



PAPER-1(B.E./B. TECH.)

JEE (Main) 2021

Questions & Solutions

Date : 26 February, 2021 (SHIFT-1) Time ; (9.00 am to 12.00 pm)

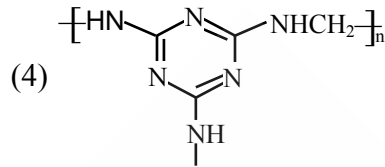
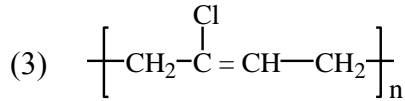
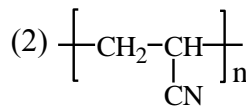
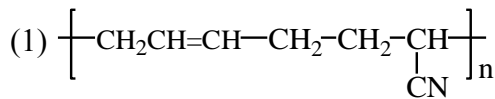
Duration : 3 Hours | Max. Marks : 300

SUBJECT : CHEMISTRY

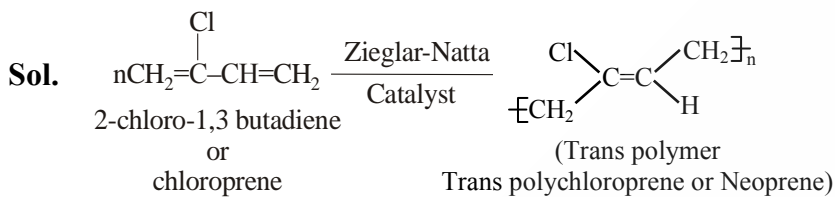
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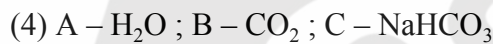
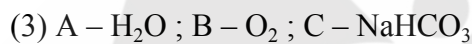
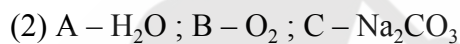
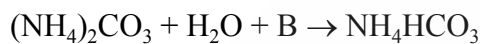
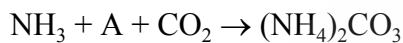
1. The structure of Neoprene is -



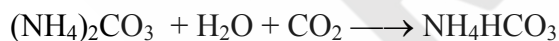
Ans. (3)



2. Find A, B and C in the following reactions :



Ans. (4)



3. The presence of ozone in troposphere

(1) protects us from the UV radiation

(2) protects us from the X-ray radiation

(3) protects us from greenhouse effect

(4) generates photochemical smog

Ans. (4)

Sol. Fact

4. Match List -I with List - II

List - I

**Electronic configuration
of elements**

- (a) $1s^2 2s^2$
(b) $1s^2 2s^2 2p^4$
(c) $1s^2 2s^2 2p^3$
(d) $1s^2 2s^2 2p^1$

List - II

$\Delta_f H$ in kJ mol^{-1}

- (i) 801
(ii) 899
(iii) 1314
(iv) 1402

Choose the most appropriate answer from the options given below -

- (1) (a) \rightarrow (ii), (b) \rightarrow (iii), (c) \rightarrow (iv), (d) \rightarrow (i)
(2) (a) \rightarrow (i), (b) \rightarrow (iv), (c) \rightarrow (iii), (d) \rightarrow (ii)
(3) (a) \rightarrow (i), (b) \rightarrow (iii), (c) \rightarrow (iv), (d) \rightarrow (ii)
(4) (a) \rightarrow (iv), (b) \rightarrow (i), (c) \rightarrow (ii), (d) \rightarrow (iii)

Ans. (1)

Sol. Order : $B < Be < O < N$

5. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Dipole-dipole interactions are the only non-covalent interactions, resulting in hydrogen bond formation.

Reason R : Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (1) A is false but R is true
(2) Both A and R are true and R is the correct explanation of A
(3) A is true R is false
(4) Both A and R are true but R is NOT the correct explanation of A

Ans. (1)

6. Statements about heavy water are given below.

- A. Heavy water is used in exchange reactions for the study of reaction mechanisms.
B. Heavy water is prepared by exhaustive electrolysis of water
C. Heavy water has higher boiling point than ordinary water.
D. Viscosity of H_2O is greater than D_2O

Choose the most appropriate answer from the options given below.

- (1) A, B and C only
(2) A and B only
(3) A and D only
(4) A and C only

Ans. (1)

Sol. On exhaustive electrolysis of H_2O . It will dissociate into H_2 and O_2 and only D_2O will remain.

7. The orbital having two radial as well as two angular nodes is -

- (1) 3p (2) 4f (3) 4d (4) 5d

Ans. (4)

Sol.

Orbital	Angular Node	Radial Node
5d	2	2
4f	3	0
3p	1	1
4d	2	1

8. Match List -I with List - II

List - I

(Ore)

- (a) Kernite
(b) Cassiterite
(c) Calamine
(d) Cryolite

List - II

(Element Present)

- (i) Tin
(ii) Boron
(iii) Fluorine
(iv) Zinc

Choose the most appropriate answer from the options given below.

- (1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)
(2) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)
(3) (a) → (ii), (b) → (iv), (c) → (i), (d) → (iii)
(4) (a) → (iii), (b) → (i), (c) → (ii), (d) → (iv)

Ans. (2)

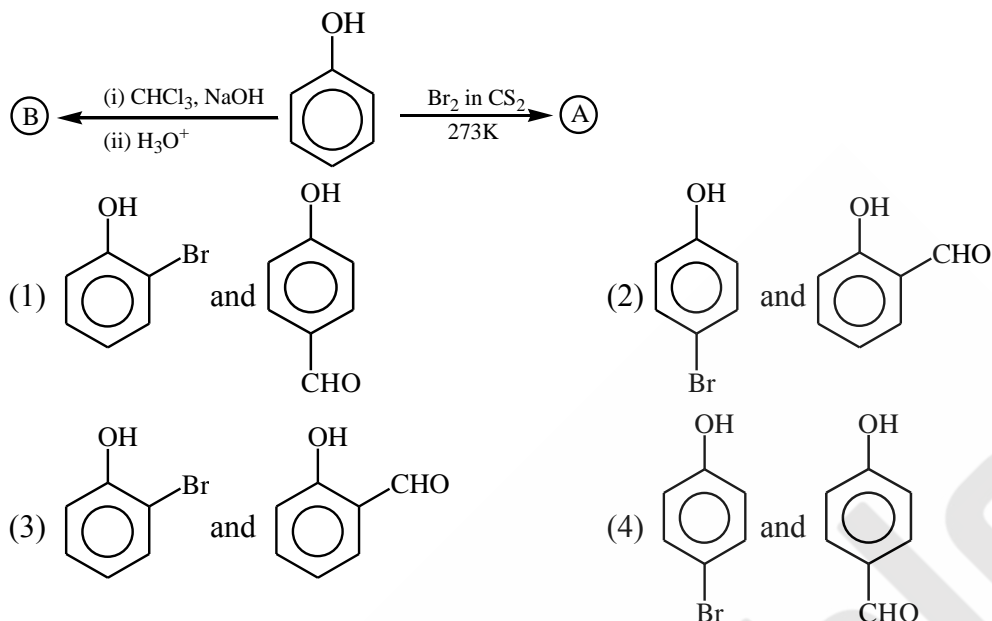
Sol. Kernite → $\text{Na}_2\text{B}_4\text{O}_6(\text{OH})_2 \cdot 3\text{H}_2\text{O}$

Cassiterite → SnO_2

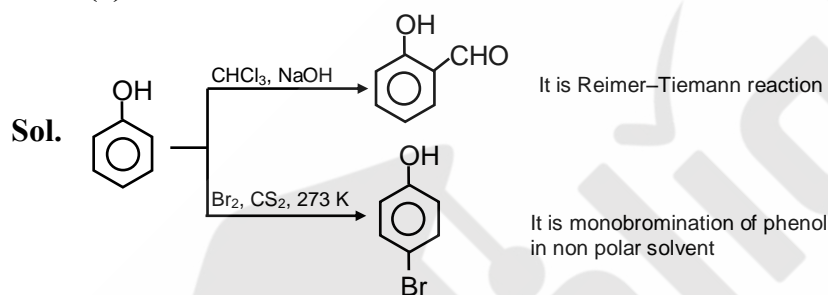
Calamine → ZnCO_3

Cryolite → Na_3AlF_6

9. Identify the major products A and B respectively in the following reactions of phenol.



Ans. (2)



10. Given below are two statements :

Statement I : A mixture of chloroform and aniline can be separated by simple distillation.

Statement II : When separating aniline from a mixture of aniline and water by steam distillation aniline boils below its boiling point.

In the light of the above statements, choose the most appropriate answer from the options given below.

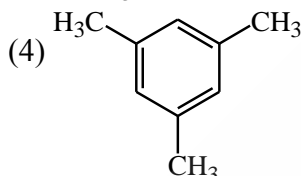
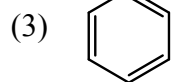
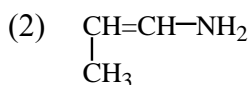
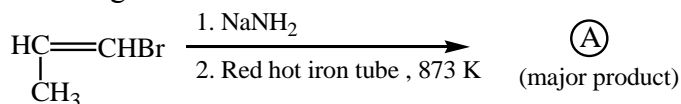
- (1) **Statement-I** is false but **Statement II** is true
- (2) **Both Statement-I** and **Statement II** are false
- (3) **Statement-I** is true but **Statement II** is false
- (4) **Both Statement-I** and **Statement II** are true

Ans. (4)

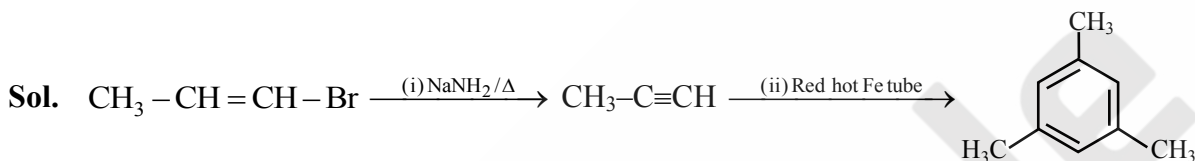
Sol. Boiling point of aniline = 184.1°C

Boiling point of Chloroform = 61.2°C

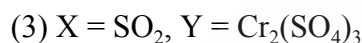
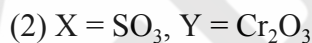
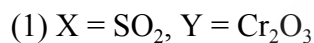
11. For the given reaction :



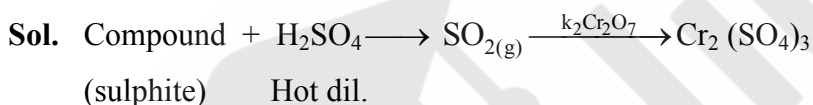
Ans. (4)



12. On treating a compound with warm dil. H_2SO_4 , gas X is evolved which turns $\text{K}_2\text{Cr}_2\text{O}_7$ paper acidified with dil. H_2SO_4 to a green compound Y. X and Y respectively are -



Ans. (3)



13. Which of the following is 'a' FALSE statement?

(1) Carius tube is used in the estimation of sulphur in an organic compound.

(2) Carius method is used for the estimation of nitrogen in an organic compound.

(3) Phosphoric acid produced on oxidation of phosphorus present in an organic compound is precipitated as $\text{Mg}_2\text{P}_2\text{O}_7$ by adding magnesia mixture.

(4) Kjeldahl's method is used for the estimation of nitrogen in an organic compound.

Ans. (2)

Sol. Carius tube is used in estimation of sulphur while kjeldahl's method and duma's method are used for estimation of nitrogen.

14. Which of the following vitamin is helpful in delaying the blood clotting?

(1) Vitamin C

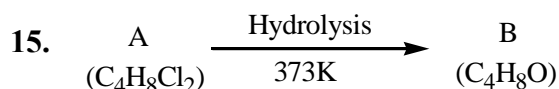
(2) Vitamin B

(3) Vitamin E

(4) Vitamin K

Ans. (4)

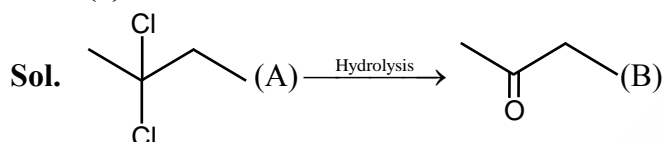
Sol. Vitamin K is used by the body to help blood clot. Warfarin (Coumadin) is used to slow blood clotting. By helping the blood clot, vitamin K might decrease the effectiveness of warfarin.



B reacts with hydroxyl amine but does not give Tollen's test. Identify A and B

- (1) 1,1-Dichlorobutane and 2-Butanone
- (2) 2,2-Dichlorobutane and Butanal
- (3) 1,1-Dichlorobutane and Butanal
- (4) 2,2-Dichlorobutane and Butan -2-one

Ans. (4)



16. Compound A used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries. Compound A is :

- (1) PbO_2
- (2) PbO
- (3) PbSO_4
- (4) Pb_3O_4

Ans. (1)

Sol. PbO_2 is a part of lead storage batteries and also used as strong oxidising agent and it is amphoteric in nature.

17. Which one of the following lanthanoids does not form MO_2 ? [M is lanthanoid metal]

- (1) Pr
- (2) Dy
- (3) Nd
- (4) Yb

Ans. (4)

Sol. Yb shows +2 & +3 only

18. Given below are two statements :

Statement I : o-Nitrophenol is steam volatile due to intramolecular hydrogen bonding.

Statement II : o-Nitrophenol has high melting due to hydrogen bonding.

In the light of the above statements, choose the most appropriate answer from the options given below :

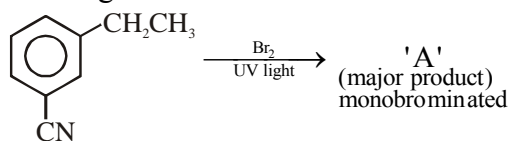
- (1) Statement I is false but Statement II is true
- (2) Both statement I and statement II are true
- (3) Both statement I and statement II are false
- (4) Statement I is true but statement II is false

Ans. (4)

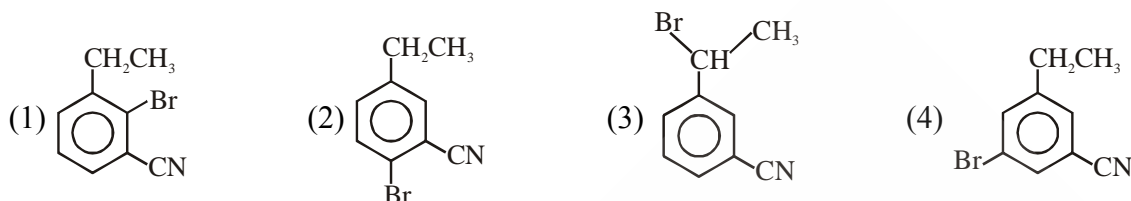
Sol. **Statement-I:** Orthonitrophenol has intramolecular H-bonding so less boiling point and more volatile nature.

Statement-II: Melting point depends on symmetry and packing efficiency.

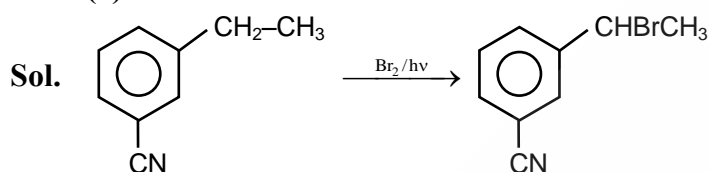
19. For the given reaction :



What is 'A'?



Ans. (3)



It is free-radical substitution reaction of alkanes, so bromination takes place at benzylic carbon.

20. An amine on reaction with benzenesulphonyl chloride produces a compound insoluble in alkaline solution. This amine can be prepared by ammonolysis of ethyl chloride. The correct structure of amine is :



Ans. (4)

Sol. Sulphonamides of secondary amine will be insoluble in KOH.

Numerical

1. For a chemical reaction $\text{A} + \text{B} \rightleftharpoons \text{C} + \text{D}$

($\Delta_r H^\circ = 80 \text{ kJ mol}^{-1}$) the entropy change $\Delta_r S^\circ$ depends on the temperature T (in K) as ($\Delta_r S^\circ = 2T \text{ (J K}^{-1} \text{ mol}^{-1})$).

Minimum temperature at which it will become spontaneous is _____ K. (Integer)

Ans. 200

Sol. For spontaneous reaction $\Delta G < 0$

$$\Delta H - T\Delta S < 0$$

$$80,000 - (T)(2T) < 0$$

$$2T^2 > 80,000$$

$$T^2 > 40,000$$

$$T > 200 \text{ K}$$

\therefore Ans. 200 K

2. The number of significant figures in 50000.020×10^{-3} is _____.

Ans. 8 (NTA Ans. 7)

Sol. Fact

3. An exothermic reaction $X \rightarrow Y$ has an activation energy 30 kJ mol^{-1} . If energy change ΔE during the reaction is -20 kJ , then the activation energy for the reverse reaction in kJ is _____. (Integer answer)

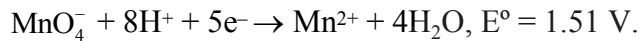
Ans. 50

Sol. $\Delta H = E_{a, f} - E_{a, b}$

$$-20 = 30 - E_{a, b}$$

$$E_{a, b} = 50 \text{ kJ/mole}$$

4. Consider the following reaction



The quantity of electricity required in Faraday to reduce five moles of MnO_4^- is _____. (Integer answer)

Ans. 25

Sol. $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$

1 mole of MnO_4^- require 5 Faraday charge

5 moles of MnO_4^- will require 25 Faraday

5. A certain gas obeys $P(V_m - b) = RT$. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$. The value of x is _____.

(Integer answer) (Z : compressibility factor)

Ans. 1

Sol. $P(V - b) = RT$

$$PV - Pb = RT$$

$$\frac{PV}{RT} - \frac{Pb}{RT} = 1$$

$$z = 1 + \frac{Pb}{RT}$$

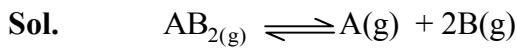
$$\frac{dz}{dp} = 0 + \frac{b}{RT}$$

$$= \frac{b}{RT} = \frac{xb}{RT}$$

$$x = 1$$

6. A homogeneous ideal gaseous reaction $AB_{2(g)} \rightleftharpoons A_{(g)} + 2B_{(g)}$ is carried out in a 25 litre flask at 27°C . The initial amount of AB_2 was 1 mole and the equilibrium pressure was 1.9 atm. The value of K_p is $x \times 10^{-2}$. The value of x is _____. (Integer answer) ($R = 0.08206 \text{ dm}^3 \text{ atm k}^{-1} \text{ mol}^{-1}$)

Ans. 73 [NTA Ans. 74]



$$n_i \quad 1 \quad - \quad -$$

$$n_{eq.} \quad 1 - x \quad x \quad 2x$$

$$P_{eq.} = 1.9 \text{ atm}$$

$$P_{eq.} V = n_{eq} RT$$

$$1.9 \times 25 = (1 + 2x) 0.08206 \times 300$$

$$= (1 + 2x) 24.618$$

$$47.5 = (1 + 2x) 24.618$$

$$1 + 2x = 1.93$$

$$2x = 0.93$$

$$x = 0.465$$

$$K_p = \frac{\left[\left(\frac{2x}{1+2x} \right) p \right]^2 \left[\frac{x}{1+2x} \right] p}{\left[\frac{1-x}{1+2x} \right] p}$$

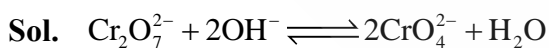
$$= \frac{4x^3 p^2}{(1+2x)^2 (1-x)}$$

$$= \frac{4 \times (0.465)^3 \times (1.9)^2}{(1.93)^2 (0.535)} = 0.729 = 72.9 \times 10^{-2}$$

Ans. = 73

7. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is _____.

Ans. 6



$$x + (-2 \times 4) = -2$$

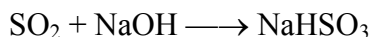
$$x = 6$$

8. 224 mL of $\text{SO}_2(\text{g})$ at 298 K and 1 atm is passed through 100 mL of 0.1 M NaOH solution. The non-volatile solute produced is dissolved in 36 g of water. The lowering of vapour pressure of solution (assuming the solution is dilute) ($P_{(\text{H}_2\text{O})} = 24 \text{ mm of Hg}$) is $x \times 10^{-2} \text{ mm of Hg}$, the value of x is _____ . (Integer answer)

Ans. 24 NTA Answer = 12

Sol. Moles of $\text{SO}_2 = \frac{224}{22400} = 0.01$

Moles of NaOH = 0.01



$$0.01 \quad 0.01 \quad 0$$

$$0 \quad 0 \quad 0.01$$

For dilute solution $\frac{p^0 - p^s}{P^0} = \frac{i n}{N}$

$$\Rightarrow \frac{24 - p_s}{24} = \frac{2 \times 0.01}{2} \left[\begin{array}{l} N_{\text{H}_2\text{O}} = 2 \\ i_{\text{NaHSO}_3} = 2 \end{array} \right]$$

$$\Rightarrow 24 - p_s = 0.24 = \text{lowering of V.P.}$$

Lowering of V.P. = 24×10^{-2}

$$x = 24$$

9. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume of oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is _____ .

[$R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

Ans. 2

Sol. Moles of $\text{O}_2 = \frac{3.12}{32} = 0.0975$

$$\text{Volume of O}_2 = \frac{nRT}{P} = \frac{0.0975 \times 0.082 \times 300}{1} = 2.3985 \text{ litres} \approx 2.4 \text{ litres}$$

$$\text{Volume of O}_2 \text{ adsorbed per gm of Pt} = \frac{2.4}{1.2} = 2$$

10. Number of bridging CO ligands in $[\text{Mn}_2(\text{CO})_{10}]$ is _____ .

Ans. 0

