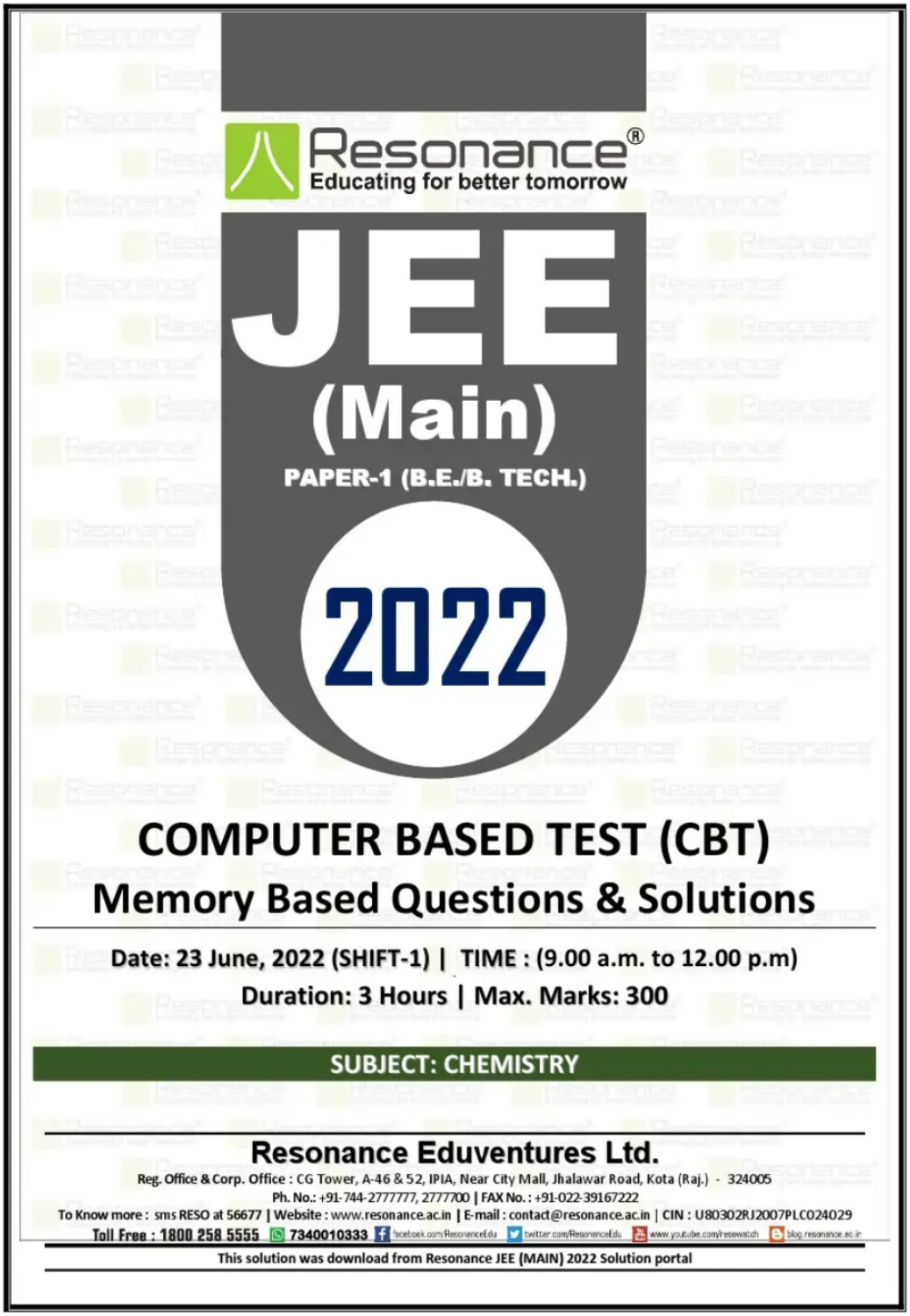





## PART : CHEMISTRY

**1** Most stable trihahide from $NF_3$, $NBr_3$, $NCl_3$, & $NI_3$ is

(1) $NF_3$ (2) $NCl_3$ (3) $NCl_3$ (4) $NI_3$

**Ans.** (1)

**Sol.** $NF_3$ is stable while $NCl_3$, $NBr_3$, $NI_3$ are explosive

**2** Atom 'X' arranged in HCP unit cell while Y atom occupy $\frac{2}{3}$ tetrahedral voids then % of X in unit cell.

[Report your answer to nearest integer]

**Ans.** (43)

**Sol.** X = 6[HCP unit cell]

$Y = \frac{2}{3} \times [TV] = \frac{2}{3} \times 12 = 8$

Formula= $X_6Y_8 \Rightarrow X_3Y_4$

% of × in unit cell = $\frac{3}{7} \times 10$

$= 42.857 \approx 43$

**3** which set of quantum number represent degenerate orbital

(a) $n = 3, \ell = 2, m = o, s = \frac{-1}{2}$ & $n = 3, \ell = 2\ m = -1\ s = \frac{+1}{2}$

(b) $n = 2, \ell = 1, m = 1, s = \frac{-1}{2}$ & $n = 3, \ell = 1\ m = 1\ s = \frac{+1}{2}$

(c) $n = 4, \ell = 2, m = -1, s = \frac{1}{2}$ & $n = 3, \ell = 2\ m = -1\ s = \frac{1}{2}$

(1) a (2) b (3) c (4) a, b

**Ans.** (1)

**Sol.** The orbitals with same n & $\ell$ value but with different m value are degenerate

**4.** Emf of the following cell

$Pt(s) \mid H_2(g)\ (1\ atm) \mid H^+(aq) \mid Cu^{2+}\ (0.01\ M) \mid Cu(s)$ is 0.576 V

then find pH of anodic half-cell given

$E^\circ_{Cu^{2+}|Cu} = 0.34\ V$ & $\frac{2.303RT}{F} = 0.06$

[Report your answer to nearest integer]

**Ans.** (5)





**Sol.** Anode $\Rightarrow H_2(g) \longrightarrow 2H^+(aq) + 2e^-$

Cathode $\Rightarrow \underline{Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)}$

Overall $\Rightarrow \underline{H_2(g) + Cu^{2+}(aq) \longrightarrow 2H^+(aq) + Cu(s)}$

$E^\circ_{cell} = E^\circ_{Cu^{2+}|Cu} - E^\circ_{H^+|H_2} = 0.34\ V$

$E_{cell} = E^\circ_{cell} - \frac{0.06}{2} \log \frac{[H^+]^2}{[Cu^{2+}]}$

$0.576 = 0.34 + 0.03\ [-\log[H^+]^2 + \log[Cu^{2+}]$

$0.576 = 0.34 + 0.03\ [2pH + \log[Cu^{2+}]]$

$0.236 = 0.03\ [2pH - 2]$

$7.866 = 2pH - 2$

$pH = 4.93 \approx 5$

**5.** $C_{15}H_{30}$ is used as rocket fuel then find mass of oxygen used for per lit consumption of $C_{15}H_{30}$ also find mass of $CO_2$ produced. Given density of $C_{15}H_{30} = 0.756$ gram/ml

(1) 2592 gram, 2376 gram (2) 2376 gram, 2592 gram

(3) 2592 gram, 2868 gram (4) 2868 gram, 2776 gram

**Ans.** (1)

**Sol.** density = $\frac{mass}{}$

volume

mass of $C_{15}H_{30}$ = d × V = 0.756 × 1000 = 756 gram

$$C_{15}H_{30}(\ell) + \frac{45}{2}O_2(g) \longrightarrow 15CO_2(g) + 15H_2O$$

$$\frac{756}{210} \qquad \frac{45}{2}\left[\frac{756}{210}\right]\text{mole} \qquad 15\left[\frac{756}{210}\right]$$

$$W_{O_2} = \frac{45}{2}\left[\frac{756}{210}\right]32 = 2592 \text{ gram}$$

$W_{CO_2}$ = 2376 gram

**6.** What is concentration of a glucose solution in interavenous injection in gram/lit which is isotonic with Blood solution which has osmotic pressure 7.93 bar at 300 K.
[Report your answer to nearest integer]

**Ans.** (58)





**Sol.** For isotonic solution

$\pi_{Injection} = \pi_{Blood}$

(CRT) = 7.93

C × 0.082 × 300 = 7.93

C = 0.322 mole/lit

= 0.322 × 180 = 58 gram/lit

**7** Which ion is not present in teeth enamel

(1) $Ca^{2+}$ (2) $F^-$ (3) $P^{3+}$ (4) $P^{5+}$

**Ans.** (3)

**Sol.** Calcium and phosphate are the major component of hydroxyapatite crystal that form the inorganic portion of the teeth

**8** How many of the following oxides are amphoteric in nature?

(a) $Na_2O$ (b) $As_2O_3$ (c) NO

(d) $N_2O$ (e) $Cl_2O_7$

(1) O (2) 1 (3) 2 (4) 3

**Ans.** (2)

**Sol.** Acidic ⇒ $Cl_2O7$

Basic ⇒ $Na_2O$

Amphoteric ⇒ $As_2O_3$

Neutral ⇒ NO, $N_2O$

**9.** A cation $Y^{2+}$ on reaction with reagent X form Red colour complex then cation $Y^{2+}$ and reagent X are respectively :

(1) $Ni^{2+}$, ammonical solution of dimethylglyoxime

(2) $Cu^{2+}$, $K_4[Fe(CN)_6]$

(3) $Fe^{3+}$, $K_4[Fe(CN)_6]$

(4) $Zn^{2+}$, $NH_3(aq)$ (excess)

**Ans.** (1)

**Sol.** $Ni^{2+} + dmg \xrightarrow[\text{Red colour}]{\text{Ammonical Solution}} [Ni(dmg)_2]\downarrow$

**10.** Which is used for commercial production of dihydrogen.

(1) Carbon (2) Oxygen (3) Chlorine (4) Nitrogen

**Ans.** (1)





**Sol.** Reaction of steam on coke at high temperature in presence of catalyst yield hydrogen

$$C(s) + H_2O(g) \xrightarrow{1270\ K} Co(g) + H_2(g)$$

**11.** Match the Column.

| | Column I | | Column II |
|---|---|---|---|
| | **Compound** | | **Hybridisation** |
| (i) | $PC\ell_5$ | (a) | $SP^3d^2$ |
| (ii) | $[Pt(CN)_4]^{2+}$ | (b) | $SP^3d$ |
| (iii) | $[Co(NH_3)_6]^{3+}$ | (c) | $d^2SP^3$ |
| (iv) | $BrF_5$ | (d) | $dSP^2$ |

Correct matching is :

| | I | II | III | IV | | I | II | III | IV |
|---|---|---|---|---|---|---|---|---|---|
| (1) | b | d | c | a | (2) | a | b | c | d |
| (3) | b | d | a | c | (4) | d | b | a | c |

**Ans.** (1)

**Sol.**

| | Compound | | Hybridisation |
|---|---|---|---|
| (1) | $PC\ell_5$ | (a) | $SP^3d$ |
| (2) | $[Pt(CN)_4]^{2+}$ | (b) | $dSP^2$ |
| (3) | $[Co(NH_3)_6]^{3+}$ | (c) | $d^2SP^3$ |
| (4) | $BrF_5$ | (d) | $SP^3d^2$ |

**12.** An $Co_2(CO)_8$

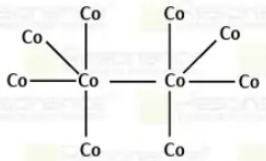
no. of Co–Co bonds = X

Terminal Co–CO bonds = Y

then (X+Y) is _____.

**Ans.** (9)

**Sol.** $Co_2(CO)_8$




No. of Co – Co bond = X = 1

No. of Co – Co bond = Y = 8

X + Y = 9

**13** Match the List,

| | List I | | List II |
|---|---|---|---|
| (i) | Calamine | (a) | ZnS |
| (ii) | Sphalarite | (b) | $ZnCO_3$ |
| (iii) | Galena | (c) | PbS |
| (iv) | Siderite | (d) | $FeCO_3$ |

Identity correct match :

| | I | II | III | IV | | I | II | III | IV |
|---|---|---|---|---|---|---|---|---|---|
| (1) | a | b | c | d | (2) | b | a | c | d |
| (3) | b | a | d | c | (4) | d | c | b | a |

**Ans.** (2)

**Sol.**

| | |
|---|---|
| Calamine | $ZnCO_3$ |
| Sphalarite | ZnS |
| Galena | PbS |
| Siderite | $FeCO_3$ |

**14.** Among the following statements correct set of statements is.

(a) $B_2H_6$ is Lewis acid

(b) $B_2H_6$ has planar structure

(c) All B–H Bond lengths are equal in $B_2H_6$

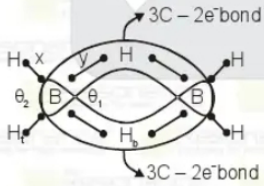
(d) In $B_2H_6$ four 3C–$2e^-$ bonds are present

(e) $B_2H_6$ can be prepared by reaction of $BF_3$ and $NaBH_4$

(1) a, b, c, d, e (2) a, e (3) a, b (4) d, e

**Ans.** (2)

**Sol.**




$B_2H_6$ have 4 2c-2e bonds and 2 3c-2e bonds. Bridging bonds have larger bond length than terminal bonds. Angle between terminal bonds is more than angle between bridging bonds if all 4 terminal bonds are in one plane then bridging bonds are in perpendicular plane.

$3NaBH_4 + 4BF_3 \xrightarrow[450\,K]{\text{ether}} 3NaBF_4 + 2B_2H_6$





**15** $S_1$ : In emulsion oil in water get separated in two different layers.

$S_2$ : It can be stabilized by adding excess of electrolyte.

(1) $S_1$ is true and $S_2$ is false

(2) Both statements are true

(3) Both statements are false

(4) $S_1$ is false and $S_2$ is true

**Ans.** (1)

**Sol.** Emulsions of oil in water are unstable and sometimes they separate into two layers on standing. For stabilisation of an emulsion, a third component called emulsifying agent is usually added

**16** For a equilibrium reaction

$$A \rightleftharpoons B + \frac{1}{2}C$$

correct relation between degree of dissociation equilibrium pressure and equilibrium constant is :

(1) $\frac{\sqrt{2}(\alpha)^{\frac{3}{2}}P^{\frac{1}{2}}}{(1-\alpha)(2+\alpha)^{\frac{1}{2}}}$ (2) $\frac{\sqrt{2}(\alpha)P}{(1-\alpha)(2+\alpha)}$ (3) $\frac{\sqrt{2}(\alpha)P\frac{1}{2}}{(1-\alpha)(2+\alpha)^{\frac{1}{2}}}$ (4) $\frac{2\alpha P}{(1-\alpha)(2+\alpha)}$

**Ans.** (1)

**Sol.**

| | $A \rightleftharpoons$ | B + | $\frac{1}{2}C$ |
|---|---|---|---|
| Initially | 1 | 0 | 0 |
| | $(1-\alpha)$ | $\alpha$ | $\frac{\alpha}{2}$ |

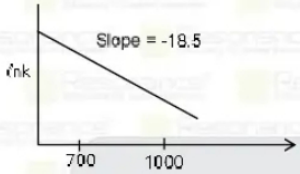
$$n_{Total} = \left(1+\frac{\alpha}{2}\right)$$

$$K_p = \frac{\left[\frac{\alpha}{1+\frac{\alpha}{2}}P\right]\left[\left(\frac{\alpha}{1+\frac{\alpha}{2}}\right)P\right]^{\frac{1}{2}}}{\left[\frac{1-\alpha}{1+\frac{\alpha}{2}}P\right]} = \frac{\left[\frac{2\alpha}{(2+\alpha)}P\right]\left[\frac{2\alpha}{2+\alpha}P\right]^{\frac{1}{2}}}{\left[\frac{2(1-\alpha)}{(2+\alpha)}P\right]} = \frac{\alpha}{(1+\alpha)} \times \left(\frac{2\alpha}{(2+\alpha)} \times P\right)^{\frac{1}{2}} = \frac{\sqrt{2}(\alpha)^{\frac{3}{2}}P^{\frac{1}{2}}}{(1-\alpha)(2+\alpha)^{\frac{1}{2}}}$$





**17.** For a 1st order reaction following graph is obtained between $\ell$nk and $\frac{1000}{T}$. Then activation energy of reaction in kcal is :




**Ans.** (37)

**Sol.** $k = Ae^{\frac{-Ea}{Rt}}$

$$\ell nk = \ell nA - \frac{E_a}{R_T}$$

$$\ell nk = \ell nA + \left[\frac{-E_a}{1000R}\right]\frac{1000}{T}$$

$$\text{Slope} = \frac{-E_a}{1000R} = -18.5$$

$E_a = 18.5 \times 1000 \times 2$

$= 37 \times 10^3 Cal$

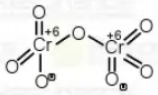
$= 37$ kCal

**18** The difference between oxidation state of chromium in chromate & dichromate is –

**Ans.** (0)

**Sol.** Chromate ⇒ $CrO_4^{2-}$

Dichromate ⇒ $Cr_2O_7^{2-}$



**19.** Which of the following is not a broad spectrum antibiotic

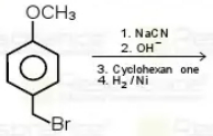
(1*) Penicillin G (2) Ofloxacin (3) Amoxicillin (4) Chloramphenicol

**Ans.** (1)

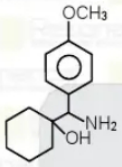




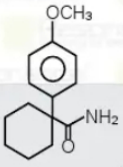
**20.**



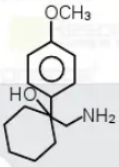
(1)



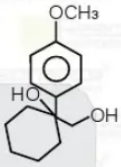
(2)



(3)

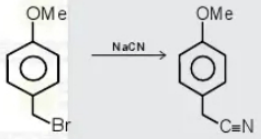


(4)



**Ans.** (1)

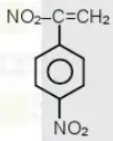
Sol.



**21.** $C_8H_{10} \xrightarrow[H_2SO_4]{HNO_3} A \xrightarrow[\Delta]{Br_2} B \xrightarrow[KOH]{\text{alcoholic}} C$

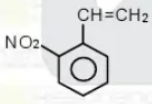
What is major product C.

(1)

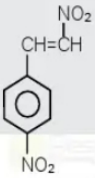


(2*)

(3)

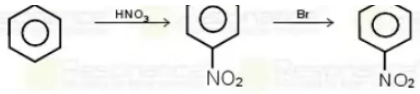


(4)



**Ans.** (2)

**Sol.**








**22.** Which of following will form polyester

(1) β-Hydroxy butanoic acid & β-hydroxy pentanoic acid

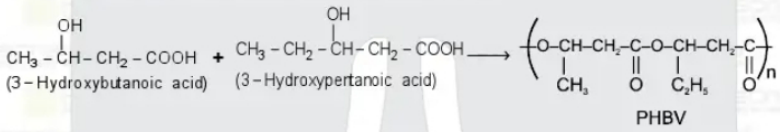
(2) Butadiene & styrene

(3) Neoprene

(4) Melamine formaldehyde

**Ans.** (1)

**Sol.** Poly β-hydroxybutyrate-co-β-hydroxy valerate (PHBV) : **It is obtained by the copolymerisation of 3-hydroxybutanoic acid and 3-hydroxypentanoic acid.**




PHBV

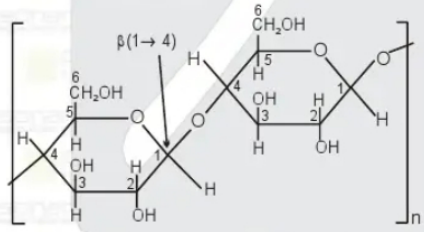
PHBV is used in speciality packaging, orthopaedic devices and in controlled release of drugs. PHBV undergoes bacterial degradation in the environment.

**23.** Compound 'A' hydrolysis gives compound 'B' which on reaction with $Br_2$ water to form gluconic acid. 'A' originally has β-glycosidic linkages. Which of the following is compound A

(1) Starch (2) Cellulose (3) Amylose (4) Amylopection

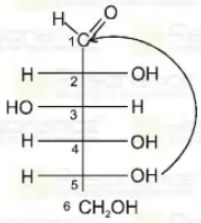
**Ans.** (2)

Sol. **Cellulose, $(C_6H_{10}O_5)_n$**

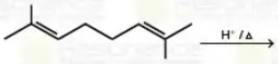



1,4-Glycosidic linkage of β-D-Glucose

Cellulose

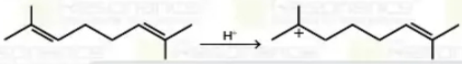



**D-Glucose**
**Specific rotation (+52.7°)**

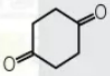
**24.** 2, 7 Dimethyl 2,6 Octadiene $\xrightarrow{O/\Delta}$ 

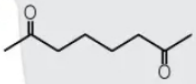
Number of $sp^2$ carbon present in product :

**Ans.** (2)

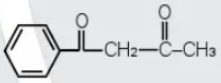
**Sol.** 

**25.** Which of the following is conjugated diketone

(1) 

(2) 

(3) 

(4) 

**Ans.** (3)