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

# JEE (Main) 2021

## Questions & solutions
(Reproduced from memory retention)

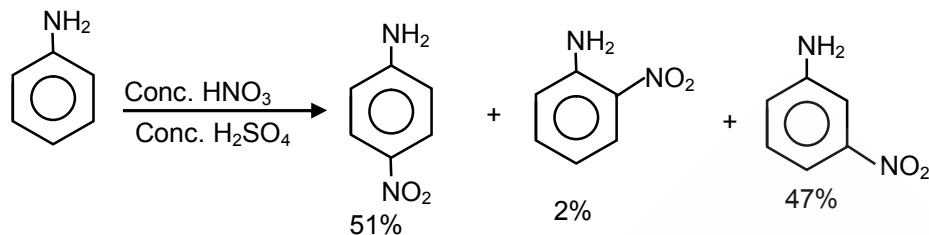**Date : 24 February, 2021 (SHIFT-1) Time ; (9.00 am to 12.00 pm)**

**Duration : 3 Hours | Max. Marks : 300**

## SUBJECT : CHEMISTRY

# CHEMISTRY

**1.** What is the reason for the formation of meta product in the following reaction?



(1) Aniline is ortho/para directing

(2) Aniline is meta directing

(3) In acidic medium, aniline is converted into anilinium ion which is ortho/para directing

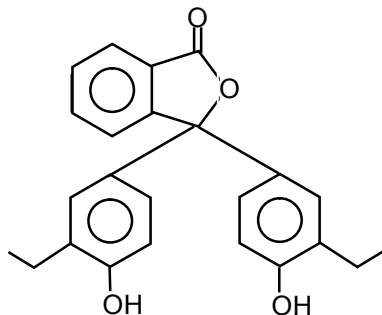(4) In acidic medium, aniline is converted into anilinium ion which is meta directing

**Ans.** **(4)**

**Sol.** In acidic medium, aniline is converted into anilinium ion which is meta directing

**2.**
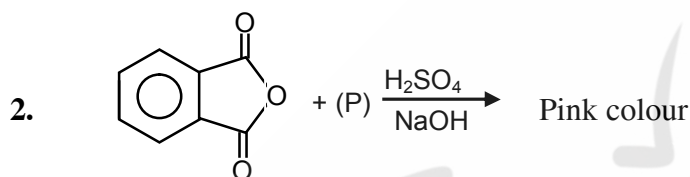


Missing reagent (P) is
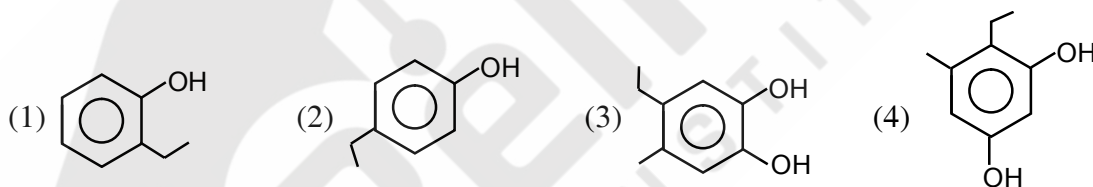


**Ans.** **(1)**

**Sol.** P is

**3.** Which force is responsible for the stacking of α-helix structure of protein?

(1) H-bonding      (2) Ionic bonding      (3) Covalent bond      (4) Vanderwal forces

**Ans.** **(1)**

**Sol.** Hydrogen bond is responsible for the stacking of α-helix structure of protein.

**4.** The gas evolved due to anaerobic degradation of vegetation causes?

(1) Global warming and caner

(2) Acid rain

(3) Ozone hole

(4) Metal corrosion

**Ans.** **(1)**

**Sol.** The gas $CH_4$ evolved due to anaerobic degradation of vegetation which causes global warming and caner.
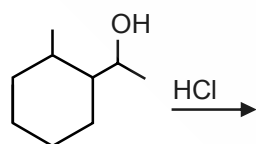
**5.** Match the column

| | |
|---|---|
| (i) Caprolactum | (a) Neoprene |
| (ii) Acrylo nitrile | (b) Buna N |
| (iii) 2-chlorobuta-1,3-diene | (c) Nyolon-6 |
| (iv) 2-Methylbuta-1,3-diene | (d) Natural rubber |

(1) (i) → (b), (ii) → (c), (iii) → (a), (iv) → (d)

(2) (i) → (a), (ii) → (c), (iii) → (b), (iv) → (d)

(3*) (i) → (c), (ii) → (b), (iii) → (a), (iv) → (d)

(4) (i) → (c), (ii) → (a), (iii) → (b), (iv) → (d)

**Ans.** **(3)**

**6.** What is the major product of the following reaction?



**Ans.** **(1)**

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**7.** What is the major product of following reaction?



+ HI ⟶

(1)  (2)  (3)  (4) 
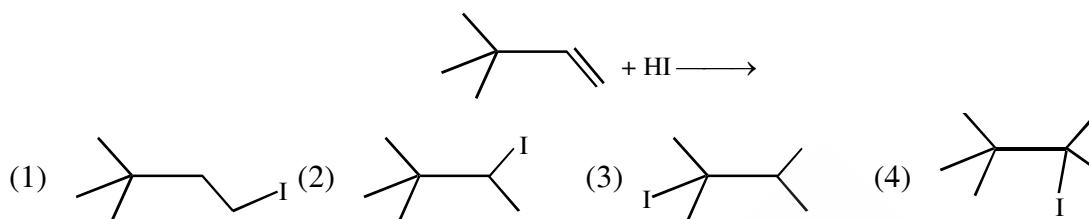
**Ans. (3)**

**8.** Identify the major product?



$\xrightarrow[\text{(Dry ether)}]{\text{Mg}}$

(1) 

(2) 

(3) 

(4) 

**Ans. (2)**

**9.**  $\xrightarrow[\text{273 K}]{\text{dil. KMnO}_4}$ A $\xrightarrow{\text{CrO}_3}$ B

Product A and B are ?

(1) A =  B = 

(2) A =  B = 

(3) A =  B = 

(4) A =  B = 

**Ans. (1)**

**Sol.**  $\xrightarrow[\text{273 K}]{\text{dil. KMnO}_4}$  $\xrightarrow{\text{CrO}_3}$

**10.**  $CH_3–CH_2–CH_3 \xrightarrow{(A)} CH_3–CH_2–\overset{\overset{\displaystyle O}{\|}}{C}–H$
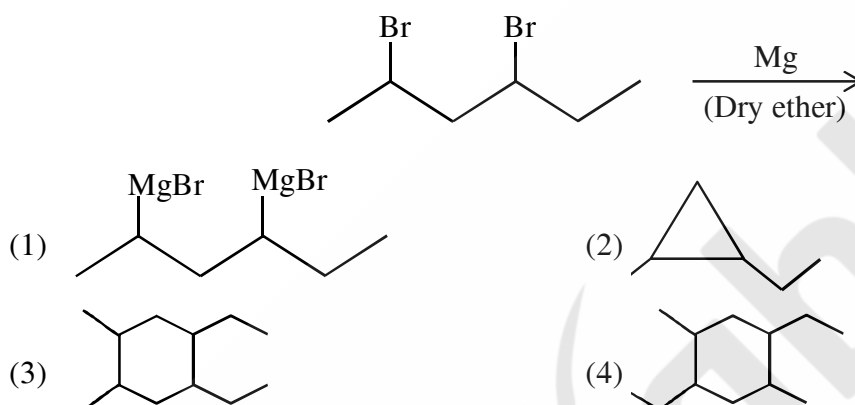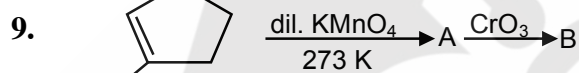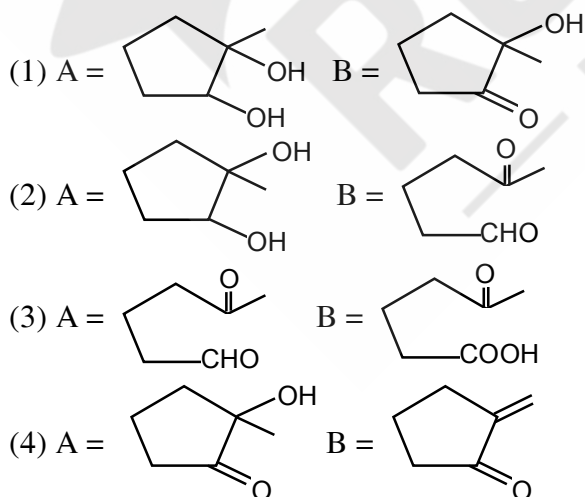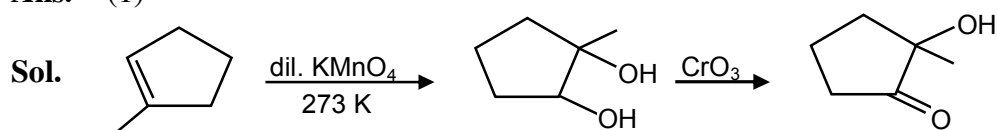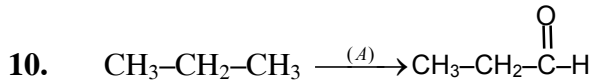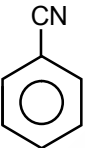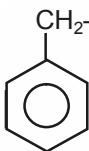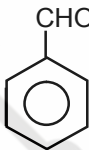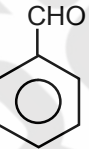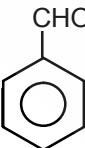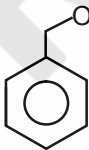
Which reagent (A) is used for following given conversion?

(1) $Cu/\Delta/$ high pressure

(2) Molybdenum oxide

(3) Manganese acetate

(4) Potassium permanganate

**Ans.**  **(2)**

**11.**



Find A and B

(1) A = [benzonitrile, ring with CN]    B = [ring with CH$_2$–NH$_2$]

(2) A = [ring with Cl]    B = [ring with CHO]

(3) A = [ring with CN]    B = [ring with CHO]

(4) A = [ring with CHO]    B = [ring with OH]
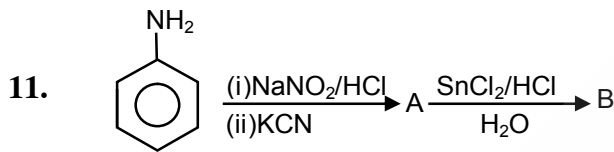
**Ans.**  **(3)**

**12.**  Which of the following have both the compound isostructural.

(A) $TiCl_4$, $SiCl_4$    (B) $SO_4^{2-}, CrO_4^{2-}$    (C) $NH_3$, $NO_3^-$    (D) $ClF_3$, $BCl_3$

(1) A,B      (2) A,C      (3) B,C      (4) A,D

**Ans.**  **(1)**

**13.**  Which of the following ores are concentrated by cyanide of group I$^{st}$ element.

(1) Sphalerite      (2) Malachite      (3) Calamine      (4) Siderite

**Ans.**  **(1)**

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**14.** S-1: Colourless cupric metaborate is converted into cuprous metaborate in luminous flame.

**S-2:** Cuprous metaborate is formed by reacting copper sulphate with boric anhydride heated in non luminous flame.

(1) $S_1$ is true and $S_2$ is false
(2) $S_1$ is flase and $S_2$ is true
(3) Both are false
(4) Both are true.

**Ans. (3)**

**15.** (1) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

**(2)** $H_2O_2 + HOCl \longrightarrow Cl^- + H_3O^+ + O_2$

(1) $H_2O_2$ is acting as oxidising agent in both the reaction
(2) $H_2O_2$ is acting as reducing agent in both the reaction
(3) $H_2O_2$ is acting as oxidising agent in reaction (1) and as reducing agent in reaction(2)
(4) $H_2O_2$ is acting as reducing agent in reaction (1) and as oxidising agent in reaction (2)

**Ans. (2)**

**16.** $E^o_{M^{2+}/M}$ has positive value for which of the element of 3d transition series.

**Ans. (Cu)**

**17.** $Al + NaOH \longrightarrow X \xrightarrow{Y_{(g)}} Z$

Identify X,Y,Z in the above reaction sequence
(1) X = Na[Al(OH)$_4$]    Y = CO$_2$    Z = Al$_2$O$_3$. x H$_2$O
(2) X = Na[Al(OH)$_4$]    Y = SO$_2$    Z = Al$_2$O$_3$. x H$_2$O
(3) X = Al(OH)$_3$         Y = CO$_2$    Z = Al$_2$O$_3$
(4) Al(OH)$_3$            Y = SO$_2$    Z = Al$_2$O$_3$

**Ans. (1)**

**18.** The slope of the straight line given in the following diagram for adsorption is



(1) $\frac{1}{n}$ (0 to 1)    (2) $\frac{1}{n}$ (0.1 to 0.5)    (3) log n    (4) log $\frac{1}{n}$

**Ans. (1)**

**Sol.** Slope $=\frac{1}{n}$ (0 to 1)

**19.** Composition of gun metal is
(1) Cu, Zn, Sn
(2) Al, Mg, Mn, Cu
(3) Cu, Ni, Fe
(4) Cu, Sn, Fe

**Ans. (1)**

**20.** Arrange the following in the correct order of ionisation potential

Mg, Al, Si, P, S

**Ans.** Al < Mg < Si < S < P

**Sol.** Theory

**21.** $Cl_{2(g)} \rightleftharpoons 2Cl_{(g)}$

For the given reaction at equilibrium moles of $Cl_{2(g)}$ is equal to the moles of $Cl_{(g)}$ and equilibrium pressure is 1atm. if $K_p$ of this reaction is $x \times 10^{-1}$. Find x

**Ans.** **(5)**

**Sol.**         $Cl_2 \rightleftharpoons 2Cl$

Moles    x          x
at eq$^n$

P.P.    $\dfrac{1}{2}$       $\dfrac{1}{2}$

$K_P = \dfrac{P_{Cl}^2}{P_{Cl_2}}$

$= \dfrac{\left(\dfrac{1}{2}\right)^2}{\dfrac{1}{2}} = \dfrac{1}{2} = 0.5$

$= 5 \times 10^{-1}$

$x = 5$

**22.** $S_8 + b\,OH^- \longrightarrow c\,S^{2-} + d\,S_2O_3^{2-} + H_2O$

Find the value of c.

**Ans.** **(4)**

**Sol.** $S_8 + 12\,OH^- \longrightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$

**23.** Calculate time taken in seconds for 40% completion of first order reaction if rate constant is $3.3 \times 10^{-4}$ sec$^{-1}$.

**Ans.** 1535.3

**Sol.** $t = \dfrac{2.303}{K} \log \dfrac{100}{100 - x}$

$= \dfrac{2.303}{3.3 \times 10^{-4}} \log \dfrac{100}{100 - 40}$

$= \dfrac{2.303}{3.3 \times 10^{-4}} \times 0.22$

$= 1535.3$ sec.

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**24.** For a chemical reaction $K_{eq}$ is 100 at 300K, the value of $\Delta_r G$ is $-xR$ Joule at 1 atm pressure. Find the value of x. (Use ln 10 = 2.3)

**Ans.** 1380

**Sol.** $\Delta_r G° = - RT\ln K_{eq}$

$= -R \times 300 \times 2 \times 2.3$

$= -1380\ R$

**25.** $Cu^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)]^{2+}$          $K_1 = 10^4$

$[Cu(NH_3)]^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_2]^{2+}$       $K_2 = 1.58 \times 10^3$

$[Cu(NH_3)_2]^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_3]^{2+}$      $K_3 = 5 \times 10^2$

$[Cu(NH_3)_3]^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}$      $K_4 = 10^2$

Dissociation constant of $[Cu(NH_3)_4]^{2+}$ is $x \times 10^{-12}$.

Determine x

**Ans.** 1.26 (Nearest integer = 1 )

**Sol.** $[Cu(NH_3)_4]^{2+} \rightleftharpoons Cu^{2+} + 4NH_3$

$K = \dfrac{1}{K_1 K_2 K_3 K_4} = \dfrac{1}{10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2}$

$= 1.26 \times 10^{-12} = 1.26$

**26.** $CH_2ClCOOH$ is dissolved in 500ml of $H_2O$ solution and depression in freezing point of solution is 0.5°C

Find percentage dissociation .

$(K_f)_{H_2O} = 1.86\,k\,kg\,mole^{-1}$

**Ans.** (7.5)

**Sol.** $\Delta T_f = i \times K_f \times m$

$0.5 = (1+\alpha) \times 1.86 \times \dfrac{9.45 \times 1000}{94.5 \times 500}$

$\Rightarrow (1+\alpha) = 1.075$

$\Rightarrow \alpha = 0.075$

$\Rightarrow \alpha = 7.5\%$

**27.** What is the coordination number in Body centered cubic (BCC) arrangement of identical particles

**Ans.** 8

**Sol.** Theory

**28.** Among the following compounds how many are amphoteric in nature

$Be(OH)_2$, $BeO$, $Ba(OH)_2$, $Sr(OH)_2$

**Ans.** 2

**Sol.** $Be(OH)_2$, $BeO$

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**29.** 4.5 gm of solute having molar mass of 90 gm/mol is dissolved in water to make 250 ml solution. Calculate molarity of the solution

**Ans.** **0.2**

**Sol.** $M = \dfrac{n}{V} = \dfrac{4.5/90}{250/1000} = 0.2$

**30.** Mass of $Li^{3+}$ is 8.33 times mass of proton $Li^{3+}$ and proton are accelerated through same potential difference. Then ratio of debroglie's wavelength of $Li^{3+}$ to proton is $x \times 10^{-1}$. Find x

**Ans.** **2**

**Sol.** $\lambda_{DB} \, \alpha \, \dfrac{1}{\sqrt{m.K.E.}}$

$\dfrac{\lambda_{Li^{3+}}}{\lambda_P} = \sqrt{\dfrac{m_p \times e_p V}{8.33 m_p \times 3 e_p V}}$

$\sqrt{\dfrac{1}{25}} = \dfrac{1}{5} = 0.2 = 2 \times 10^{-1}$

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