

# QUESTIONS & SOLUTIONS

Reproduced from Memory Retention

 18 March, 2021

SHIFT-1

 09:00 am to 12 Noon



Duration : 3 Hours

Max. Marks : 300

## SUBJECT - PHYSICS

### JEE (MAIN) FEB 2021 RESULT

Legacy of producing  
**Best Results Proved again**

RELIABLE  
TOPPER



**100%**tile  
in **MATHS**

PRANAV JAIN  
Roll No. : 20771421  
**99.993%**tile  
Overall

**100%**tile  
in **MATHS & PHYSICS**

KHUSHAGRA GUPTA  
Roll No. : 20975433

#### RESULT HIGHLIGHTS

**21** Students  
Secured  
**100%**tile  
in Maths / Physics

**138**  
students secured  
above **99%**tile (Overall)

All are from **KOTA CLASSROOM** only



TARGET  
JEE (MAIN+ADV.)  
2021

**SHAKTI**  
COMPACT COURSE

for XII passed students

Course  
Duration  
**250+**  
Hrs

Starting from



**22<sup>nd</sup>** MAR  
2021

Course will be available in both  
Offline & Online mode

**JEE(MAIN) 2021 (18 MARCH ATTEMPT) SHIFT-1**

**PHYSICS**

1. If a simple pendulum completes 200 oscillation in 100 sec. Least count of watch is 1 sec., length of simple pendulum is 100 cm and it's least count is 1 mm then find max. possible percentage error in measuring acceleration due to gravity.

- (1) 3.2                      (2) 5.2                      (3) 2.1                      (4) 4.1

Ans. (3)

Sol.  $T = 2\pi\sqrt{\frac{l}{g}}$   
 $T^2 = 4\pi^2\left(\frac{l}{g}\right)$

$g = 4\pi^2\left(\frac{l}{T^2}\right)$

$\frac{\Delta g}{g} = \frac{\Delta l}{l} + 2\frac{\Delta T}{T}$

$\frac{\Delta g}{g} \times 100 = \frac{0.1\text{cm}}{100\text{cm}} \times 100\% + 2\left(\frac{1\text{sec}}{100\text{sec}}\right) \times 100\%$

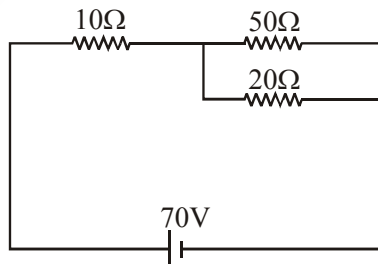
$\frac{\Delta g}{g} \times 100 = 2.1\%$

2. A girl is looking at the distant rectangular window, she finds window to be blurred & non-uniformly curved. What eye defect she may have?

- (1) Myopia & Astigmatism                      (2) Myopia & Hypermetropia  
 (3) Astigmatism                      (4) Hypermetropia & Astigmatism

Ans. (1)

3. In the circuit shown evaluate potential difference across 10Ω in volts?



Ans. 70.00

**Sol.**  $R_{eq} = 10 + \frac{10 \times 20}{50 \times 20}$   
 $= \frac{170}{7} \Omega$

$I = \frac{V}{R_{eq}} = \frac{170}{170} \times 7 = 7 \text{ amp}$

$V_{10\Omega} = IR$   
 $= 7 \times 10 = 70 \text{ v}$

4. A satellite revolves in a circular orbit of radius R around earth with time period T. Find its time period if it starts revolving in radius 9R?

- (1) 3T                      (2) 6T                      (3) 9T                      (4) 27T

**Ans.** (4)

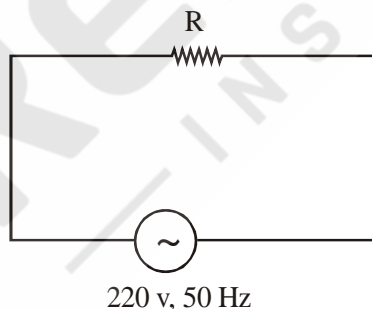
**Sol.**  $T^2 \propto R^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{R_2}{R_1}\right)^3$

$\therefore \left(\frac{T_2}{T_1}\right)^2 = 9^3$

$\therefore \frac{T_2}{T_1} = 27$

5. AC circuit diagram is shown. Find time taken to reach its current from  $i_{rms}$  to  $i_{max}$ .



- (1) 10 milli sec.              (2) 1 milli sec.              (3) 2.5 milli sec.              (4) 5 milli sec.

**Ans.** (3)

**Sol.**  $i = i_{max} \sin(\omega t + \theta)$

at  $t = 0$ ,  $i = i_{rms}$

$i_{rms} = \sqrt{2} (i_{rms}) \sin \theta$

$\theta = \frac{\pi}{4}$

$$i = i_{\max} \sin \left( \omega t + \frac{\pi}{4} \right)$$

at  $t = t_1$ ,  $i = i_{\max}$

$$i_{\max} = i_{\max} \sin \left( \omega t_1 + \frac{\pi}{4} \right)$$

$$\omega t_1 + \frac{\pi}{4} = \frac{\pi}{2}$$

$$\omega t_1 + \frac{\pi}{4}$$

$$\frac{2\pi}{T} t_1 = \frac{\pi}{4}$$

$$t_1 = \frac{T}{8}$$

$$t_1 = \frac{1}{8} \left( \frac{1}{f} \right) = \frac{1}{8} \left( \frac{1}{50} \right)$$

$$t_1 = \frac{1000}{400} \text{ m sec} = 2.5 \text{ m sec}$$

6. In LCR circuit L and C are constant and R is increased then:

- (1) Quality factor and resonant frequency both are unchanged.
- (2) Quality factor is increased.
- (3) Band width is increased.
- (4) Quality factor remains unchanged

Ans. (3)

Sol.  $\omega = \frac{1}{\sqrt{LC}}$ ,  $Q = \frac{1}{R} \sqrt{\frac{L}{C}}$ , Band width =  $\frac{R}{L}$

7. In YDSE setup, distance between slits is 0.5 mm & separation between slits plane & screen is 0.5 m. Find the distance between 1<sup>st</sup> maxima & 3<sup>rd</sup> maxima if light used has wave length 5890 Å.

- (1)  $1178 \times 10^{-6} \text{ m}$       (2)  $1178 \times 10^{-7} \text{ m}$       (3)  $1178 \times 10^{-8} \text{ m}$       (4)  $5890 \times 10^{-7} \text{ m}$

Ans. (1)

Sol. Distance between 1<sup>st</sup> & 3<sup>rd</sup> maxima will be  $3\beta$ .

$$\therefore 2 \times \frac{\lambda D}{d} = 2 \times 5890 \times 10^{-10} \times \frac{0.5}{0.5 \times 10^{-3}}$$

$$= 11780 \times 10^{-7} \text{ m}$$

8. A closed current carrying loop is placed in uniform magnetic field. Then in equilibrium shape of wire will be :
- (1) straight
  - (2) unchanged
  - (3) circular and plane perpendicular to magnetic field
  - (4) Circular and plane parallel to magnetic field

Ans. (3)

9. A muon particle (mass =  $207 m_e$ ) revolves around hydrogen nucleus. Find its ionisation energy?  
[ $m_e$  = mass of electron]
- (1) 13.6 eV
  - (2) 27.2 eV
  - (3)  $13.6 \times 207$  eV
  - (4) 331.8 eV

Ans. (Bonus)

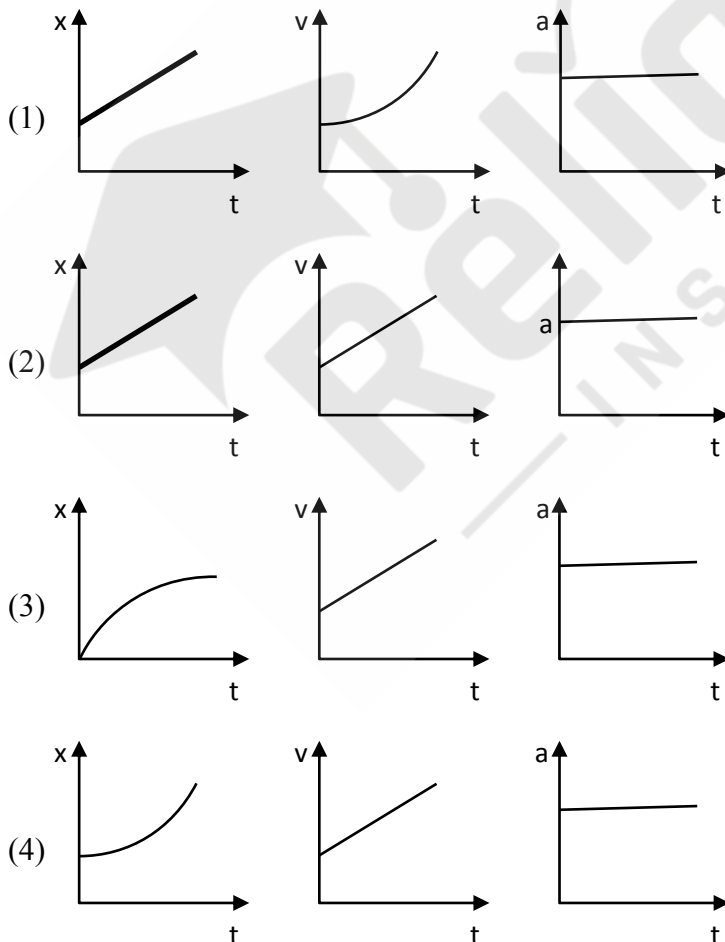
Sol.  $E_n = -13.6 \times \frac{\mu}{m_e} \text{ eV}$

$$\mu = \frac{(1836m_e)(207m_e)}{(1836 + 207)m_e}$$

$$= \frac{1836 \times 207}{2043} = 186 m_e.$$

$\therefore$  Ionisation energy =  $13.6 \times 186$  eV

10. An object is moving with constant acceleration. Choose the correct option.



Ans. (4)

**Sol.**  $a = \text{constant}$

$$v \propto t$$

$$x \propto t^2$$

**11.** A ring of mass  $M$  is rotating with constant angular velocity  $\omega$  about axis of rotation passing through centre and perpendicular to the plane of ring. Two particles each of mass  $m$  are placed gently diametrically at opposite position. Find new angular velocity.

(1)  $\left(\frac{M+2m}{M}\right)\omega$       (2)  $\left(\frac{M\omega}{M+2m}\right)$       (3)  $\left(\frac{M-2m}{M}\right)\omega$       (4)  $\left(\frac{m\omega}{M+2m}\right)$

**Ans.** (3)

**Sol.** Using angular momentum conservation

$$L_i = MR^2\omega$$

$$L_f = (MR^2 + 2mR^2)\omega'$$

$$\omega' = \left(\frac{M\omega}{M+2m}\right)$$

**12.** Electromagnetic wave is propagating in  $x$  direction. Magnetic field in space is given by  $\vec{B} = 2 \times 10^{-8} (\text{T}) \hat{k}$ . What will be the value and direction of electric field.

(1)  $0.6 \hat{j}$       (2)  $6 \hat{j}$       (3)  $0.6 \hat{k}$       (4)  $6 \hat{k}$

**Ans.** (2)

**Sol.**  $E = CB$

$$E = 3 \times 10^8 \times 2 \times 10^{-8}$$

$$E = 6$$

direction of  $\vec{v}$  is  $\vec{E} \times \vec{B}$

$$\hat{i} = \hat{j} \times \hat{k}$$

$$\text{so } \vec{E} = 6\hat{j}$$

**13.** A machine starting from Rest delivers constant Power ' $P$ '. Then distance travelled by it in time ' $t$ ' is proportional to:-

(1)  $t^{-3/2}$       (2)  $t^{1/2}$       (3)  $t^{3/2}$       (4)  $t^{-1/2}$

**Ans.** (3)

**Sol.**  $P = Fv$

$$P = mav$$

$$P \int dt = m \int v dv$$

$$m \frac{v^2}{2} = Pt$$

$$v = \left(\frac{2Pt}{m}\right)^{1/2}$$

$$\frac{dx}{dt} = \left(\frac{2Pt}{m}\right)^{1/2}$$

$$x = \left(\frac{2P}{m}\right)^{1/2} \frac{t^{3/2}}{\frac{3}{2}}$$

$$x \propto t^{3/2}$$

14. An object is performing SHM with time period 2 sec. If time taken by it to move from mean position to half of amplitude is  $\frac{1}{K}$  sec. Then value of K is.

- (1) 3                                      (2) 6                                      (3) 4                                      (4) 2

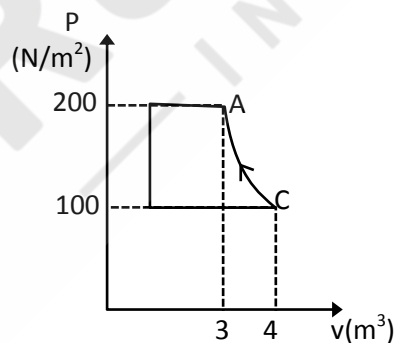
Ans. (2)

Sol. from 0 to  $\frac{A}{2}$

$$\text{time} = \frac{T}{12} \text{ sec}$$

$$\frac{2}{12} = \frac{1}{6} \text{ sec}$$

15. In given P-V graph process CA is adiabatic. Find work done in process CA if gas is diatomic ( $\gamma = 1.4$ ):

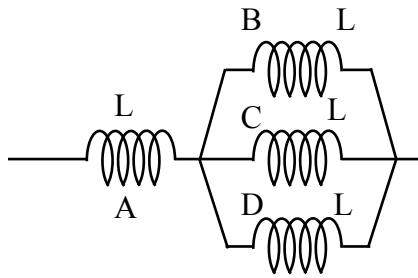


- (1) -400 J                                      (2) -500 J                                      (3) 200                                      (4) 400

Ans. (2)

$$\text{Sol. } W = \frac{nR\Delta T}{1-\gamma} = \frac{P_2V_2 - P_1V_1}{1-\gamma} = \frac{200 \times 3 - 100 \times 4}{1-1.4} = -500 \text{ J}$$

16. Four identical solenoids are connected as shown in figure



If magnetic field in A is 3T, evaluate magnetic field in C

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

Ans. (1)

Sol.  $B_A = \mu_0 nI = 3T$

$$B_C = \mu_0 n \frac{I}{3}$$

$$B_C = 1T$$

17. In a wire  $V = 5.0V$ ,  $I = 2.00A$ ,  $L = 10.0$  cm and diameter  $d = 5.00$  mm. Evaluate  $\frac{\Delta\rho}{\rho} \times 100$  ?

- (1) 3.9%                      (2) 1.9%                      (3) 2.9%                      (4) 3%

Ans. (1)

Sol. 
$$\frac{\Delta\rho}{\rho} = \frac{\Delta R}{R} + \frac{\Delta\ell}{\ell} + \frac{2\Delta d}{d}$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta V}{V} + \frac{\Delta I}{I} + \frac{\Delta\ell}{\ell} + \frac{2\Delta d}{d}$$

$$\frac{\Delta\rho}{\rho} \% = \left( \frac{0.1}{5} + \frac{0.01}{2} + \frac{0.1}{10} + 2 \times \frac{0.01}{5} \right) \times 100$$

$$= 2 + 0.5 + 1 + 0.4 = 3.9\%$$

18. A is forming B and C independently if  $A \rightarrow B$  with half life =  $T_{1/2}(B)$  and if  $A \rightarrow C$  with half life  $T_{1/2}(C)$  then what will be overall half life:

(1)  $\frac{T_{1/2}(B) \times T_{1/2}(C)}{T_{1/2}(B) + T_{1/2}(C)}$

(2)  $\frac{T_{1/2}(B) + T_{1/2}(C)}{T_{1/2}(B) \times T_{1/2}(C)}$

(3)  $\frac{T_{1/2}(B) \times T_{1/2}(C)}{T_{1/2}(B) - T_{1/2}(C)}$

(4)  $\frac{T_{1/2}(B) + T_{1/2}(C)}{T_{1/2}(B) - T_{1/2}(C)}$

Ans. (1)



**Sol.**  $-\frac{dN_A}{dt} = \lambda_B N_A + \lambda_C N_A$

$$= (\lambda_B + \lambda_C) N_A = \lambda_{eq} N_A$$

$$\lambda_{eq} = \lambda_B + \lambda_C$$

$$\frac{\ln 2}{T_{eq}} = \frac{\ln 2}{T_{1/2B}} + \frac{\ln 2}{T_{1/2C}} \Rightarrow \frac{1}{T_{eq}} = \frac{1}{T_{1/2B}} + \frac{1}{T_{1/2C}}$$

$$T_{eq} = \frac{T_{1/2B} \times T_{1/2C}}{T_{1/2B} + T_{1/2C}}$$

19. Two wires A and B of same material having elongation 2 mm and 4 mm respectively on applying 2N take. If radius of B is four times the radius of A and ratio of length of A is to B in the form of  $\frac{1}{x}$  then the value of x is

**Ans.** 32.00

**Sol.**  $\frac{F}{A} = Y \frac{\Delta L}{L}$

$$\frac{F}{\pi r_A^2} = Y \frac{\Delta L_A}{L_A} \quad \text{--- (i)}$$

$$\frac{F}{\pi r_B^2} = Y \frac{\Delta L_B}{L_B} \quad \text{--- (ii)}$$

$$\left(\frac{r_B}{r_A}\right)^2 = \frac{\Delta L_A}{\Delta L_B} \times \frac{L_A}{L_B} \quad r_B = 4r_A$$

$$16 = \frac{2}{4} \times \frac{L_B}{L_A} \quad \frac{r_B}{r_A} = 4$$

$$\frac{L_B}{L_A} = 32$$

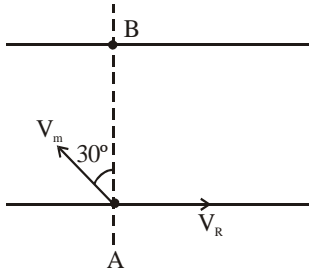
$$\frac{a}{b} = \frac{1}{32}$$

$$x = 32$$

20. A man is swimming in a river at an angle  $120^\circ$  with river flow. Speed of man in still water is 10m/s. If he reaches the other bank exactly opposite to origin point, find speed of flow of river (in m/s)

**Ans.** 5.00

Sol.



Net speed perpendicular to line.

AB must be zero.

$$\therefore v_m \sin 30 = V_R$$

$$\therefore v_r = 5 \text{ m/s}$$

21. If ratio of de-Broglie wavelength of particle and electron is 2 : 1 and ratio of their velocity is 4 : 1. Then

- (1) mass of particle is 8 times that of electron
- (2) mass of electron is 8 times that of particle
- (3) mass of electron is 16 times that of particle
- (4) mass of particle is 16 times that of electron

Ans. (2)

Sol. 
$$\frac{\lambda_p}{\lambda_e} = \frac{\frac{h}{m_p v_p}}{\frac{h}{m_e v_e}} \Rightarrow \frac{2}{1} = \frac{m_e v_e}{m_p v_p} = \frac{m_e}{m_p} \times \frac{1}{4}$$

$$\frac{m_e}{m_p} = 8$$

22. In the millikan oil drop experiment radius of drop is  $r = 2 \text{ mm}$  and density  $\rho = 3 \text{ gm/cm}^3$ . If the applied electric field is  $E = 3.55 \times 10^5 \text{ N/C}$ . Find excess electrons.

- (1)  $1.769 \times 10^{10}$       (2)  $1.567 \times 10^{10}$       (3)  $1.769 \times 10^{12}$       (4)  $1.567 \times 10^{12}$

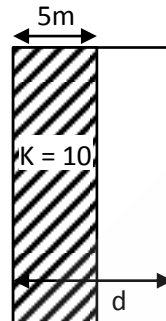
Ans. (1)

Sol.  $mg = qE$

$$q = \frac{mg}{E}$$

$$N = \frac{mg}{eE} = \frac{3 \times 10^{-3} \times 10 \times \frac{4}{3} \pi \times 8 \times 10^{-9}}{10^{-6} \times 3.55 \times 10^5 \times 1.6 \times 10^{-19}} = 1.769 \times 10^{10}$$

23. A partially filled capacitor has half of its space filled with dielectric of relative permittivity 10. Equivalent capacitance if area of plates is  $100 \text{ m}^2$  and distance between plates is  $10 \text{ m}$  is given as  $x \text{ pF}$ . Find  $x$ ? ( $\epsilon_0 = 8.85 \times 10^{-12}$ )



Ans. 161.00

Sol.  $C_2 = \frac{\epsilon_0 \times 100}{5} = 20\epsilon_0$

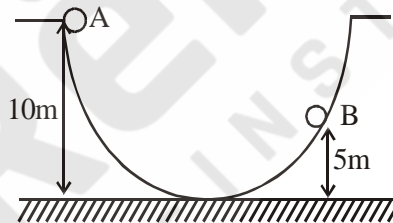
$$C_1 = 10 \times \frac{\epsilon_0 \times 100}{5} = 200\epsilon_0$$

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

$$C_{eq} = \frac{4000 \epsilon_0}{220}$$

$$= 160.90 \times 10^{-12} = 161 \text{ pF}$$

24. A ball is released from point A. Evaluate its velocity (m/s) when it reaches to point B (assume frictionless surface):



Ans. 10.00

Sol.  $mg(5) = \frac{1}{2}mv^2$

$$V = 10 \text{ m/s.}$$

25. Initially a body of mass  $10 \text{ kg}$  is moving along  $x$ -axis with velocity  $10\sqrt{3} \text{ m/s}$ . It collides with another body of mass  $20 \text{ kg}$  and comes to rest. The  $20 \text{ kg}$  mass object disintegrates in 2 parts each of mass  $10 \text{ kg}$ . One part moves along  $y$ -axis with velocity  $10 \text{ m/s}$  and another at  $30^\circ$  with  $x$ -axis. Evaluate the velocity of the object which moves at angle  $30^\circ$  with  $x$ -axis.

Ans. 20.00

**Sol.**  $|\vec{v}| = 20 \text{ m/s}$

$$10 \times 10\sqrt{3}\hat{i} = 10 \times 10\hat{j} + 10\vec{v}$$

$$\frac{100\sqrt{3}\hat{i} - 100\hat{j}}{10} = \vec{v}$$

$$\vec{v} = 10\sqrt{3}\hat{i} - 10\hat{j}$$

- 26.** A bullet of mass 0.1 kg initially moving with a velocity 10 m/sec and then passes through a wooden block and comes to rest with uniform deceleration by travelling 50cm. If the force exerted by wooden block on bullet is x newton, then find x.

**Ans.** 10.00

**Sol.**  $v^2 = u^2 + 2as$

$$0 = 100 + 2(-a)\left(\frac{1}{2}\right)$$

$$a = 100 \text{ m/s}^2$$

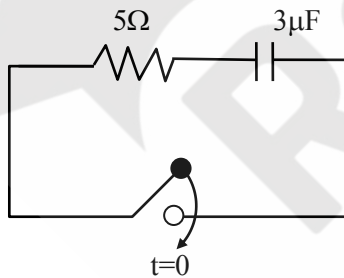
$$F = ma = (0.1)(100)$$

$$F = 10 \text{ N}$$

- 27.** A capacitor of capacitance 3  $\mu\text{F}$  has charge 30 nC is connected to a resistance of 5 $\Omega$ . If current in circuit just after closing the switch is x A. Then x is :

**Ans.** 2.00

**Sol.**



$$q = Qe^{-\frac{t}{RC}}$$

$$I = \frac{Q}{RC} e^{-\frac{t}{RC}}$$

$$I(t=0) = \frac{Q}{RC} = \frac{30}{5 \times 3} = 2 \text{ A}$$

- 28.** Coming soon.  
**29.** Coming soon.  
**30.** Coming soon.