 - \frac{T_2}{T_1}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	7	2021	-
2020	4	2020	-
2019	2	2019	-
2018	2	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 18 (JEE-Main)

Q. A reversible engine has an efficiency of $\frac{1}{4}$. If the temperature of the sink is reduced by 58°C, its efficiency becomes double. Calculate the temperature of the sink :

[JEE-Main 2021]

(1) 174°C

(2) 280°C

(3) 180.4°C

(4) 382°C

Ans. (1)

Q. A heat engine operates between a cold reservoir at temperature $T_2 = 400$ K and a hot reservoir at temperature T_1. It takes 300 J of heat from the hot reservoir and delivers 240 J of heat to the cold reservoir in a cycle. The minimum temperature of the hot reservoir has to be _____K. [JEE-Main 2021]

Ans. 500

❖ Refrigerator:

$$C.O.P. = \frac{T_L}{T_H - T_L}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A refrigerator consumes an average 35 W power to operate between temperature –10°C to 25°C. If there is no loss of energy then how much average heat per second does it transfer ?

[JEE-Main 2021]

(1) 263 J/s

(2) 298 J/s

(3) 350 J/s

(4) 35 J/s

Ans. (1)

Q. If minimum possible work is done by a refrigerator in converting 100 grams of water at 0°C to ice, how much heat (in calories) is released to the surrounding at temperature 27°C (Latent heat of ice = 80 Cal/gram) to the nearest integer? [JEE-Main 2020]

Ans. 8791

❖ Entropy:

$$S = \frac{Q}{\Delta T}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. The entropy of any system is given by

$$S = \alpha^2 \beta \ln\left[\frac{\mu k R}{J\beta^2} + 3\right]$$

where α and β are the constants. μ, J, k and R are no. of moles, mechanical equivalent of heat, Boltzmann constant and gas constant respectively.

$$\left[\text{Take } S = \frac{dQ}{T}\right]$$

Choose the incorrect option from the following : [JEE-Main-2021]

(1) α and J have the same dimensions.

(2) S, β, k and μR have the same dimensions.

(3) S and α have different dimensions.

(4) α and k have the same dimensions.

Ans. (4)

Q. An ideal gas in a cylinder is separated by a piston in such a way that the entropy of one part is S_1 and that of the other part is S_2. Given that $S_1 > S_2$. If the piston is removed then the total entropy of the system will be : [JEE-Main 2021]

(1) $S_1 \times S_2$

(2) $S_1 - S_2$

(3) $\frac{S_1}{S_2}$

(4) $S_1 + S_2$

Ans. (4)

Thanks!

PHYSICS FORMULA RACE

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MEASUREMENT ERROR, UNIT & DIMENSIONS

❖ Fractional & Absolute Error in measurement:

$$A = \frac{x^a y^b}{Z^c}$$

$$\frac{\Delta A}{A} = a\frac{\Delta x}{X} + b\frac{\Delta y}{Y} + c\frac{\Delta z}{Z}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	9	2021	-
2020	2	2020	-
2019	3	2019	1
2018	4	2018	1
2017	2	2017	1
2016	1	2016	1
2015	1	2015	1
2014	-	2014	1
2013	-	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 6 (JEE-Advanced) and 23 (JEE-Main)

Q. A student determined Young's Modulus of elasticity using the formula $Y = \frac{MgL^3}{4bd^3\delta}$. The value of g is taken to be 9.8 m/s^2, without any significant error, his observation are as following.

[JEE-Main 2021]

Physical Quantity	Least count of the Equipment used for measurement	Observed value
Mass (M)	1 g	2 kg
Length of bar (L)	1 mm	1 m
Breadth of bar (b)	0.1 mm	4 cm
Thickness of bar (d)	0.01 mm	0.4 cm
Depression (δ)	0.01 mm	5 mm

Then the fractional error in the measurement of Y is :

(1) 0.0083 (2) 0.0155 (3) 0.155 (4) 0.083

Ans. (2)

Q. The acceleration due to gravity is found upto an accuracy of 4% on a planet. The energy supplied to a simple pendulum to known mass 'm' to undertake oscillations of time period T is being estimated. If time period is measured to an accuracy of 3%, the accuracy to which E is known as .....% [JEE-Main 2021]

Ans. (14)

❖ Vernier Calliper

LC = 1 MSD – 1 VSD

Reading = MSR + VSR × LC ± zero error

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	1
2020	1	2020	-
2019	-	2019	-
2018	-	2018	1
2017	-	2017	-
2016	-	2016	1
2015	-	2015	1
2014	-	2014	1
2013	-	2013	1
2012	1	2012	-

☛Total Questions in last 10 years: 6 (JEE-Advanced) and 5 (JEE-Main)

Q. The diameter of a spherical bob is measured using a vernier callipers. 9 divisions of the main scale, in the vernier callipers, are equal to 10 divisions of vernier scale. One main scale division is 1 mm. The main scale reading is 10 mm and 8^{th} division of vernier scale was found to coincide exactly with one of the main scale division. If the given vernier callipers has positive zero error of 0.04 cm, then the radius of the bob is_____ $\times 10^{-2}$ cm.

[JEE-Main 2021]

Ans. (52)

Q. The vernier scale used for measurement has a positive zero error of 0.2 mm. If while taking a measurement it was noted that '0' on the vernier scale lies between 8.5 cm and 8.6 cm, vernier coincidence is 6, then the correct value of measurement is_____ cm.
(least count = 0.01 cm) [JEE-Main 2021]

(1) 8.36 cm
(2) 8.54 cm
(3) 8.58 cm
(4) 8.56 cm

Ans. (2)

❖ Screw Gange

$$\text{L.C.} = \frac{\text{Pitch}}{\text{Total Divisions on circular scale}}$$

$$\text{Reading} = \text{MSR} + \text{L.C.} \times \text{CSR} \pm \text{zero error}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	3	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	1

☛Total Questions in last 10 years: 1 (JEE-Advanced) and 11 (JEE-Main)

Q. In a Screw Gauge, fifth division of the circular scale coincides with the reference line when the ratchet is closed. There are 50 divisions on the circular scale, and the main scale moves by 0.5 mm on a complete rotation. For a particular observation the reading on the main scale is 5 mm and the 20^{th} division of the circular scale coincides with reference line. Calculate the true reading. [JEE-Main 2021]

(1) 5.00 mm (2) 5.25 mm (3) 5.15 mm (4) 5.20 mm

Ans. (3)

Q. Assertion A : If in five complete rotations of the circular scale, the distance travelled on main scale of the screw gauge is 5 mm and there are 50 total divisions on circular scale, then least count is 0.001 cm.

Reason R :

$$\text{Least Count} = \frac{\text{Pitch}}{\text{Total divisions on circular scale}}$$

In the light of the above statements, choose the most appropriate answer from the options given below : [JEE-Main 2021]

(1) A is not correct but R is correct.

(2) Both A and R are correct and R is the correct explanation of A.

(3) A is correct but R is not correct.

(4) Both A and R are correct and R is NOT the correct explanation of A.

Ans. (1)

MEASUREMENT ERROR, UNIT & DIMENSIONS

❖ S.I. Unit:

Mass	–kg
Length	–m
Time	–s
Electric Current	–A
Temperature	–K
Amount of substance	–Mole
Luminous intensity	–Cd

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Match List-I with List-II. [JEE-Main 2021]

List-I	List-II
(a) R_H (Rydberg constant)	(i) kg m^{-1} s^{-1}
(b) h(Planck's constant)	(ii) kg m^2 s^{-1}
(c) μ_B (Magnetic field energy density)	(iii) m^{-1}
(d) η(coefficient of viscocity)	(iv) kg m^{-1} s^{-2}

Choose the most appropriate answer from the options given below :

(1) (a)–(ii), (b)–(iii), (c)–(iv), (d)–(i)

(2) (a)–(iii), (b)–(ii), (c)–(iv), (d)–(i)

(3) (a)–(iv), (b)–(ii), (c)–(i), (d)–(iii)

(4) (a)–(iii), (b)–(ii), (c)–(i), (d)–(iv)

Ans. 2

Q. If E and H represents the intensity of electric field and magnetising field respectively, then the unit of E/H will be : [JEE-Main 2021]

(1) ohm
(2) mho
(3) joule
(4) newton

Ans. (1)

MEASUREMENT ERROR, UNIT & DIMENSIONS

❖ Dimensional Formula:

Mass	–[M]
Length	–[L]
Time	–[T]
Electric Current	–[A]
Temperature	–[K]

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	14	2021	1
2020	8	2020	1
2019	8	2019	1
2018	1	2018	2
2017	1	2017	-
2016	2	2016	1
2015	-	2015	2
2014	-	2014	1
2013	1	2013	1
2012	-	2012	-

☛Total Questions in last 10 years: 10 (JEE-Advanced) and 35 (JEE-Main)

Q. If velocity [V], time [T] and force [F] are chosen as the base quantities, the dimensions of the mass will be : [JEE-Main 2021]

(1) $[FT^{-1} V^{-1}]$

(2) $[FTV^{-1}]$

(3) $[FT^{2} V]$

(4) $[FVT^{-1}]$

Ans. (2)

Q. Which of the following equations is dimensionally incorrect ?

Where t = time, h = height, s = surface tension, θ = angle, ρ = density, a, r = radius, g = acceleration due to gravity, v = volume , p = pressure, W = work done, Γ = torque, $\in$ = permittivity, E = electric field, J = current density, L = length. [JEE-Main 2021]

(1) $v = \frac{\pi p a^4}{8 \eta L}$

(2) $h = \frac{2 s \cos\theta}{\rho r g}$

(3) $J = \in \frac{\partial E}{\partial t}$

(4) $W = \Gamma\theta$

Ans. (1)

❖ Significant Figure:

- ☛All non-zero digits are significant
- ☛All zeros occurring between two non-zeros digits are significant
- ☛ Trailing zeroes after decimal place are significant
- ☛In the number less than one, all zeros after decimal point and to the left of first non-zero digit are insignificant.
- ☛Rule of addition, subtraction, multiplication, division and rounding off.

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	2	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. A student measuring the diameter of a pencil of circular cross-section with the help of a vernier scale records the following four readings 5.50 mm, 5.55 mm, 5.45 mm; 5.65 mm. The average of these four readings is 5.5375 mm and the standard deviation of the data is 0.07395 mm. The average diameter of the pencil should therefore be recorded as :

[JEE-Main 2020]

(1) (5.5375 ± 0.0739) mm

(2) (5.538 ± 0.074) mm

(3) (5.54 ± 0.07) mm

(4) (5.5375 ± 0.0740) mm

Ans. (3)

Q. For the four sets of three measured physical quantities as given below. Which of the following options is correct ? [JEE-Main 2020]

(i) $A_1 = 24.36, B_1 = 0.0724, C_1 = 256.2$

(ii) $A_2 = 24.44, B_2 = 16.082, C_2 = 240.2$

(iii) $A_3 = 25.2, B_3 = 19.2812, C_3 = 236.183$

(iv) $A_4 = 25, B_4 = 236.191, C_4 = 19.5$

(1) $A_4 + B_4 + C_4 < A_1 + B_1 + C_1 < A_3 + B_3 + C_3 < A_2 + B_2 + C_2$

(2) $A_1 + B_1 + C_1 < A_3 + B_3 + C_3 < A_2 + B_2 + C_2 < A_4 + B_4 + C_4$

(3) $A_1 + B_1 + C_1 = A_2 + B_2 + C_2 = A_3 + B_3 + C_3 = A_4 + B_4 + C_4$

(4) $A_4 + B_4 + C_4 > A_3 + B_3 + C_3 = A_2 + B_2 + C_2 > A_1 + B_1 + C_1$

Ans. (4)

Thanks!

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❖ De-broglie wavelength :

$$\lambda = \frac{h}{P}$$

$$\lambda = \frac{h}{\sqrt{2mk}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	4	2021	-
2020	9	2020	-
2019	5	2019	-
2018	3	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 22 (JEE-Main)

Q. A particle of mass 4M at rest disintegrates into two particles of mass M and 3M respectively having non zero velocities. The ratio of de-Broglie wavelength of particle of mass M to that of mass 3M will be : [JEE-Main 2021]

(1) 1 : 3

(2) 3 : 1

(3) 1 : $\sqrt{3}$

(4) 1 : 1

Ans. (4)

Q. A moving proton and electron have the same de-Broglie wavelength. If K and P denote the K.E. and momentum respectively. Then choose the correct option : [JEE-Main 2021]

(1) $K_p < K_e$ and $P_p = P_e$

(2) $K_p = K_e$ and $P_p = P_e$

(3) $K_p < K_e$ and $P_p < P_e$

(4) $K_p > K_e$ and $P_p = P_e$

Ans. (1)

❖ Half life formula :

$$t_{1/2} = \frac{\ell n 2}{\lambda}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. There are 10^{10} radioactive nuclei in a given radioactive element, Its half-life time is 1 minute. How many nuclei will remain after 30 seconds ? [JEE-Main 2021]

$\left(\sqrt{2} = 1.414\right)$

(1) 2×10^{10}

(2) 7×10^{9}

(3) 10^{5}

(4) 4×10^{10}

Ans. (2)

Q. A radioactive substance decays to $\left(\frac{1}{16}\right)^{th}$ of its initial activity in 80 days. The half life of the radioactive substance expressed in days is____. [JEE-Main 2021]

Ans. 20

❖ Photoelectric effect formula :

$$E_{incident} = E_{Threshold} + (K.E.)$$

$$\nu_{in} = \nu_{th} + \frac{e\phi}{h}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	13	2021	1
2020	7	2020	1
2019	6	2019	-
2018	-	2018	-
2017	1	2017	-
2016	3	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 30 (JEE-Main)

Q. When radiation of wavelength λ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength 3λ, the stopping potential is $\frac{V}{4}$. If the threshold wavelength for the metallic surface is $n\lambda$ then value of n will be _____. [JEE-Main 2020]

Ans. 9

❖ Energy of the nth orbit :

$$E_n = -13.6 \times \frac{Z^2}{n^2} \text{ (eV)}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	
2020	1	2020	
2019		2019	
2018		2018	
2017		2017	1
2016		2016	1
2015		2015	1
2014		2014	
2013		2013	
2012		2012	

☛ Total Questions in last 10 years: 3 (JEE-Advanced) and 2 (JEE-Main)

Q. Which level of the single ionized carbon has the same energy as the ground state energy of hydrogen atom? [JEE-Main 2021]

(1) 1

(2) 6

(3) 4

(4) 8

Ans. (2)

Q. In a hydrogen atom the electron makes a transition from $(n + 1)^{th}$ level to the n^{th} level. If $n >> l$, the frequency of radiation emitted is proportional to : [JEE-Main 2020]

(1) $\frac{1}{n^4}$

(2) $\frac{1}{n^3}$

(3) $\frac{1}{n^2}$

(4) $\frac{1}{n}$

Ans. (2)

❖ Velocity of nth orbit :

$$V_n = 2.2 \times 10^6 \times \frac{Z}{n} \text{ m/s}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	
2020		2020	
2019		2019	
2018		2018	
2017		2017	
2016		2016	
2015		2015	
2014		2014	
2013		2013	
2012		2012	

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. If an electron is moving in the n^{th} orbit of the hydrogen atom, then its velocity (v_n) for the n^{th} orbit is given as : [JEE-Main 2021]

(1) $v_n \propto n$

(2) $v_n \propto \frac{1}{n}$

(3) $v_n \propto n^2$

(4) $v_n \propto \frac{1}{n^2}$

Ans. (2)

❖ Activity formula :

$$A = A_0 e^{-\lambda t}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	1
2016	2	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 5 (JEE-Main)

Q. The half-life of Au^{198} is 2.7 days. The activity of 1.50 mg of Au^{198} if its atomic weight is 198 g mol^{-1} is, ($N_A = 6 \times 10^{23}$/mol) [JEE-Main 2021]

(1) 240 Ci

(2) 357 Ci

(3) 535 Ci

(4) 252 Ci

Ans. (2)

Q. The first three spectral lines of H-atom in the Balmer series are given $\lambda_1, \lambda_2, \lambda_3$ considering the Bohr atomic model, the wave lengths of first and third spectral lines $\left(\frac{\lambda_1}{\lambda_3}\right)$ are related by a factor of approximately 'x' $\times 10^{-1}$. The value of x, to the nearest integer, is _____.

[JEE-Main 2021]

Ans. 15

❖ Lambda in terms of potential :

$$\lambda = \frac{12.27}{\sqrt{v}} \text{Volt}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	4	2021	1
2020	2	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 9 (JEE-Main)

Q. The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of 100 V. What should nearly be the ratio of their wavelengths ? (m_p = 1.00727 u, m_e = 0.00055u) [JEE-Main 2021]

(1) 1860 : 1

(2) $(1860)^2$: 1

(3) 41.4 : 1

(4) 43 : 1

Ans. (4)

❖ Number of active nuclei :

$$N(t) = N_0 e^{-\lambda t}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	3	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 3 (JEE-Main)

Q. The de-Broglie wavelength associated with an electron and a proton were calculated by accelerating them through same potential of 100 V. What should nearly be the ratio of their wavelengths ? (m_p = 1.00727 u, m_e = 0.00055u) [JEE-Main 2021]

(1) 1860 : 1

(2) $(1860)^2$: 1

(3) 41.4 : 1

(4) 43 : 1

Ans. (4)

Q. In a radioactive material, fraction of active material remaining after time t is 9/16. The fraction that was remaining after t/2 is : [JEE-Main 2021]

(1) $\frac{3}{4}$

(2) $\frac{7}{8}$

(3) $\frac{4}{5}$

(4) $\frac{3}{5}$

Ans. (1)

❖ Transition of wavelength in hydrogen spectrum

$$\frac{1}{\lambda} = R_H z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	4	2021	1
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 2 (JEE-Main)

Q. The first three spectral lines of H-atom in the Balmer series are given λ_1, λ_2, λ_3 considering the Bohr atomic model, the wave lengths of first and third spectral lines $\left(\frac{\lambda_1}{\lambda_3}\right)$ are related by a factor of approximately 'x' $\times 10^{-1}$. The value of x, to the nearest integer, is _____. [JEE-Main 2021]

Ans. 15

❖ Equivalent decay constant :

$$\lambda_{eq} = \lambda_1 + \lambda_2$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A radioactive nucleus decays by two different processes. The half life for the first process is 10 s and that for the second is 100s. the effective half life of the nucleus is close to : [JEE-Main 2020]

(1) 9 sec

(2) 55 sec

(3) 6 sec

(4) 12 sec

Ans. (1)

❖ Radius of the nucleus

$$R = R_0 A^{1/3}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. The radius of R of a nucleus of mass number A can be estimated by the formula $R = (1.3 \times 10^{-15})A^{1/3}$ m. It follows that the mass density of a nucleus is of the order of:

$\left(M_{prot.} \cong M_{neut.} \square 1.67 \times 10^{-27} kg\right)$ [JEE-Main 2020]

(1) 10^{24} kg m^{-3}

(2) 10^{3} kg m^{-3}

(3) 10^{17} kg m^{-3}

(4) 10^{10} kg m^{-3}

Ans. (3)

❖ Radius of the orbit

$$r_n = \frac{a_0 \times n^2}{2}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0(JEE-Advanced) and 1(JEE-Main)

Q. A hydrogen atom, initially in the ground state is excited by absorbing a photon of wavelength 980Å. The radius of the atom in the excited state, it terms of Bohr radius a_0, will be :

(h_c = 12500 eV – Å) [JEE-Main 2019]

(1) $9a_0$ (2) $25a_0$

(3) $4a_0$ (4) $16a_0$

Ans. (4)

❖ Force and potential energy relation :

$$F = -\frac{du}{dr}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A particle of mass m moves in a circular orbit in a central potential field $U(r) = \frac{1}{2}kr^2$. If Bohr's quantization conditions are applied, radii of possible orbitals and energy levels vary with quantum number n as : [JEE-Main 2019]

(1) $r_n \propto n^2$, $E_n \propto \frac{1}{n^2}$

(2) $r_n \propto \sqrt{n}, E_n \propto \frac{1}{n}$

(3) $r_n \propto n$, $E_n \propto n$

(4) $r_n \propto \sqrt{n}$, $E_n \propto n$

❖ Mass energy equivalence :

$$E = \Delta mc^2$$

$\Delta m \rightarrow$ mass defect

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	-	2021	-
2020	-	2020	-
2019	3	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 5 (JEE-Main)

Q. Condiser the nuclear fission

$Ne^{20} \rightarrow 2He^{4} + C^{12}$

Given that the binding energy/nucleon of

Ne^{20}, He^{4} and C^{12} are, respectively, 8.03 MeV, 7.07 MeV and 7.86 MeV, identify the correct statement :

(1) 8.3 MeV energy will be released

(2) energy of 12.4 MeV will be supplied

(3) energy of 11.9 MeV has to be supplied

(4) energy of 3.6 MeV will be released

Q. Find the binding energy per nucleon for $^{120}_{50}Sn$. Mass of proton m_P = 1.00783 U, mass of neutron m_n = 1.00867 U and mass of tin nucleus m_{Sn} = 119.902199 U. (take 1U = 931 MeV)

[JEE-Main 2020]

(1) 8.5 MeV (2) 7.5 MeV (3) 8.0 MeV (4) 9.0 MeV

Ans. (1)

❖ Energy of photon:

$$E = h\nu$$

or $$P = (n/t)h\nu$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	2	2020	-
2019	1	2019	-
2018	2	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 5 (JEE-Main)

Q. A Laser light of wavelength 660 nm is used to weld Retina detachment. If a Laser pulse of width 60 ms and power 0.5 kW is used the approximate number of photons in the pulse are : [Take Planck's constant $h = 6.62 \times 10^{-34}$ Js] [JEE-Main 2021]

(1) 10^{19} (2) 10^{18} (3) 10^{22} (4) 10^{20}

Ans. (4)

Q. A 2 mW laser operates at a wavelength of 500 nm. The number of photons that will be emitted per second is : [Given Planck's constant $h = 6.6 \times 10^{-34}$ Js, speed of light $c = 3.0 \times 10^{8}$ m/s] [JEE-Main 2021]

(1) 2×10^{16}

(2) 1.5×10^{16}

(3) 5×10^{15}

(4) 1×10^{16}

Ans. (3)

❖ Radiation pressure:

$$P = \frac{I}{C}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. If 2.5×10^{-6} N average force is exerted by a light wave on a non-reflecting surface of 30 cm^2 area during 40 minutes of time span, the energy flux of light just before it falls on the surface is ____ W/cm^2. [JEE-Main 2021]

(Round off to the Nearest Integer)

(Assume complete absorption and normal incidence conditions are there)

Ans. 25

Thanks!

PHYSICS FORMULAE RACE

Reliable
INSTITUTE
Unleashing Potential

NEWTON'S LAW OF MOTION, FRICTION & CIRCULAR MOTION

❖ Variable mass :

$$F_{thrust} = \left(\frac{dm}{dt}\right) V_{rel}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 10 (JEE-Main)

Q. The initial mass of a rocket is 1000 kg. Calculate at what rate the fuel should be burnt so that the rocket is given an acceleration of 20 ms^{-2}. The gases come out at a relative speed of 500 ms^{-1} with respect to the rocket :[Use g = 10 m/s^2] [JEE-Main 2021]

(1) 6.0×10^2 kg s^{-1}

(2) 500 kg s^{-1}

(3) 10 kg s^{-1}

(4) 60 kg s^{-1}

Ans. (4)

❖ Equilibrium :

$$F_{net} = 0$$

$$\Sigma F_x = \Sigma F_y = \Sigma F_z = 0$$

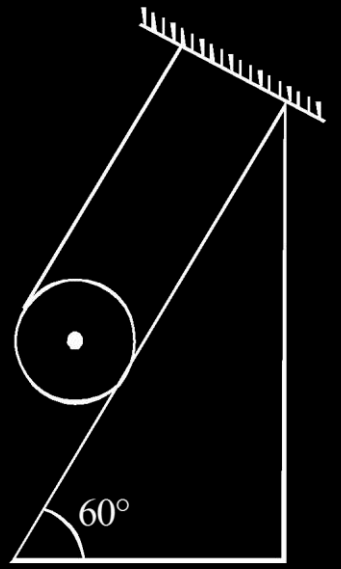
JEE Main	Que./Year	JEE Advanced	Que./Year
2021	4	2021	1
2020	2	2020	4
2019	4	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	1	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 5 (JEE-Advanced) and 14 (JEE-Main)

Q. An inclined plane is bent in such a way that the vertical cross-section is given by $y = \frac{x^2}{4}$ where y is in vertical and x in horizontal direction. If the upper surface of this curved plane is rough with coefficient of friction $\mu = 0.5$, the maximum height in cm at which a stationary block will not slip downward is _____ cm. [JEE-Main 2021]

Ans. 25

Q. A solid cylinder of mass m is wrapped with an inextensible light string and, is placed on a rough inclined plane as shown in the figure. The frictional force acting between the cylinder and the inclined plane is : [The coefficient of static friction, μ_s, is 0.4] [JEE-Main 2021]



(1) $\frac{7}{2}$mg

(2) 5 mg

(3) $\frac{mg}{5}$

(4) 0

Ans. (3)

❖ String constraints :

$$V_A\cos\theta_A = V_B\cos\theta_B$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	3	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

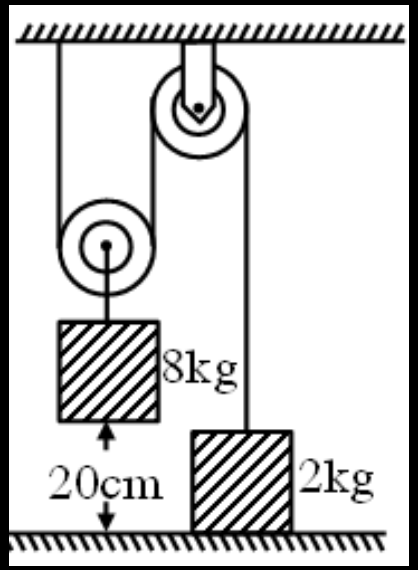
Q The boxes of masses 2 kg and 8 kg are connected by a massless string passing over smooth pulleys. Calculate the time taken by box of mass 8 kg to strike the ground starting from rest. (use $g = 10\ m/s^2$) [JEE-Main 2021]

(1) 0.34 s

(2) 0.2 s

(3) 0.25 s

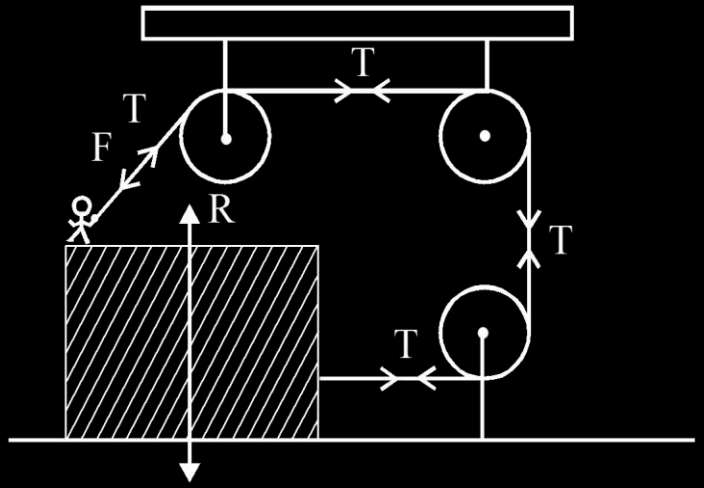
(4) 0.4 s



Ans. 4

Q. A boy of mass 4 kg is standing on a piece of wood having mass 5kg . If the coefficient of friction between the wood and the floor is 0.5, the maximum force that the boy can exert on the rope so that the piece of wood does not move from its place is _____N.(Round off to the Nearest Integer) [Take g = 10 ms^{-2}] [JEE-Main 2021]

Ans. (30)



❖ Static and kinetic friction :

$f_s = \mu_s N$ $\quad (\mu_k < \mu_s)$

$f_k = \mu_k N$

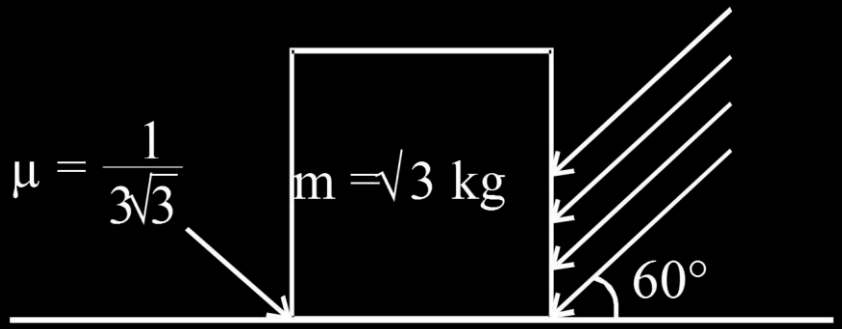
JEE Main	Que./Year	JEE Advanced	Que./Year
2021	8	2021	
2020		2020	
2019	3	2019	
2018	3	2018	
2017		2017	
2016		2016	
2015		2015	
2014		2014	
2013		2013	
2012		2012	

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 14 (JEE-Main)

Q. As shown in the figure, a block of mass $\sqrt{3}$ kg is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle 60° with horizontal such that it does not move, will be 3x. The value of x will be

[g = 10 m/s^2; sin 60° $\frac{\sqrt{3}}{2}$; cos 60° = $\frac{1}{2}$] [JEE-Main 2021]

Ans. 10



Q. A given object takes n times more time to slide down a 45° rough inclined plane as it takes to slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is : [JEE-Main 2018]

(1) $\sqrt{1-\frac{1}{n^2}}$

(2) $1-\frac{1}{n^2}$

(3) $\frac{1}{2-n^2}$

(4) $\sqrt{\frac{1}{1-n^2}}$

Ans. **(2)**

Q. The coefficient of static friction between a wooden block of mass 0.5 kg and a vertical rough wall is 0.2. The magnitude of horizontal force that should be applied on the block to keep it adhere to the wall will be _____N. [$g = 10\ ms^{-2}$]

[JEE-Main 2021]

Ans. 25

❖ Banking of road :

$$V = \sqrt{rg \tan \theta}$$

$$V_{max} = \sqrt{\frac{gR(\tan \theta + \mu)}{(1 - \mu \tan \theta)}}$$

$$V_{min} = \sqrt{\frac{gR(\tan \theta - \mu)}{(1 + \mu \tan \theta)}}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	3	2021	
2020		2020	
2019		2019	
2018		2018	
2017		2017	
2016		2016	
2015		2015	
2014		2014	
2013		2013	
2012		2012	

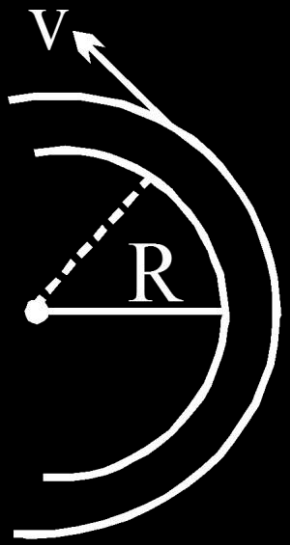
☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. A modern grand-prix racing car of mass m is travelling on a flat track in a circular arc of radius R with a speed v. If the coefficient of static friction between the tyres and the track is μ_s, then the magnitude of negative lift F_L acting downwards on the car is :

(Assume forces on the four tyres are identical and

g = acceleration due to gravity)

[JEE-Main 2021]



(1) $m\left(\frac{v^2}{\mu_s R}+g\right)$

(2) $m\left(\frac{v^2}{\mu_s R}-g\right)$

(3) $m\left(g-\frac{v^2}{\mu_s R}\right)$

(4) $-m\left(g+\frac{v^2}{\mu_s R}\right)$

Ans. (2)

Q. Statement I : A cyclist is moving on an unbanked road with a speed of 7 kmh^{-1} and takes a sharp circular turn along a path of radius of 2m without reducing the speed. The static friction coefficient is 0.2. The cyclist will not slip and pass the curve ($g = 9.8\ m/s^2$)

Statement II : If the road is banked at an angle of 45°, cyclist can cross the curve of 2m radius with the speed of 18.5 kmh^{-1} without slipping.

In the light of the above statements, choose the correct answer from the options given below.

[JEE-Main 2021]

(1) Statement I is incorrect and statement II is correct

(2) Statement I is correct and statement II is incorrect

(3) Both statement I and statement II are false

(4) Both statement I and statement II are true

Ans. (4)

❖ Pseudo force

$$F = ma_{frame}$$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 2 (JEE-Main)

Q. A person standing on a spring balance inside a stationary lift measures 60 kg. The weight of that person if the lift descends with uniform downward acceleration of 1.8 m/s^2 will be_____ N. [g = 10 m/s^2] [JEE-Main 2021]

Ans. 492

Q. A rocket is fired vertically from the earth with an acceleration of 2g, where g is the gravitational acceleration. On an inclined plane inside the rocket, making an angle θ with the horizontal, a point object of mass m is kept. The minimum coefficient of friction μ_{min} between the mass and the inclined surface such that the mass does not move is :

[JEE-Main 2021]

(1) $2 \tan \theta$ (2) $3 \tan \theta$

(3) $\tan \theta$ (4) $\tan 2\theta$

Ans. (3)

❖ Variable force

$F(x, y, z)$

Or $F(t)$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	2	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. A particle is projected with velocity v_0 along x-axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e., $ma = -\alpha x^2$. The distance at which the particle stops : [JEE-Main 2021]

(1) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$

(2) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$

(3) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$

(4) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$

Q. A particle moving in the xy plane experiences a velocity dependent force $\vec{F} = k(v_y\hat{i} + v_x\hat{j})$, where v_x and v_y are the x and y components of its velocity $\vec{v}$.

If $\vec{a}$ is the acceleration of the particle, then which of the following statements is true for the particle ? [JEE-Main 2020]

(1) quantity $\vec{v} \cdot \vec{a}$ is constant in time.

(2) kinetic energy of particle is constant in time.

(3) quantity $\vec{v} \times \vec{a}$ is constant in time.

(4) $\vec{F}$ arises due to a magnetic field.

Ans. (3)

❖ Centripetal acceleration

$$a_c = \frac{v^2}{r}$$

Or $a_c = \omega^2 r$

JEE Main	Que./Year	JEE Advanced	Que./Year
2021	5	2021	-
2020	1	2020	1
2019	2	2019	-
2018	1	2018	-
2017	1	2017	-
2016	2	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 12 (JEE-Main)

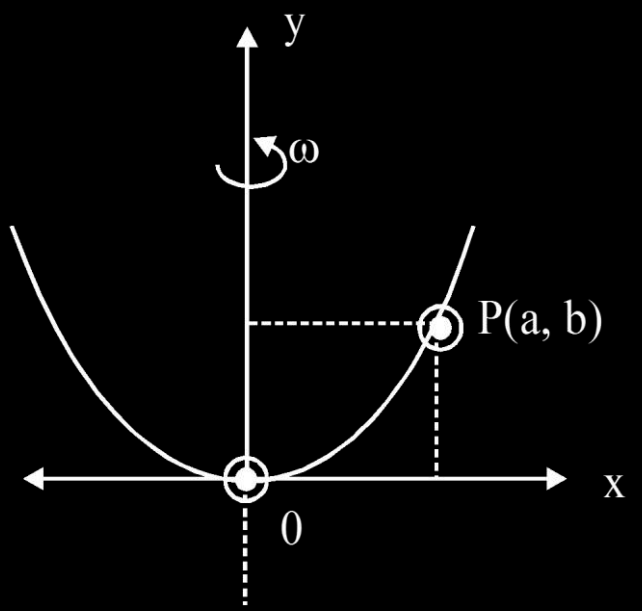
Q. A bead of mass m stays at point P(a, b) on a wire bent in the shape of a parabola $y = 4Cx^2$ and rotating with angular speed ω (see figure). The value of ω is (neglect friction) : [JEE-Main 2020]

(1) $\sqrt{\frac{2gC}{ab}}$

(2) $2\sqrt{2gC}$

(3) $\sqrt{\frac{2g}{C}}$

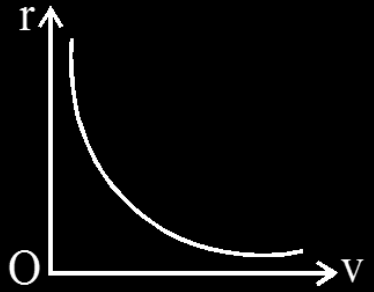
(4) $2\sqrt{gC}$



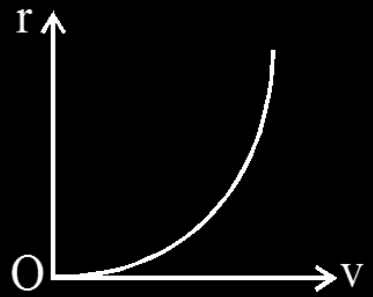
Ans. (2)

Q. A particle of mass m moves in a circular orbit under the central potential field, $U(r) = \frac{-C}{r}$, where C is a positive constant. The correct radius – velocity graph of the particle's motion is : [JEE-Main 2021]

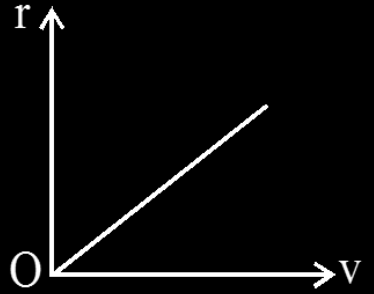
(1)



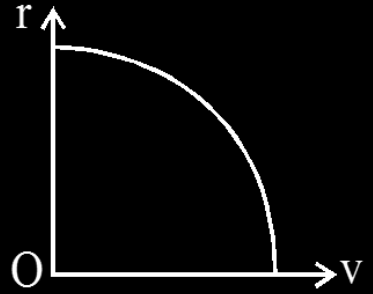
(2)



(3)



(4)



Ans. (1)

Thanks!

PHYSICS FORMULA RACE

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PRINCIPLE OF COMMUNICATION

❖ Height of Transmitting Antenna & Area Covered:

$$d = \sqrt{2Rh}$$

$$A = \pi d^2$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. What should be the height of transmitting antenna and the population covered if the television telecast is to cover a radius of 150 km? The average population density around the tower is 2000/km^2 and the value of $R_e = 6.5 \times 10^6$ m.

(1) Height = 1731 m
Population Covered = 1413×10^5

(2) Height = 1241 m
Population Covered = 7×10^5

(3) Height = 1600 m
Population Covered = 2×10^5

(4) Height = 1800 m
Population Covered = 1413×10^8

Ans. (2)

Q. For VHF signal broadcasting, ____ km^2 of maximum service area will be covered by an antenna tower of height 30m, if the receiving antenna is placed at ground. Let radius of the earth be 6400 km. (Round off to the Nearest Integer) (Take π as 3.14) [JEE-Main 2021]

Ans. 1206

❖ Range of line of sight communication :

$$d = \sqrt{2Rh_R} + \sqrt{2Rh_T}$$

Where, R = Radius of earth

h_T = height of Transmitting Antenna

h_R = height of Receiving Antenna

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 6 (JEE-Main)

Q. A carrier wave with amplitude of 250 V is amplitude modulated by a sinusoidal base band signal of amplitude 150 V. The ratio of minimum amplitude to maximum amplitude for the amplitude modulated wave is 50 : x, then value of x is ..... [JEE-Main 2021]

Ans. 200

PRINCIPLE OF COMMUNICATION

Q. A transmitting antenna has a height of 320 m and that of receiving antenna is 2000 m. The maximum distance between them for satisfactory communication in line of sight mode is 'd'. The value of 'd' is ..... km. [JEE-Main 2021]

Ans. (224)

❖ Relation between wave length & height of antenna:

$$\lambda = 4H$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. An antenna is mounted on a 400 m tall building. What will be the wavelength of signal of signal that can be radiated effectively by the transmission tower upto a range of 44 km?

[JEE-Main 2021]

(1) 37.8 m

(2) 605 m

(3) 75.6 m

(4) 302 m

Ans. (2)

Q. A 25 m long antenna is mounted on an antenna tower. The height of the antenna tower is 75 m. The wavelength (in meter) of the signal transmitted by this antenna would be : [JEE-Main 2021]

(1) 300

(2) 400

(3) 200

(4) 100

Ans. (4)

❖ **Relation between wave length & power radiated through antenna:**

$$P_{eff.} \alpha \frac{1}{\lambda^2}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A signal is to be transmitted through a wave of wavelength λ, using a linear antenna. The length l of the antenna and effective power radiated P_{eff} will be given respectively as :- (K is a constant of proportionality) [JEE-Main 2021]

(1) $\lambda, P_{eff} = K\left(\frac{l}{\lambda}\right)^2$

(2) $\frac{\lambda}{5}, P_{eff} = K\left(\frac{l}{\lambda}\right)^{\frac{1}{2}}$

(3) $\frac{\lambda}{16}, P_{eff} = K\left(\frac{l}{\lambda}\right)^3$

(4) $\frac{\lambda}{8}, P_{eff} = K\left(\frac{l}{\lambda}\right)$

Ans. (1)

❖ Modulating frequency:-

$$f_m = \frac{\omega_m}{2\pi}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. An amplitude modulated wave is represented by

The modulating frequency in kHz will be ..... . [JEE-Main 2021]

Ans. (2)

Q. An amplitude modulated signal is given by $V(t)= 10[1 + 0.3\cos(2.2 \times 10^4 t)] \sin(5.5 \times 10^5 t)$. Here t is in seconds. The sideband frequencies (in kHz) are, [Given $\pi = 22/7$] [JEE-Main 2019]

(1) 1785 and 1715

(2) 892.5 and 857.5

(3) 89.25 and 85.75

(4) 178.5 smf 171.5

Ans. (2)

❖ Modulation Index:

$$\text{M.I.} = \frac{\text{Amplitude of modulating wave}}{\text{Amplitude of Carrier wave}}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	5	2021	-
2020	-	2020	-
2019	2	2019	-
2018	1	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. The maximum amplitude for an amplitude modulated wave is found to be 12V while the minimum amplitude is found to be 3V. The modulation index is 0.6x where x is _____.

[JEE-Main 2021]

Ans. 1.00

Q. A message signal of frequency 20 kHz and peak voltage of 20 volt is used to modulate a carrier wave of frequency 1 MHz and peak voltage of 20 volt. The modulation index will be :

[JEE-Main 2021]

Ans. (1)

❖ Bandwidth of modulated signal:

$$\text{Band width} = 2 \times f_m$$

$$\text{Upper band} = f_c + f_m$$

$$\text{Lower band} = f_c - f_m$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	-	2020	-
2019	2	2019	-
2018	2	2018	-
2017	1	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. In amplitude modulation, the message signal

$V_m(t) = 10 \sin (2\pi \times 10^5 t)$ volts and

Carrier signal

$V_C(t) = 20 \sin (2\pi \times 10^7 t)$ volts

The modulated signal now contains the message signal with lower side band and upper side band frequency, therefore the bandwidth of modulated signal is α kHz. The value of α is :

[JEE-Main 2021]

(1) 200 kHz (2) 50 kHz

(3) 100 kHz (4) 0

Ans. (1)

Q. A carrier signal $C(t) = 25 \sin (2.512 \times 10^{10}\ t)$ is amplitude modulated by a message signal $m(t) = 5 \sin (1.57 \times 10^{8}\ t)$ and transmitted through an antenna. What will be the bandwidth of the modulated signal ? [JEE-Main 2021]

(1) 8 GHz

(2) 2.01 GHz

(3) 1987.5 MHz

(4) 50 MHz

Ans. (4)

❖ Maximum & Minimum Amplitude of modulated wave:

$$A_{max} = A_c + A_m$$

$$A_{min} = A_c - A_m$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. A carrier wave with amplitude of 250 V is amplitude modulated by a sinusoidal base band signal of amplitude 150 V. The ratio of minimum amplitude to maximum amplitude for the amplitude modulated wave is 50 : x, then value of x is ..... [JEE-Main 2021]

Ans. 200

Q. A carrier wave $V_C(t) = 160 \sin (2\pi \times 10^6 t)$ volts is made to vary between $V_{max} = 200$ V and $V_{min} = 120$ V by a message signal $V_m(t) = A_m \sin(2\pi \times 10^3 t)$ volts. The peak voltage A_m of the modulating signal is _____. [JEE-Main 2021]

Ans. 40

Thanks!

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SEMICONDUCTORS

❖ Doping of Semiconductor :

e^- donor doping $\Rightarrow$ n-type

e^- acceptor doping $\Rightarrow$ p-type

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Statement-I : By doping silicon semiconductor with pentavalent material, the electrons density increases.

Statement-II : The n-type semiconductor has net negative charge.

In the light of the above statements, choose the most appropriate answer from the options given below : [JEE-Main 2021]

(1) Statement-I is true but Statement-II is false.

(2) Statement-I is false but Statement-II is true.

(3) Both Statement-I and Statement-II are true.

(4) Both Statement-I and Statement-II are false.

Ans. (1)

Q. For extrinsic semiconductors; when doping level is increased; [JEE-Main 2021]

(1) Fermi-level of p-type semiconductor will go upward and Fermi-level of n-type semiconductors will go downward.

(2) Fermi-level of p-type semiconductors will go downward and Fermi-level of n-type semiconductor will go upward.

(3) Fermi-level of both p-type and n-type semiconductors will go upward for $T > T_F K$ and downward for $T < T_F$ K, where T_F is Fermi temperature.

(4) Fermi-level of p and n-type semiconductors will not be affected.

Ans. (2)

❖ Conductivity of a Semiconductor:

$$\sigma = e\,(n_e\mu_e + n_h\mu_h)$$

n = no. density of charge carrier

μ = mobility

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Mobility of electrons in a semiconductor is defined as the ratio of their drift velocity to the applied electric field. If, for an n-type semiconductor, the density of electrons is $10^{19} m^{-3}$ and their mobility is 1.6 $m^2/(V.s)$ then the resistivity of the semiconductor (since it is an n-type semiconductor contribution of holes is ignored) is close to:

[JEE-Main 2019]

(1) 2Ωm

(2) 0.4Ωm

(3) 4Ωm

(4) 0.2Ωm

Ans. (3)

Q. What is the conductivity of a semiconductor sample having electron concentration of 5×10^{18} m^{-3}, hole concentration of 5×10^{19} m^{-3}, electron mobility of 2.0 m^2 V^{-1} s^{-1} and hole mobility of 0.01 m^2 V^{-1} s^{-1} ? [JEE-Main 2017]

(Take charge of electron as 1.6×10^{-19} C)

(1) 1.20 $(\Omega\text{-m})^{-1}$

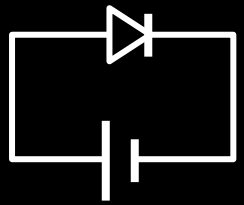
(2) 1.68 $(\Omega\text{-m})^{-1}$

(3) 0.59 $(\Omega\text{-m})^{-1}$

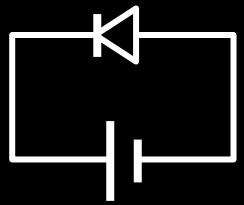
(4) 1.83 $(\Omega\text{-m})^{-1}$

Ans. (2)

❖ Biasing of Diode:



Forward Bias



Reverse Bias

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	4	2021	-
2020	2	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

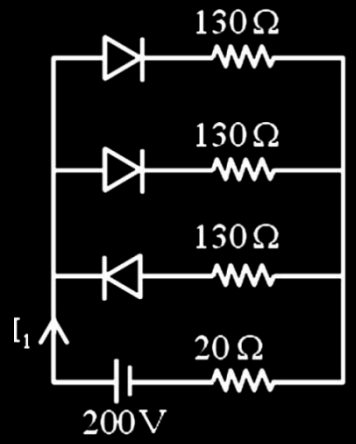
Q. In the given figure, each diode has a forward bias resistance of 30Ω and infinite resistance in reverse bias. The current I_1 will be : [JEE-Main 2021]

(1) 3.75 A

(2) 2.35 A

(3) 2 A

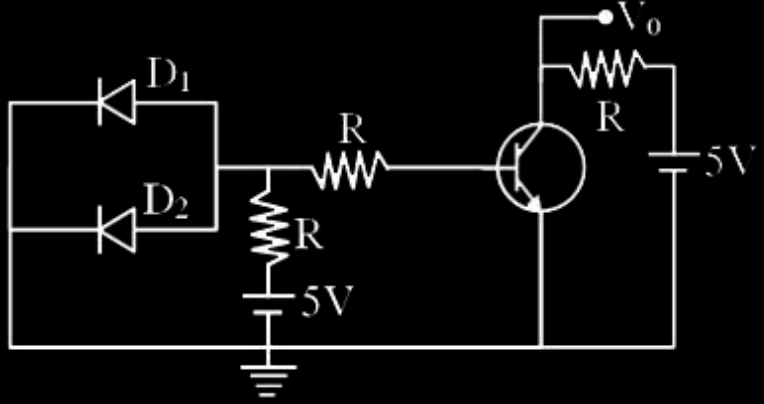
(4) 2.73 A



Ans. (3)

Q. A circuit is arranged as shown in figure. The output voltage V_0 is equal to ..... V.

[JEE-Main 2021]



Ans. 5

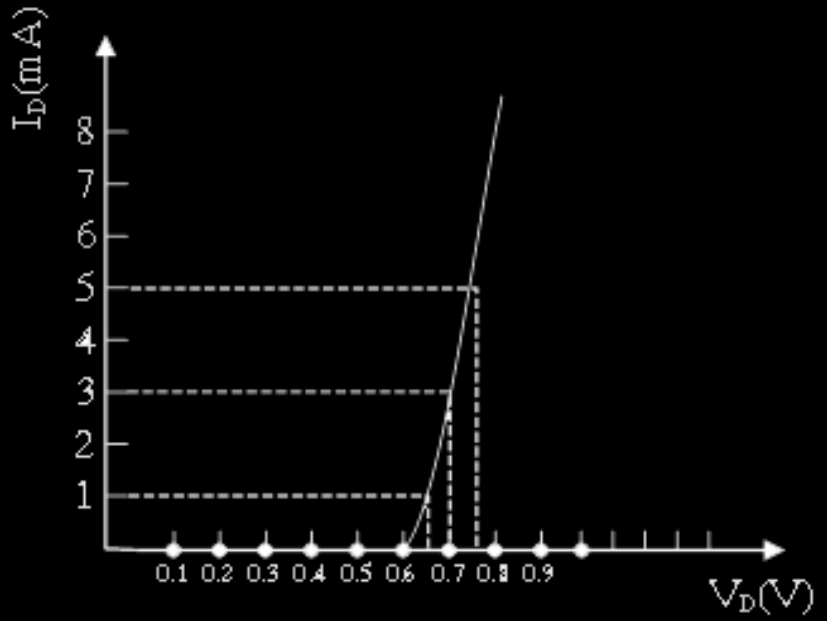
❖ Dynamic Resistance for the F.B. Diode Characteristics:

$$R_d = \frac{dV}{di}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. For the forward biased diode characteristics shown in the figure, the dynamic resistance at $I_D = 3$ mA will be_____Ω. [JEE-Main 2021]

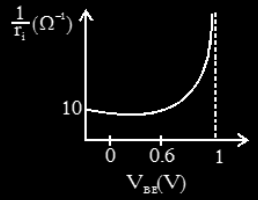


Ans. 25

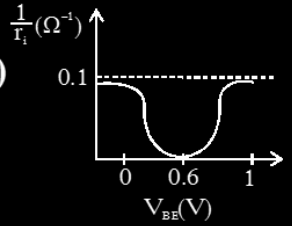
Q. A realistic graph depicting the variation of the reciprocal of input resistance in an input characteristics measurement in a common emitter transistor configuration is :

[JEE-Main 2016]

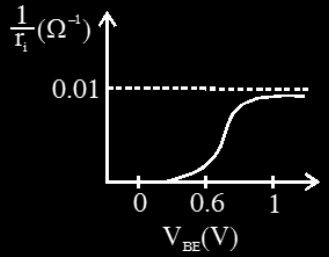
(1)



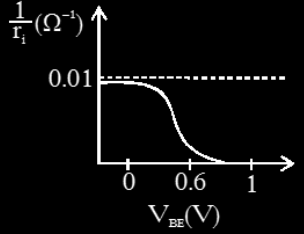
(2)



(3)



(4)



Ans. 25

❖ Bandgap Energy Based on Wavelength of Photon:

$$E = \frac{hC}{\lambda}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. LED is constructed from Ga-As-P semiconducting material. The energy gap of this LED is 1.9 eV. Calculate the wavelength of light emitted and its colour.

[JEE-Main 2021]

[$h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^{8}$ ms^{-1}]

(1) 1046 nm and red colour

(2) 654 nm and orange colour

(3) 1046 nm and blue colour

(4) 654 nm and red colour

Ans. 4

Q. If a semiconductor photodiode can detect a photon with a maximum wavelength of 400 nm, then its band gap energy is: [JEE-Main-2021]

Planck's constant $h = 6.63 \times 10^{-34}$ J.s.

Speed of ligh $c = 3 \times 10^{8}$ m/s

(1) 2.0 eV

(2) 1.5 eV

(3) 3.1 eV

(4) 1.1 eV

Ans. (3)

❖ Circuit with Zener Diode

$$P_{Rating} = VI$$

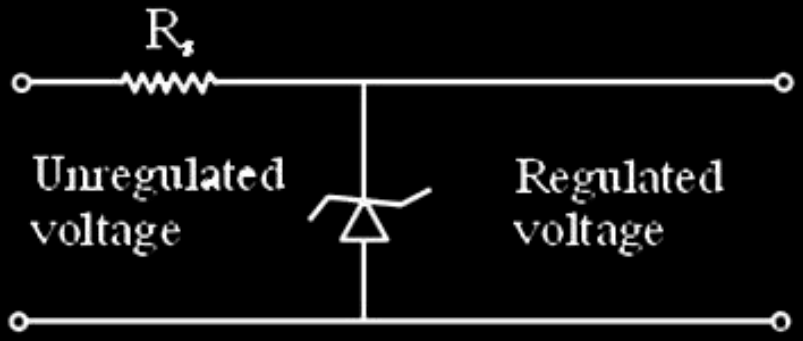
V = (Breakdown Voltage)

I = (Current through Diode)

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	8	2021	-
2020	2	2020	-
2019	5	2019	-
2018	1	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

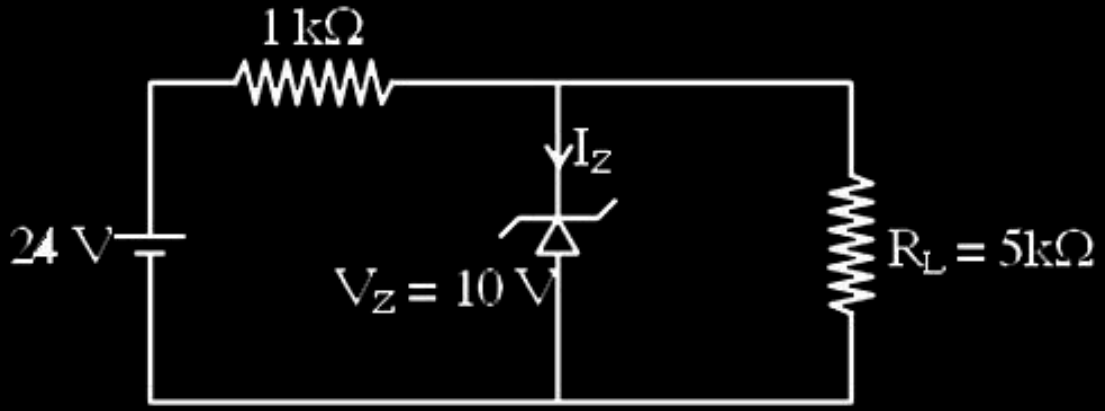
☛Total Questions in last 10 years: 0 (JEE-Advanced) and 17 (JEE-Main)

Q. A zener diode of power rating 2W is to be used as a voltage regulator. If the zener diode has a breakdown of 10 V and it has to regulate voltage fluctuated between 6 V and 14 V, the value of R_s for safe operation should be _____ Ω. [JEE-Main 2021]



Ans. 20

Q. For the given circuit, the power across zener diode is ..... mW. [JEE-Main-2021]



Ans. 120

❖ For Common Emitter Configuration of transistor:

$$\text{Current gain } (\beta) = \frac{\Delta I_C}{\Delta I_B}$$

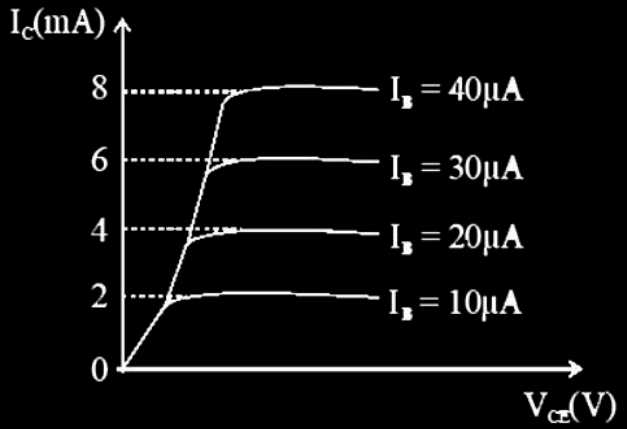
$$\text{Voltage gain } (A_V) = \beta \times \frac{r_{out}}{R_{in}}$$

$$\text{Power gain} = \beta^2 \times \frac{r_{out}}{R_{in}} = 10 \log_{10} \frac{P}{P_0}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	3	2021	-
2020	1	2020	-
2019	4	2019	-
2018	1	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. The typical output characteristics curve for a transistor working in the common-emitter configuration is shown in the figure. [JEE-Main 2021]



The estimated current gain from the figure is

Ans. 200

Q. An npn transistor operates as a common emitter amplifier with a power gain of 10^6. The input circuit resistance is 100Ω and the output load resistance is 10 KΩ. The common emitter current gain 'β' will be _____. (Round off to the Nearest Integer)

[JEE-Main 2021]

Ans. 100

❖ For Common Base Transistor:

$$\text{Current gain } (\alpha) = \frac{\Delta I_C}{\Delta I_\varepsilon}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. If an emitter current is changed by 4 mA, the collector current changes by 3.5 mA.

The value of β will be: [JEE-Main 2021]

(1) 0.875

(2) 0.5

(3) 3.5

(4) 7

Ans. 7

❖ Relation between α & β:

$$\beta = \frac{\alpha}{1 - \alpha}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. For a transistor α and β are given as $\alpha = \frac{I_C}{I_E}$ and $\beta = \frac{I_C}{I_B}$. Then the correct relation between α and β will be : [JEE-Main 2021]

(1) $\alpha = \frac{1-\beta}{\beta}$

(2) $\beta = \frac{\alpha}{1-\alpha}$

(3) $\alpha\beta = 1$

(4) $\alpha = \frac{\beta}{1-\beta}$

Ans. 2

Q. The current gain of a common emitter amplifier is 69. If the emitter current is 7.0 mA, collector current is :- [JEE-Main 2017]

(1) 69 mA

(2) 6.9 mA

(3) 0.69 mA

(4) 9.6 mA

Ans. (2)

❖ Logic Gates (Truth Table):

OR = A+B 

And = A·B 

NOT = $\overline{Y}$ 

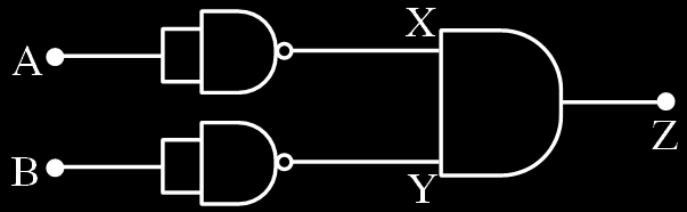
NOR = $\overline{A+B}$ 

NAND = $\overline{A \cdot B}$ 

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	11	2021	-
2020	6	2020	-
2019	4	2019	-
2018	1	2018	-
2017	-	2017	-
2016	3	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 26 (JEE-Main)

Q. Identify the logic operation carried out by the given circuit :- [JEE-Main 2021]



(1) OR

(2) AND

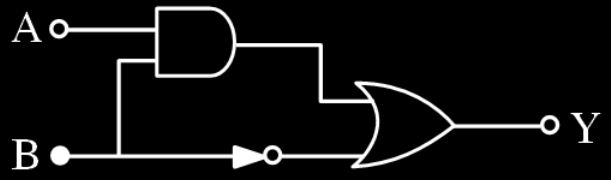
(3) NOR

(4) NAND

Ans. (3)

Q. Find the truth table for the function Y of A and B represented in the following figure.

[JEE-Main 2021]



(1)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	0

(2)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	1

(3)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(4)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Ans. (2)

❖ In Common Emitter Configuration:

$$V_{CE} = V_{CC} - I_C R_C$$

$$V_{BB} = I_B R_B + V_{BE}$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. In the figure, given that V_{BB} supply can vary from 0 to 5.0 V, V_{CC} = 5V, β_{dc} = 200, R_B = 100 kΩ, R_C=l kΩ and V_{BE}=1.0 V, The minimum base current and the input voltage at which the transistor will go to saturation, will be, respectively :

[JEE-Main 2019]

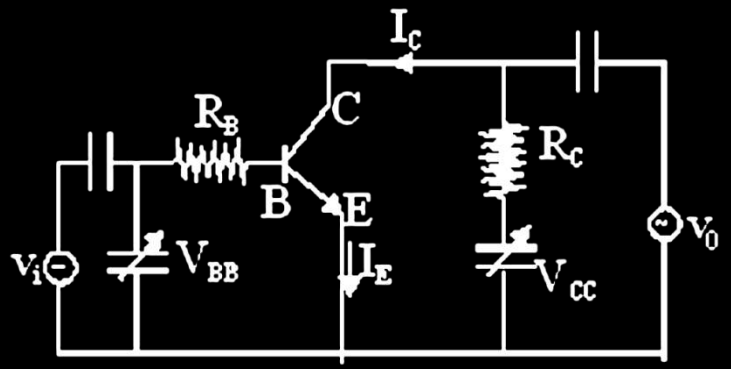
(1) 20μA and 3.5V

(2) 25μA and 3.5V

(3) 25μA and 2.5V

(4) 20μA and 2.8V

Ans. (2)



Thanks!

PHYSICS FORMULA RACE

Reliable
INSTITUTE
Unleashing Potential

SIMPLE HARMONIC MOTION

❖ Equation of S.H.M :

$$X = A \sin(\omega t + \phi)$$

$$V = \omega A \cos(\omega t .+ \phi)$$

$$a = -\omega^2 X$$

$$V = \omega\sqrt{A^2 - X^2}$$

Time Period of S.H.M

$$T = \frac{2\pi}{\omega}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	13	2021	-
2020	3	2020	-
2019	1	2019	-
2018	2	2018	-
2017	1	2017	-
2016	3	2016	-
2015	-	2015	-
2014	3	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 27 (JEE-Main)

Q. $Y = A\sin(\omega t + \phi_0)$ is the time-displacement equation of a SHM. At $t = 0$ the displacement of the particle is $Y = \frac{A}{2}$ and it is moving along negative x-direction. Then the initial phase angle ϕ_0 will be : [JEE-Main 2021]

(1) $\frac{\pi}{6}$

(2) $\frac{\pi}{3}$

(3) $\frac{5\pi}{6}$

(4) $\frac{2\pi}{3}$

Ans. (3)

Q. A particle executes simple harmonic motion represented by displacement function as

$$x(t) = A \sin(\omega t + \phi)$$

If the position and velocity of the particle at t = 0 s are 2 cm and 2ω cm s^{-1} respectively, then its amplitude is $x\sqrt{2}$ cm where the value of x is ____.

[JEE-Main 2021]

Ans. 2.00

❖ Energy of S.H.M :

$$K \cdot E = \frac{1}{2} m\omega^2 (A^2 - X^2) = \frac{1}{2} k(A^2 - x^2)$$

$$P \cdot E = \frac{1}{2} kx^2$$

$$T \cdot E = \frac{1}{2} KA^2$$

$$\langle K \cdot E \rangle_{0-T} = \frac{1}{4} KA^2$$

$$\langle P \cdot E \rangle_{0-T} = \frac{1}{4} KA^2$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	7	2021	-
2020	1	2020	-
2019	3	2019	-
2018	-	2018	-
2017	2	2017	-
2016	-	2016	1
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 14 (JEE-Main)

Q. A particle starts executing simple harmonic motion (SHM) of amplitude 'a' and total energy E. At any instant, its kinetic energy is $\frac{3E}{4}$ then its displacement 'y' is given by : [JEE-Main-2021]

(1) $y = a$

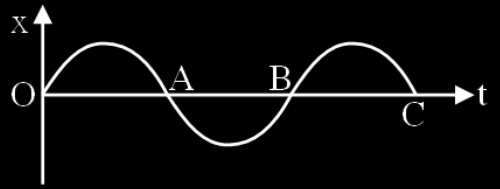
(2) $y = \frac{a}{\sqrt{2}}$

(3) $y = \frac{a\sqrt{3}}{2}$

(4) $y = \frac{a}{2}$

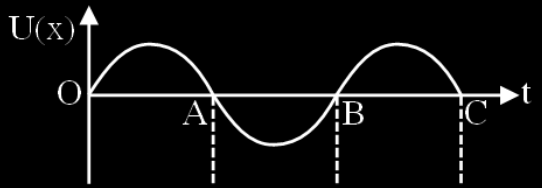
Ans. (4)

Q. The variation of displacement with time of a particle executing free simple harmonic motion is shown in the figure. **[JEE-Main 2021]**

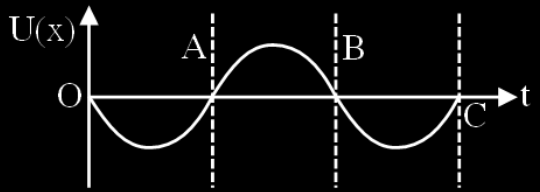


The potential energy U(x) versus time (t) plot of the particle is correctly shown in figure :

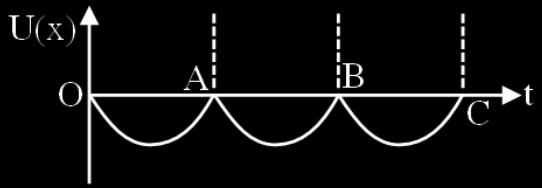
(1)



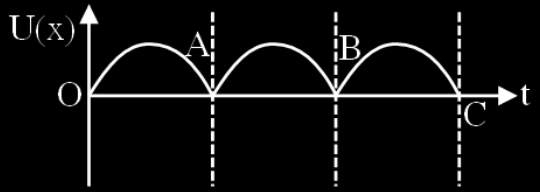
(2)



(3)

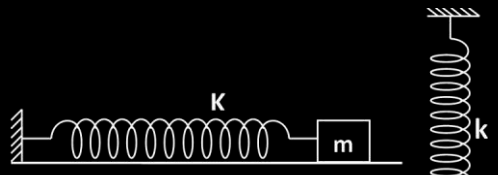


(4)



Ans. (4)

❖ For Spring Mass System :



$$T = 2\pi\sqrt{\frac{m}{k}}$$

For series combination of spring

$$\frac{1}{k_{eq.}} = \frac{1}{k_1} + \frac{1}{k_2}$$

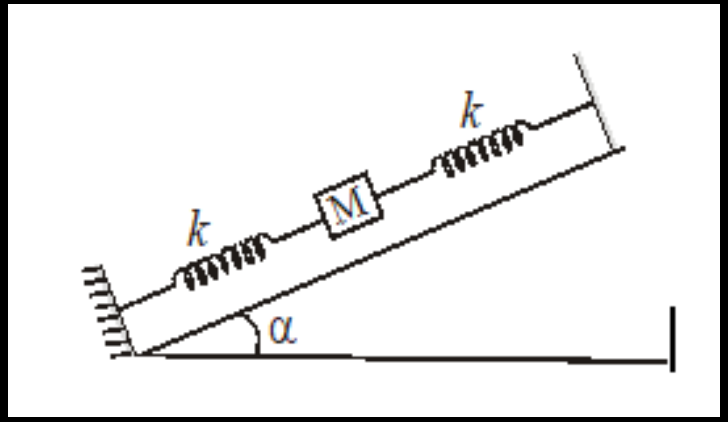
For parallel combination of spring

Keq. = $k_1 + k_2$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	5	2021	-
2020	3	2020	1
2019	-	2019	-
2018	-	2018	1
2017	1	2017	-
2016	-	2016	1
2015	1	2015	-
2014	1	2014	-
2013	1	2013	1
2012	-	2012	1

☛ Total Questions in last 10 years: 5 (JEE-Advanced) and 12 (JEE-Main)

Q. In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has spring constant k, the frequency of oscillation of given body is : [JEE-Main 2021]



(1) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$

(2) $\frac{1}{2\pi}\sqrt{\frac{2k}{Mg\ \sin\alpha}}$

(3) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$

(4) $\frac{1}{2\pi}\sqrt{\frac{k}{Mg\ \sin\alpha}}$

Ans. (3)

Q. Consider two identical springs each of spring constant k and negligible mass compared to the mass M as shown. Fig.1 shows one of them and Fig.2 shows their series combination. The ratios of time period of oscillation of the two SHM is $\frac{T_b}{T_a} = \sqrt{x}$, where value of x is _____. [JEE-Main 2021]

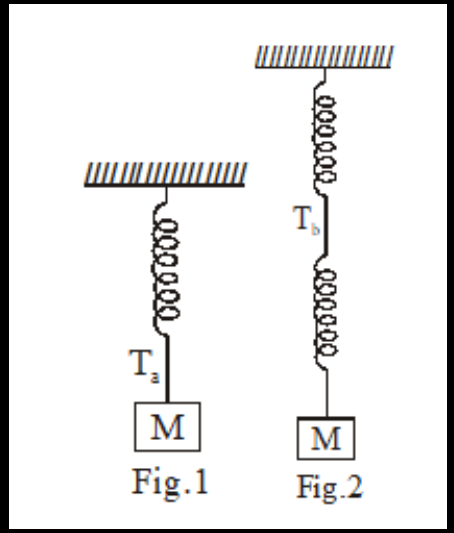


Fig.1 Fig.2

Ans. 2

❖ Time Period for Simple Pendulum :

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. A pendulum clock loses 12s a day if the temperature is 40°C and gains 4s a day if the temperature is 20°C. The temperature at which the clock will show correct time, and the co-efficient of linear expansion (α) of the metal of the pendulum shaft are respectively : [JEE-Main 2016]

(1) 55°C ; $\alpha = 1.85 \times 10^{-2}$ / °C

(2) 25°C ; $\alpha = 1.85 \times 10^{-5}$ / °C

(3) 60°C ; $\alpha = 1.85 \times 10^{-4}$ / °C

(4) 30°C ; $\alpha = 1.85 \times 10^{-3}$ / °C

Ans. (2)

Q. T_0 is the time period of a simple pendulum at a place. If the length of the pendulum is reduced to $\frac{1}{16}$ times of its initial value, the modified time period is :

[JEE-Main 2021]

(1) T_0 (2) $8\pi T_0$ (3) $4T_0$ (4) $\frac{1}{4}T_0$

Ans. (4)

❖ If Forces other then Gravity acts :

$$T = 2\pi\sqrt{\frac{\ell}{g_{eff.}}}$$

$$g_{eff.} = \left|\vec{g} + \frac{\vec{F}}{m}\right|$$

$\vec{F}$ =Constant force acting on 'm'

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. Time period of a simple pendulum is T inside a lift when the lift is stationary. If the lift moves upwards with an acceleration g/2, the time period of pendulum will be : [JEE-Main 2021]

(1) $\sqrt{3}\,T$ (2) $\frac{T}{\sqrt{3}}$

(3) $\sqrt{\frac{3}{2}}\,T$ (4) $\sqrt{\frac{2}{3}}\,T$

Ans. (4)

Q. A simple pendulum oscillating in air has period T. The bob of the pendulum is completely immersed in a non-viscous liquid. The density of the liquid is $\frac{1}{16}$th of the material of the bob. If the bob is inside liquid all the time, its period of oscillation in this liquid is : [JEE-Main-2019]

(1) $4T\sqrt{\frac{1}{15}}$

(2) $2T\sqrt{\frac{1}{10}}$

(3) $4T\sqrt{\frac{1}{14}}$

(4) $2T\sqrt{\frac{1}{14}}$

Ans.(1)

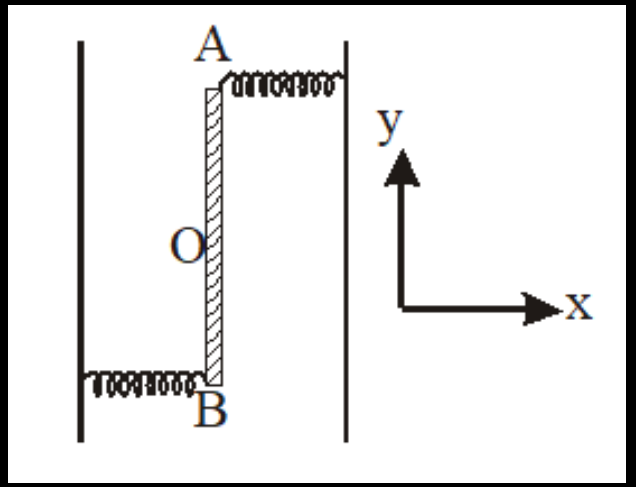
❖ Time Period of Compound Pendulum :

$$T = 2\pi\sqrt{\frac{I}{mg\ell_{c.m}}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. Two light identical springs of spring constant k are attached horizontally at the two ends of a uniform horizontal rod AB of length ℓ and mass m. The rod is pivoted at its centre 'O' and can rotate freely in horizontal plane. The other ends of the two springs are fixed to rigid supports as shown in figure. The rod is gently pushed through a small angle and released. The frequency of resulting oscillation is: [JEE-Main-2019]

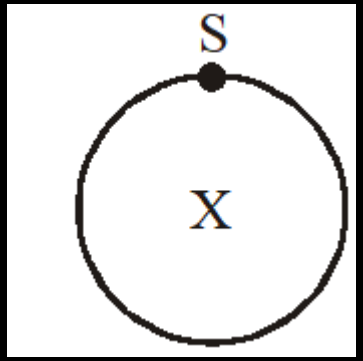


(1) $\frac{1}{2\pi}\sqrt{\frac{6k}{m}}$ **(2)** $\frac{1}{2\pi}\sqrt{\frac{2k}{m}}$

(3) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$ **(4)** $\frac{1}{2\pi}\sqrt{\frac{3k}{m}}$

Ans. **(1)**

Q. A ring is suspended from a point S on its rim as shown in the figure. When displaced from equilibrium, it oscillates with time period of 1 second. The radius of the ring is (take $g = \pi^2$) : [JEE-Main 2012]



(1) 0.15 m

(2) 0.5 m

(3) 1.0 m

(4) 1.5 m

Ans. (1)

❖ Time period of Torsional Pendulum :

$$T = 2\pi\sqrt{\frac{I}{C}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A rod of mass 'M' and length '2L' is suspended at its middle by a wire. It exhibits torsional oscillations. If two masses each of 'm' are attached at distance 'L/2' from its centre on both sides, it reduces the oscillation frequency by 20%. The value of ratio m/M is close to: [JEE-Main 2019]

(A) 0.77 (B) 0.57 (C) 0.37 (D) 0.17

Ans. (3)

❖ Superposition of Two S.H.M. in Same Direction and Same Frequency :

$X_1 = A_1 \sin\omega t$

$X_2 = A_2 \sin(\omega t + \theta)$

$X = X_1 + X_2$

$X = A_1 \sin\omega t + A_2 \sin(\omega t + \theta)$

$X = A \sin(\omega t + \phi)$

$$A = \sqrt{A_2^1 + A_2^2 + 2A_1A_2\cos\theta}$$

$$\phi = \tan^{-1}\left(\frac{A_2 \sin\theta}{A_1 + A_2\cos\theta}\right)$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. Two simple harmonic motion, are represented by the equations

$$y_1 = 10 \sin\left(3\pi t + \frac{\pi}{3}\right) \quad y_2 = 5\,(\sin 3\pi t + \sqrt{3}\cos 3\pi t)$$

Ratio of amplitude of y_1 to y_2 = x : 1. The value of x is _____.

[JEE-Main 2021]

Ans. 1

Q. Two simple harmonic motions are represented by the equations

$x_1 = 5 \sin\left(2\pi t + \frac{\pi}{4}\right)$ and $x_2 = 5\sqrt{2}(\sin 2\pi t + \cos 2\pi t)$. The amplitude of second motion is ..... times the amplitude in first motion. [JEE-Main-2021]

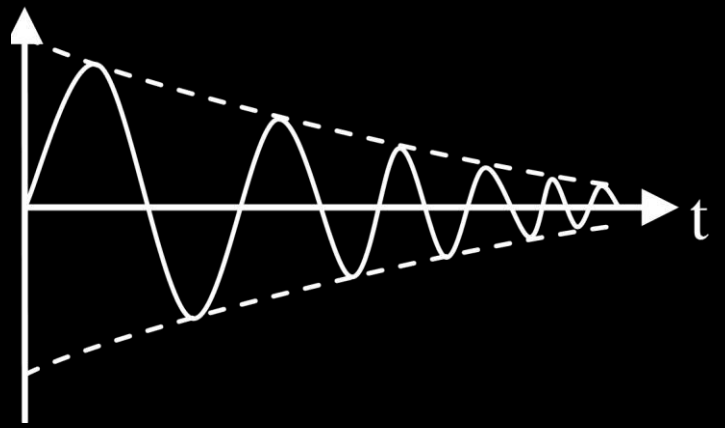
Ans. (2)

❖ Damped harmonic motion :

$$m\frac{dv}{dt} = -kx - bv$$

$$x = A_0 e^{\frac{-bt}{dt}} \sin(\omega' t + \phi)$$

$$\omega' = \sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2}$$



Forced oscillation

$$m\frac{dv}{dt} = -kx - bv + F_0 \sin \omega t$$

$$x = A\sin(\omega t + \phi)$$

$$A = \frac{\left(\frac{F_0}{m}\right)}{\sqrt{(\omega^2 - \omega_0^2)^2 + \left(\frac{b\omega}{m}\right)^2}};$$

$$\omega_0 = \sqrt{\frac{k}{m}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	-	2020	-
2019	2	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	2	2014	-
2013	1	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 9 (JEE-Main)

Q. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to : [JEE-Main 2021]

(1) 100 s

(2) 20 s

(3) 10 s

(4) 50 s

Ans. (2)

Q. Amplitude of a mass-spring system, which is executing simple harmonic motion decreases with time. If mass = 500g, Decay constant = 20 g/s then how much time is required for the amplitude of the system to drop to half of its initial value ? ($\ln 2 = 0.693$) [JEE-Main 2021]

(1) 34.65 s

(2) 17.32 s

(3) 0.034 s

(4) 15.01 s

Ans. (1)

Thanks!

PHYSICS FORMULA RACE

SOUND WAVE

❖ Pressure wave and Displacement wave :

$$S = S_0 \sin(\omega t - kx)$$

$$P = P_0 \cos(\omega t - kx)$$

$$P = -B\frac{\partial s}{\partial x}$$

$$P_0 = BKS_0$$

$$v = \frac{\omega}{k}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	1	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 4 (JEE-Main)

Q. A sound wave of frequency 245 Hz travels with the speed of 300 ms^{-1} along the positive x-axis. Each point of the wave moves to and fro through a total distance of 6 cm. What will be the mathematical expression of this travelling wave ? [JEE-Main 2021]

(1) $Y(x,t) = 0.03 [\sin 5.1 x - (0.2 \times 10^3)t]$

(2) $Y(x,t) = 0.06 [\sin 5.1 x - (1.5 \times 10^3)t]$

(3) $Y(x,t) = 0.06 [\sin 0.8 x - (0.5 \times 10^3)t]$

(4) $Y(x,t) = 0.03 [\sin 5.1 x - (1.5 \times 10^3)t]$

Ans. (4)

Q. Assume that the displacement(s) of air is proportional to the pressure difference (Δp) created by a sound wave. Displacement(s) further depends on the speed of sound (v), density of air (ρ) and the frequency (f). If $\Delta p \sim 10$Pa, $v \sim 300$ m/s, $p \sim 1$ kg/m^3 and $f \sim 1000$Hz, then s will be the order of (take multiplicative constant to be 1) [JEE-Main 2019]

(1) 10 mm

(2) $\frac{3}{100}$ mm

(3) 1 mm

(4) $\frac{1}{10}$ mm

Ans. (2)

❖ Speed of Sound :

In Solid Medium

$$v = \sqrt{\frac{\gamma}{\rho}}$$

γ = young's Modulus of elasticity
ρ = Density of Solid

In Fluid (Liquid and Gas) medium

$$v = \sqrt{\frac{B}{\rho}}$$

B = Bulk Modulus of fluid
ρ = Density of fluid

In gas medium

$$v = \sqrt{\frac{\gamma p}{\rho}} = \sqrt{\frac{\gamma RT}{M}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 3 (JEE-Main)

Q. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is 2.7×10^3 kg/m^3 and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations ? [JEE-Main 2018]

(1) 2.5 kHz
(2) 10 kHz
(3) 7.5 kHz
(4) 5 kHz

Ans. (4)

Q. The pressure wave, $P = 0.01 \sin [1000t - 3x]\ Nm^{-2}$, corresponds to the sound produced by a vibrating blade on a day when atmospheric temperature is 0°C. On some other day, when temperature is T, the speed of sound produced by the same blade and at the same frequency is found to be 336 ms^{-1} . Approximate value of T is [JEE-Main 2019]

(1) 15°C

(2) 12°C

(3) 4°C

(4) 11°C

Ans. (3)

❖ Loudness of Sound :

$$\beta = 10 \log_{10} \left(\frac{I}{I_0} \right) \text{ dB}$$

$I_o = 10^{-12}$ Watt /m^2

β = Sound Level

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	-	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. A small speaker delivers 2 W of audio output. At what distance from the speaker will one detect 120 dB intensity sound ?

[Given reference intensity of sound as $10^{-12} W/m^2$] [JEE-Main 2019]

(1) 10 cm (2) 30 cm

(3) 40 cm (4) 20 cm

Ans. (3)

❖ Interference of Sound Wave :

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$$

For Constructive Interferences

$$I = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$

For Destructive Interference

$$I = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 1 (JEE-Main)

Q. Three harmonic waves having equal frequency ν and same intensity I_0, have phase angles 0, $\frac{\pi}{4}$ and $-\frac{\pi}{4}$ respectively. When they are superimposed the intensity of the resultant wave is close to :

[JEE-Main 2020]

(1) 5.8 I_0 (2) 0.2 I_0 (3) I_0 (4) 3 I_0

Ans. (1)

❖ Organ Pipe :

For Closed Organ Pipe :

$$f = \left(\frac{2n+1}{4\ell}\right)V \quad ; \quad n = 0,1,2,3..$$

f = Frequency of n^{th} overtone or $(2n + 1)^{th}$ Harmonic

For Open Organ Pipe :

$$f = \frac{n}{2\ell}V \quad ; \quad n = 1,2,3...$$

B = Frequency of $(n - 1)^{th}$ overtone or n^{th} Harmonic

e = 0.6r :
e = end Correction
r = Radius of Organ Pipe

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	1
2020	1	2020	1
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	1	2016	-
2015	-	2015	-
2014	1	2014	-
2013	-	2013	-
2012	3	2012	1

☛ Total Questions in last 10 years: 3 (JEE-Advanced) and 9 (JEE-Main)

Q. A tuning fork is vibrating at 250 Hz. The length of the shortest closed organ pipe that will resonate with the tuning fork will be _____ cm. (Take speed of sound in air as 340 ms^{-1}) [JEE-Main 2021]

Ans. 34

Q. A closed organ pipe of length L and an open organ pipe contain gases of densities ρ_1 and ρ_2 respectively. The compressibility of gases are equal in both the pipes. Both the pipes are vibrating in their first overtone with same frequency. The length of the open pipe is $\frac{x}{3}L\sqrt{\frac{\rho_1}{\rho_2}}$ where x is _____. (Round off to the Nearest Integer) [JEE-Main 2021]

Ans. 4

❖ Resonance column method for determining the speed of sound in air :

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	1
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 5 (JEE-Main)

Q. In a resonance tube experiment when the tube is filled with water up to height of 17.0 cm from bottom, it resonates with a given tuning fork. When the water level is raised the next resonance with the same tuning fork occurs at a height of 24.5 cm. If the velocity of sound in air is 330 m/s, the tuning fork frequency is : [JEE-Main 2020]

(1) 1100 Hz

(2) 3300 Hz

(3) 2200 Hz

(4) 550 Hz

Ans. (3)

Q. A student is performing the experiment of resonance column. The diameter of the column tube is 6 cm. The frequency of the tuning fork is 504 Hz. Speed of the sound at the given temperature is 336 m/s. The zero of the meter scale coincides with the top end of the resonance column tube. The reading of the water level in the column when the first resonance occurs is : [JEE-Main 2021]

(1) 13 cm

(2) 16.6 cm

(3) 18.4 cm

(4) 14.8 cm

Ans. (4)

❖ Beats frequency :

$$f_B = |f_1 - f_2| \; ; \quad T_B = \frac{1}{|f_1 - f_2|}$$

f_B = Beats frequency

T_B = Beats time period

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	2	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	1
2016	1	2016	1
2015	-	2015	-
2014	1	2014	-
2013	2	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 2 (JEE-Advanced) and 8 (JEE-Main)

Q. 5 beats/second are heard when a turning fork is sounded with a sonometer wire under tension, when the length of the sonometer wire is either 0.95 m or 1 m. The frequency of the fork will be [JEE-Main 2018]

(1) 251 Hz

(2) 300 Hz

(3) 195 Hz

(4) 150 Hz

Ans. (3)

Q. A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the frequency of fork A ? [JEE-Main 2021]

(1) 342 Hz (2) 345 Hz

(3) 335 Hz (4) 338 Hz

Ans. (3)

❖ Doppler's formula :

$$f = \left(\frac{v \pm v_0}{v \pm v_s}\right) f_0 \quad ; \quad \lambda = \left(\frac{v - v_s}{v}\right) \lambda_0$$

v = velocity of sound w.r.t ground

v_0 = velocity of observer w.r.t. ground

v_s = velocity of source w.r.t. ground

λ = Apparent wave length

f = observed frequency

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	4	2021	1
2020	4	2020	1
2019	7	2019	1
2018	-	2018	1
2017	-	2017	1
2016	2	2016	-
2015	3	2015	-
2014	2	2014	-
2013	2	2013	1
2012	1	2012	-

☛ Total Questions in last 10 years: 6 (JEE-Advanced) and 25 (JEE-Main)

Q. The frequency of a car horn encountered a change from 400 Hz to 500 Hz. When the car approaches a vertical wall. If the speed of sound is 330 m/s. Then the speed of car is _____ km/h. [JEE-Main 2021]

Ans. 132

Q. Two cars X and Y are approaching each other with velocities 36 km/h and 72 km/h respectively. The frequency of a whistle sound as emitted by a passenger in car X, heard by the passenger in car Y is 1320 Hz. If the velocity of sound in air is 340 m/s, the actual frequency of the whistle sound produced is ..... Hz. [JEE-Main 2021]

Ans. 1210

Thanks!

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WAVE ON A STRING

❖ Equation of Traveling Wave :

$y(x = x_0, t) = f(t)$

If wave is propagating in positive x – direction

$$y(x, t) = f\left(t - \frac{x - x_0}{v}\right)$$

If wave is propagating in negative x – direction

$$y(x, t) = f\left(t + \frac{x - x_0}{v}\right)$$

$y = A \sin(\omega t - kx)$

$V = \frac{\omega}{K}$; V = velocity of wave

$$V_P = \frac{dy}{dt} = -V \times \text{slope}$$

V_p = Velocity of particle

PHYSICS FORMULA RACE
WAVE ON A STRING

$$f = \frac{w}{2\pi} \; ; \; k = \frac{2\pi}{\lambda} \; ; \; V = f\lambda$$

$$\frac{\partial^2 y}{\partial x^2} = \frac{1}{V^2}\frac{\partial^2 y}{\partial t^2}$$

Speed of Transverse Wave in string :

$$V = \sqrt{\frac{T}{\mu}}$$

T = Tension in String

μ = Mass per unit length

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	4	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	1	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 10 (JEE-Main)

Q. The amplitude of wave disturbance propagating in the positive x-direction is given by $y = \frac{1}{(1+x)^2}$ at time t = 0 and $y = \frac{1}{1+(x-2)^2}$ at t = 1s, where x and y are in meres. The shape of wave does not change during the propagation. The velocity of the wave will be ____m/s. [JEE-Main 2021]

Ans. 2

Q. The mass per unit length of a uniform wire is 0.135 g/cm. A transverse wave of the form $y = -0.21 \sin(x + 30t)$ is produced in it, where x is in meter and t is in second. Then, the expected value of tension in the wire is $x \times 10^{-2}$ N. Value of x is .

(Round-off to the nearest integer) [JEE-Main 2021]

Ans. 12

❖ Interference of Wave moving in same Direction :

$y_1 = A_1 \sin(kx - \omega t)$

$y_2 = A_2 \sin(kx - \omega t + \phi)$

$y = y_1 + y_2$

$$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

$$\tan\alpha = \frac{A_2\sin\phi}{A_1 + A_2\cos\phi}$$

A = Amplitude of resultant wave

α = Phase difference between resultant wave and first wave

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Two waves are simultaneously passing through a string and their equations are :

$y_1 = A_1 \sin k(x - vt)$, $y_2 = A_2 \sin k(x - vt + x_0)$. Given amplitudes $A_1 = 12$ mm and $A_2 = 5$ mm, $x_0 = 3.5$ cm and wave number $k = 6.28$ cm^{-1}. The amplitude of resulting wave will be ..... mm. [JEE-Main 2021]

Ans. 7

❖ Standing Wave :

$y = 2A \sin kx \cos\omega t$

(i) Fixed at both ends

$$f = \frac{n}{2\ell}\sqrt{\frac{T}{\mu}} \quad ; \quad n = 1,2,3,...$$

f = Frequency of n^{th} Harmonic
or $(n-1)^{th}$ overtone

(ii) Fixed at one end

$$f = \left(\frac{2n+1}{4\ell}\right)\sqrt{\frac{T}{\mu}} \quad ; \quad n = 0,1,2,3,..$$

f = Frequency of $(2n+1)^{th}$ Harmonic
or n^{th} overtone

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	3	2020	-
2019	4	2019	-
2018	-	2018	-
2017	1	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	1
2013	2	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 13 (JEE-Main)

Q. A wire having a linear mass density 9.0×10^{-4} kg/m is stretched between two rigid supports with a tension of 900 N. The wire resonates at a frequency of 500 Hz. The next higher frequency at which the same wire resonates is 550 Hz. The length of the wire is _____m. [JEE-Main 2021]

Ans. 10

Q. Two travelling waves produces a standing wave represented by equation,

$y = 1.0\ mm \cos(1.57\ cm^{-1})\ x \sin(78.5\ s^{-1})t.$

The node closest to the origin in the region $x > 0$ will be at $x =$ ..... cm.

Ans. 1 [JEE-Main 2021]

Thanks!

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VECTORS

❖ Addition of vector :

$$\vec{A} + \vec{B} = \vec{R}$$

$$|\vec{R}| = \sqrt{|\vec{A}|^2 + |\vec{B}|^2 + 2|\vec{A}||\vec{B}|\cos\theta}$$

$$\phi = \tan^{-1}\left(\frac{|\vec{B}|\sin\theta}{|\vec{A}| + |\vec{B}|\cos\theta}\right)$$

ϕ = Angle between $\vec{R}$ and $\vec{A}$

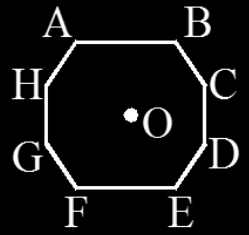
JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	1	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	1	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. In an octagon ABCDEFGH of equal side, what is the sum of

$\overrightarrow{AB}+\overrightarrow{AC}+\overrightarrow{AD}+\overrightarrow{AE}+\overrightarrow{AF}+\overrightarrow{AG}+\overrightarrow{AH}$;

if, $\overrightarrow{AO}=2\hat{i}+3\hat{j}-4\hat{k}$ **[JEE-Main 2021]**



(1) $-16\hat{i}-24\hat{j}+32\hat{k}$

(2) $16\hat{i}+24\hat{j}-32\hat{k}$

(3) $16\hat{i}+24\hat{j}+32\hat{k}$

(4) $16\hat{i}-24\hat{j}+32\hat{k}$

Ans. **(2)**

Q. The sum of two forces $\vec{P}$ and $\vec{Q}$ is $\vec{R}$ such that $|\vec{R}| = |\vec{P}|$. The angle θ (in degrees) that the resultant of $2\vec{P}$ and $\vec{Q}$ will make with $\vec{Q}$ is, ____ .

[JEE Main 2020]

Ans. 90.00

❖ Dot product :

$$\vec{A}\cdot\vec{B}=|\vec{A}||\vec{B}|\cos\theta$$

$$\vec{A}=A_x\hat{i}+A_y\hat{j}+A_z\hat{k}$$

$$\vec{B}=B_x\hat{i}+B_y\hat{j}+B_z\hat{k}$$

$$\vec{A}\cdot\vec{B}=A_xB_x+A_yB_y+A_zB_z$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Let $\left|\vec{A}_1\right| = 3, \left|\vec{A}_2\right| = 5$ and $\left|\vec{A}_1 + \vec{A}_2\right| = 5$. The value of $\left(2\vec{A}_1 + 3\vec{A}_2\right).\left(3\vec{A}_1 - 2\vec{A}_2\right)$ is [JEE Main 2020]

(1) –106.5

(2) –99.5

(3) –112.5

(4) –118.5

Ans. (4)

❖ Cross product :

$$\vec{A} \times \vec{B} = |\vec{A}||\vec{B}| \sin\theta \, \hat{n}$$

$$|\vec{A} \times \vec{B}| = |\vec{A}||\vec{B}| \sin\theta$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	1	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. If $\vec{P} \times \vec{Q} = \vec{Q} \times \vec{P}$, the angle between $\vec{P}$ and $\vec{Q}$ is θ ($0^o < \theta < 360^o$). The value of 'θ' will be _____^{o}. [JEE-Main 2021]

Ans. 180

❖ Condition for coplanar vector :

$$\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$$

JEE Main	Questions/ Year	JEE Advanced	Questions/ Year
2021	-	2021	-
2020	-	2020	-
2019	-	2019	-
2018	1	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 1 (JEE-Main)

Q. Let $\vec{A} = \left(\hat{i} + \hat{j}\right)$ and, $\vec{B}\left(2\hat{i} - \hat{j}\right)$. The magnitude of a coplanar vector $\vec{C}$ such that $\vec{A} \cdot \vec{C} = \vec{B} \cdot \vec{C} = \vec{A} \cdot \vec{B}$, is given by : [JEE Main 2018]

(1) $\sqrt{\frac{20}{9}}$

(2) $\sqrt{\frac{5}{9}}$

(3) $\sqrt{\frac{9}{12}}$

(4) $\sqrt{\frac{10}{9}}$

Ans. (2)

Thanks!

PHYSICS FORMULA RACE

WAVE OPTICS

❖ Maximum & Minimum Intensity

$$\frac{I_{max}}{I_{min}} = \frac{\left[\sqrt{I_1} + \sqrt{I_2}\right]^2}{\left[\sqrt{I_1} + \sqrt{I_2}\right]^2}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	3	2021	-
2020	-	2020	-
2019	2	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 5 (JEE-Main)

Q. The width of one of the two slits in a Young's double slit experiment is three times the other slit. If the amplitude of the light coming from a slit is proportional to the slit-width, the ratio of minimum to maximum intensity in the interference pattern is x : 4 where x is _____.

[JEE Main-2021]

Ans. 1

Q. Two coherent light sources having intensity in the ratio 2x produce an interference pattern. The ratio $\frac{I_{max}-I_{min}}{I_{max}+I_{min}}$ will be : [JEE Main-2021]

(1) $\frac{2\sqrt{2x}}{x+1}$ (2) $\frac{\sqrt{2x}}{2x+1}$ (3) $\frac{\sqrt{2x}}{x+1}$ (4) $\frac{2\sqrt{2x}}{2x+1}$

Ans. (4)

❖ Fringe Width

$$\beta = \frac{\lambda D}{d}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	8	2021	-
2020	4	2020	-
2019	-	2019	1
2018	-	2018	-
2017	1	2017	-
2016	1	2016	-
2015	-	2015	-
2014	-	2014	1
2013	-	2013	-
2012	-	2012	1

☛ Total Questions in last 10 years: 3 (JEE-Advanced) and 14 (JEE-Main)

Q. In a Young's double slit experiment, the slits are separated by 0.3 mm and the screen is 1.5 m away from the plane of slits. Distance between fourth bright fringes on both sides of central bright is 2.4 cm. The frequency of light used is_____$\times 10^{14}$ Hz. [JEE Main-2021]

Ans. 5

Q. In Young's double slit arrangement, slits are separated by a gap of 0.5 mm, and the screen is placed at a distance of 0.5 m from them. The distance between the first and the third bright fringe formed when the slits are illuminated by a monochromatic light of 5890 Å is :- [JEE Main -2021]

(1) 1178×10^{-9} m (2) 1178×10^{-6} m

(3) 1178×10^{-12} m (4) 5890×10^{-7} m

Ans. (2)

❖ Malus Law

$$I = I_0 \cos^2 \theta$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	2	2020	-
2019	1	2019	-
2018	2	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	1	2014	-
2013	1	2013	-
2012	1	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 10 (JEE-Main)

Q. A source of light is placed in front of a screen. Intensity of light on the screen is I. Two Polaroids P_1 and P_2 are so placed in between the source of light and screen that the intensity of light on screen is I/2. P_2 should be rotated by an angle of _____(degrees) so that the intensity of light on the screen becomes $\frac{3I}{8}$. [JEE Main -2021]

Ans. 30

Q. An unpolarized light beam is incident on the polarizer of a polarization experiment and the intensity of light beam emerging from the analyzer is measured as 100 Lumens. Now, if the analyzer is rotated around the horizontal axis (direction of light) by 30° in clockwise direction, the intensity of emerging light will be _____ Lumens. [JEE Main -2021]

Ans. 75

❖ Path Difference

$$d \sin \theta = n\lambda$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	3	2019	1
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 4 (JEE-Advanced) and 4 (JEE-Main)

Q. In the Young's double slit experiment, the distance between the slits varies in time as $d(t) = d_0 + a_0 \sin\omega t$; where d_0 , ω and a_0 are constants. The difference between the largest fringe width and the smallest fringe width obtained over time is given as : [JEE Main-2021]

(1) $\frac{2\lambda D(d_0)}{(d_0^2 - a_0^2)}$ (2) $\frac{2\lambda D a_0}{(d_0^2 - a_0^2)}$ (3) $\frac{\lambda D}{d_0^2} a_0$ (4) $\frac{\lambda D}{d_0 + a_0}$

Ans. (2)

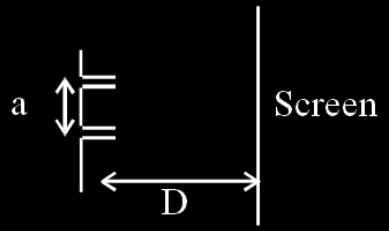
❖ Optical Path Difference

$$x = t_{(\text{thickness})}(\mu - 1)$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 1 (JEE-Advanced) and 2 (JEE-Main)

Q. The figure shows a Young's double slit experimental setup. It is observed that when a thin transparent sheet of thickness t and refractive index μ is put in front of one of the slits, the central maximum gest shifted by a distance equal to n fringe widths. If the wavelength of light used is λ, t will be: [JEE Main-2019]



(1) $\frac{2D\lambda}{a(\mu-1)}$ (2) $\frac{D\lambda}{a(\mu-1)}$ (3) $\frac{2nD\lambda}{a(\mu-1)}$ (4) $\frac{nD\lambda}{a(\mu-1)}$

Ans. (Bonus)

Q. In a double slit experiment, when a thin film of thickness t having refractive index μ is introduced in front of one of the slits, the maximum at the centre of the fringe pattern shifts by one fringe width. The value of t is (λ is the wavelength of the light used) : [JEE Main-2019]

(1) $\frac{\lambda}{2(\mu-1)}$ (2) $\frac{\lambda}{(2\mu-1)}$ (3) $\frac{2\lambda}{(\mu-1)}$ (4) $\frac{\lambda}{(\mu-1)}$

Ans. (4)

❖ Diffraction Angular Fringe Width

For minima: $\theta = \sin^{-1}\left[\frac{n\lambda}{a}\right]$

For maxima: $\theta = \sin^{-1}\left[\frac{(2n+1)\lambda}{2a}\right]$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	1	2020	-
2019	1	2019	-
2018	2	2018	-
2017	2	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

Q. Orange light of wavelength 6000×10^{-10} m in illuminates a single slit of width 0.6×10^{-4} m. The maximum possible number of diffraction minima produced on both sides of the central maximum is _____. [JEE Main-2020]

Ans. 200

Q. Visible light of wavelength 6000×10^{-8} cm falls normally on a single slit and produces a diffraction pattern. It is found that the second diffraction minimum is at 60° from the central maximum. If the first minimum is produced at θ_1, then θ_1 is close to : [JEE Main -2020]

(1) 20° (2) 45° (3) 30° (4) 25°

Ans. (4)

❖ General Formula of Intensity in Interference

$$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\Delta\phi$$

$\Delta\phi$ = Phase Difference

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	2	2020	-
2019	1	2019	1
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	1
2012	1	2012	-

☛ Total Questions in last 10 years: 3 (JEE-Advanced) and 5 (JEE-Main)

Q. The light waves from two coherent sources have same intensity $I_1 = I_2 = I_0$. In interference pattern the intensity of light at minima is zero. What will be the intensity of light at maxima?

(1) I_0 (2) $2\ I_0$ (3) $5\ I_0$ (4) $4\ I_0$ [JEE Main-2021]

Ans. (4)

Q. A Young's double-slit experiment is performed using monochromatic light of wavelength λ. The intensity of light at a point on the screen, where the path difference is λ, is K units. The intensity of light at a point where the path difference is $\frac{\lambda}{6}$ is given by $\frac{nK}{12}$, where n is an integer. The value of n is _____ . [JEE Main-2020]

Ans. 9

❖ Doppler Effect

$$\lambda' = \lambda\left[1 + \frac{v}{c}\right] \text{ (Wavelength)}$$

$$f = f_0\sqrt{\frac{c+v}{c-v}} \quad \text{(Frequency)}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	2	2021	-
2020	-	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. With what speed should a galaxy move outward with respect to earth so that the sodium-D line at wavelength 5890 Å is observed at 5896 Å ? [JEE Main-2021]

(1) 306 km/sec (2) 322 km/sec

(3) 296 km/sec (4) 336 km/sec

Ans. (1)

Q. A galaxy is moving away from the earth at a speed of 286 kms^{-1}. The shift in the wavelength of a red line at 630 nm is $x \times 10^{-10}$ m. The value of x, to the nearest integer, is_____.

[Take the value of speed of light c, as 3×10^8 ms^{-1}] [JEE Main-2021]

Ans. 6

❖ Velocity of EMW

$$v = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	1	2021	-
2020	1	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	-
2016	-	2016	-
2015	-	2015	-
2014	-	2014	-
2013	-	2013	-
2012	-	2012	-

☛ Total Questions in last 10 years: 0 (JEE-Advanced) and 2 (JEE-Main)

Q. The relative permittivity of distilled water is 81. The velocity of light in it will be : (Given $\mu_r = 1$) [JEE Main-2021]

(1) 4.33×10^7 m/s

(2) 2.33×10^7 m/s

(3) 3.33×10^7 m/s

(4) 5.33×10^7 m/s

Ans. (3)

❖ General Phase Difference

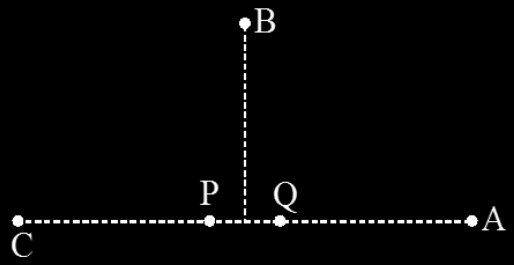
$$\Delta\phi = \frac{2\pi}{\lambda}(\Delta x)$$

$\Delta x \rightarrow$ path difference

JEE Main	Ques./Year	JEE Advanced	Ques./Year
2021	-	2021	-
2020	2	2020	-
2019	-	2019	-
2018	-	2018	-
2017	-	2017	1
2016	-	2016	-
2015	-	2015	1
2014	-	2014	-
2013	-	2013	1
2012	-	2012	-

☛ Total Questions in last 10 years: 3 (JEE-Advanced) and 2 (JEE-Main)

Q. In the figure below, P and Q are two equally intense coherent sources emitting radiation of wavelength 20 m. The separation between P and Q is 5 m and the phase of P is ahead of that of Q by 90°. A, B and C are three distinct points of observation, each equidistant from the midpoint of PQ. The intensities of radiation at A, B, C will be in the ratio: [JEE Main-2020]



(1) 0 : 1 : 2 (2) 4 : 1 : 0 (3) 0 : 1 : 4 (4) 2 : 1 : 0

Ans. (4)

Q. Two light waves having the same wavelength λ in vacuum are in phase initially. Then the first wave travels a path L_1 through a medium of refractive index n_1 while the second wave travels a path of length L_2 through a medium of refractive index n_2. After this the phase difference between the two waves is: [JEE Main-2020]

(1) $\frac{2\pi}{\lambda}(n_1L_1 - n_2L_2)$

(2) $\frac{2\pi}{\lambda}\left(\frac{L_2}{n_1} - \frac{L_1}{n_2}\right)$

(3) $\frac{2\pi}{\lambda}\left(\frac{L_1}{n_1} - \frac{L_2}{n_2}\right)$

(4) $\frac{2\pi}{\lambda}(n_2L_1 - n_1L_2)$

Ans. (1)

Thanks!

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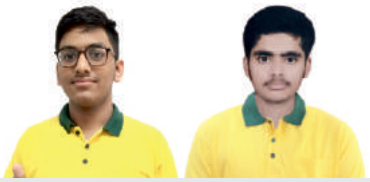

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