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CHEMISTRY

1. If the shortest wavelength in Lyman series of hydrogen atom is A, then the longest wavelength in Paschen series of He^+ is :

(1) $\dfrac{5A}{9}$ (2) $\dfrac{36A}{7}$ (3) $\dfrac{36A}{5}$ (4) $\dfrac{9A}{5}$

Sol. **2**

Shortest wavelength is corresponding to best ine

∴ $n_L = 1$ (Lyman series)

$n_H = \infty$ (infinite)

$\dfrac{1}{A} = r \times (1)^2 \left\{ \dfrac{1}{1^2} - \dfrac{1}{\infty^2} \right\} = R$

Longest wavelength ≡ 1st Line

∴ = 3 $n_H = 4$

$\dfrac{1}{\lambda} = r \times (2)^2 \left\{ \dfrac{1}{3^2} - \dfrac{1}{4^2} \right\} = \dfrac{r \times 7}{36}$

$\lambda = \dfrac{36A}{7}$

2. Among the following, the essential amino acid is :

(1) Valine   (2) Alanine   (3) Serine   (4) Aspartic acid
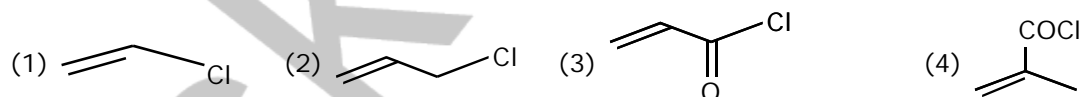
Sol. **1**

3. Identify the pollutant gases largely responsible for the discoloured and lustreless nature of marble of the Taj Mahal.

(1) SO_2 and O_3 (2) O_3 and CO_2 (3) SO_2 and NO_2 (4) CO_2 and NO_2

Sol. **3**

SO_2 and NO_2

4. Which of the following compounds will not undergo Friedel Craft's reaction with benzene ?

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

Sol. **1**

Formation of carbocation is not possible in case of $CH_2 = CHCl$

5. Which of the following is paramagnetic ?

(1) CO   (2) NO^+ (3) O_2^{2-} (4) B_2

Sol. **4**

No of e^-

CO = 14, NO^+ = 14

O_2^{2-} = 18 B_2 = 10

According to MOT

B_2 is paramagnetic

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6. The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A.

(1) 4.92 K   (2) 9.84 K   (3) 19.67 K   (4) 2.45 K

Sol. **1**

$$2 = \frac{Eq}{R}\left\{\frac{1}{300} - \frac{1}{310}\right\} \quad \ldots (i)$$

$$2 = e^{2\frac{Ea}{R}\left\{\frac{1}{300} - \frac{1}{T}\right\}} \quad \ldots (ii)$$

$$\frac{2Ea}{R}\left\{\frac{1}{300} - \frac{1}{T}\right\} = \frac{E_a}{R}\left\{\frac{1}{300} - \frac{1}{310}\right\}$$

$$\frac{1}{300} + \frac{1}{310} = \frac{2}{T} \Rightarrow T = \frac{300 \times 310}{610} \times 2$$

$$= 304.92$$

7. A solution containing a group-IV cation gives a precipitate on passing, H_2S. A solution of this precipitate in dil. HCl produces a white precipitate with NaOH solution and bluish-white prcipitate with basic potassium ferrocyanide. The cation is :

(1) Mn^{2+} (2) Zn^{2+} (3) Ni^{2+} (4) Co^{2+}

Sol. **2**

$$ZnS \xrightarrow{HCl} ZnCl_2 \xrightarrow{NaOH} Zn(OH)_2$$
$$\downarrow k_4[Fe(CN)_6]$$
$$Zn_2[Fe(CN)_6]$$
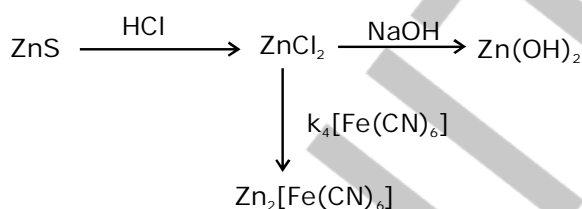
8. Which of the following statements is not true about partition chromatography ?

(1) Stationary phase is a finely divided solid adsorbent

(2)Separation depends upon equilibration of solute between a mobile and a stationary phase

(3) Paper chromatography is an example of partition chromatography

(4) Mobile phase can be a gas

Sol. **4**

9. Excess of NaOH (aq) was added to 100 mL of $FeCl_3$ (aq) resulting into 2.14 g of $Fe(OH)_3$. The molarity of $FeCl_3$(aq) is :

(Given molar mass of Fe = 56 g mol^{-1} and molar mass of Cl = 35.5 g mol^{-1})

(1) 0.3 M   (2) 0.2 M   (3) 0.6 M   (4) 1.8 M

Sol. **2**

$3NaOH + FeCl_3 \rightarrow Fe (CH)_3 + NaCl$

           100 ml   2.14 gm

           m = ?
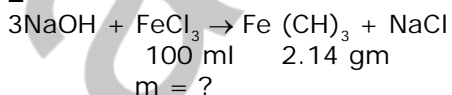
Moles of $Fe(CH_3) = \frac{2.14}{107} = 2 \times 10^{-2}$ mol

moles $FeCl_3 = 2 \times 10^{-2}$ mol

$M = \frac{2 \times 10^{-2}}{100} \times 1000 = 0.2$ M

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10. 5 g of Na_2SO_4 was dissolved in x g of H_2O. The change in freezing point was found to be 3.82°C. If Na_2SO_4 is 81.5% ionised, the value of x
(K_f for water = 1.86°C kg mol^{-1}) is approximately :
(molar mass of S = 32 g mol^{-1} and that of Na = 23 g mol^{-1})
(1) 25 g   (2) 65 g   (3) 15 g   (4) 45 g

Sol. **4**

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$
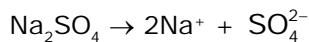
x = 1 + (3 − 1) 0.815 = 2.63

$3.82 = 1.86 \times 2.63 \times \dfrac{5 \times 1000}{142 \times x}$

$\therefore x = \dfrac{1.86 \times 2.63 \times 5000}{142 \times 3.82}$

= 45 gm

11. Consider the following standard electrode potentials (E° in volts) in aqueous solution :

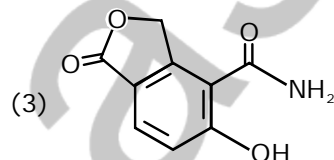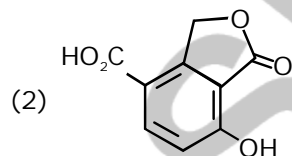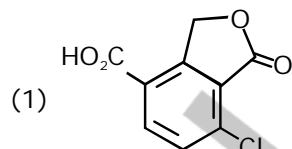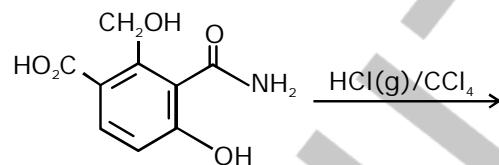| Element	M^{3+}/M	M^+/M
Al	−1.66	+ 0.55
Tl	+ 1.26	−0.34

Based on these data, which of the following statements is correct ?
(1) Tl^{3+} is more stable than Al^{3+} (2) Al^+ is more stable than Al^{3+}
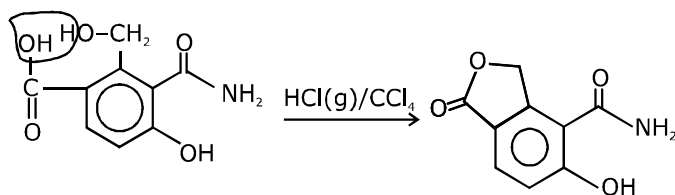(3) Tl^{3+} is more stable than Al^{3+} (4) Tl^+ is more stable than Al^+

Sol. **4**
ΔG is –ve

12. The major product expected from the following reaction is :

$\xrightarrow{HCl(g)/CCl_4}$

(1)

(2)

(3)

(4)

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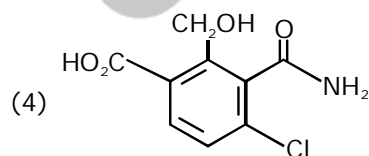
Sol. **3**

13. Among the following, the incorrect statement is :
(1) At low pressure, real gases show ideal behaviour.
(2) At very low temperature, real gases show ideal behaviour.
(3) At Boyle's temperature, real gases show idela behaviour.
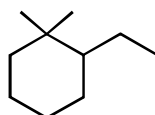(4) At very large volume, real gases show ideal behaviour.

Sol. **2**

14. The pair of compounds having metals in their highest oxidation state is :
(1) MnO_2 and CrO_2Cl_2 (2) $[Fe(CN)_6]^{3-}$ and $[Cu(CN)_4]^{2-}$
(3) $[NiCl_4]^{2-}$ and $[CoCl_4]^{2-}$ (4) $[FeCl_4]^-$ and Co_2O_3

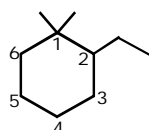**Sol.** **1**
$MnO_2 = +4$
$CrO_2Cl_2 = +6$
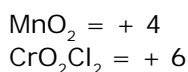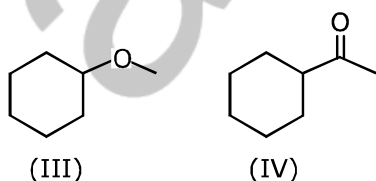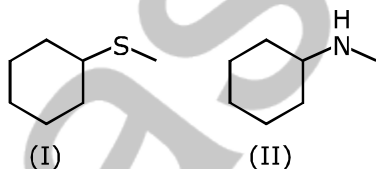
15. The IUPAC name of the following compound is

(1) 2-Ethyl-1, 1-dimethylcyclohexane
(2) 1, 1-Dimethyl 1-2-ethylcyclohexane
(3) 2, 2-Dimethyl-1-1-ethylcyclohexane
(4) 1-Ethyl-2,2-dimethylcyclohexane

Sol. **1**

16. A mixture containing the following four compounds is extracted with 1 M HCl. The compound that goes to aqueous layer is :

(I)   (II)

(III)   (IV)
(1) IV   (2) II   (3) I   (4) III

Sol. **2**

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17. Consider the following ionization enthalpies of two elements 'A' and 'B'.

| Element	Ionization enthalpy (kJ/mol)		
	1st	2nd	3rd
A	899	1757	14847
B	737	1450	7731

Which of the following statements is correct?
(1) Both 'A' and 'B' belong to group-1 where 'A' comes below 'B'.
(2) Both 'A' and 'B' belong to group-2 where 'A' comes below 'B'.
(3) Both 'A' and 'B' belong to group-1 where 'B' comes below 'A'.
(4) Both 'A' and 'B' belong to group-2 where 'B' comes below 'A'.

Sol. **4**

18. sp^3d^2 hybridization is not displayed by :
(1) SF_6 (2) BrF_5 (3) PF_5 (4) $[CrF_6]^{3-}$

Sol. **3**
$SF_6 = Sp^3d^2$ $BrF_5 = SP^3d^2$
$[CrF_6]^{3-} = sp^3d^2$ $PFs = sp^3d$
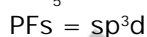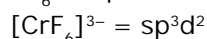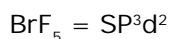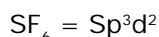
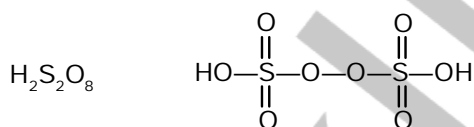**19.** The number of S = O and S–OH bonds present in peroxodisulphuric acid and pyrosulphuric acid respectively are :
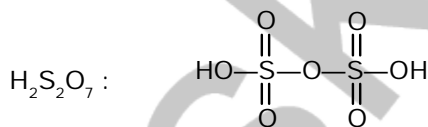(1) (2 and 4) and (2 and 4)   (2) (4 and 2) and (4 and 2)
(3) (4 and 2) and (2 and 4)   (4) (2 and 2) and (2 and 2)
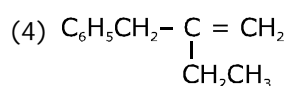
Sol. **2**
Peroxodisulphuric acid

$$H_2S_2O_8 \qquad \begin{array}{c} O \quad\quad O \\ \parallel \quad\quad \parallel \\ HO-S-O-O-S-OH \\ \parallel \quad\quad \parallel \\ O \quad\quad O \end{array}$$

Pyrosulphuric acid

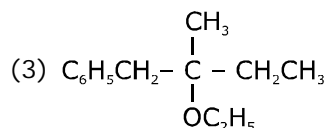$$H_2S_2O_7 : \qquad \begin{array}{c} O \quad\quad O \\ \parallel \quad\quad \parallel \\ HO-S-O-S-OH \\ \parallel \quad\quad \parallel \\ O \quad\quad O \end{array}$$
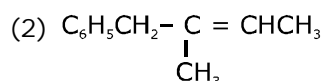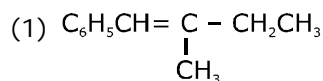
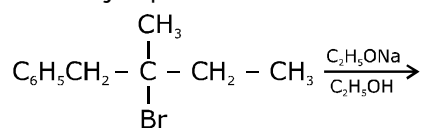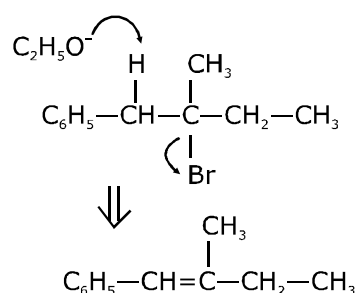**20.** Among the following, correct statement is :

(1) Sols of metal sulphides are lyophilic.

(2) Brownian movement is more pronounced for smaller particles than for bigger-particles

(3) One would expect charcoal to adsorb chlorine more than hydrogen sulphide.

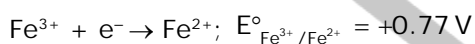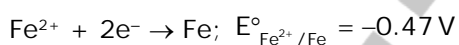(4) Hardy Schulze law states that bigger the size of the ion is, the greater is its coagulating power.

Sol. **3**

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21. The major product of the following reaction is :

$$C_6H_5CH_2 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 \xrightarrow[C_2H_5OH]{C_2H_5ONa}$$

(1) $C_6H_5CH= \underset{\underset{CH_3}{|}}{C} - CH_2CH_3$

(2) $C_6H_5CH_2- \underset{\underset{CH_3}{|}}{C} = CHCH_3$

(3) $C_6H_5CH_2- \underset{\underset{OC_2H_5}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2CH_3$

(4) $C_6H_5CH_2- \underset{\underset{CH_2CH_3}{|}}{C} = CH_2$

Sol. **1**

22. What is the standard reduction potential ($E°$) for $Fe^{3+} \rightarrow Fe$?
Given that :

$Fe^{2+} + 2e^- \rightarrow Fe;\ E°_{Fe^{2+}/Fe} = -0.47\,V$

$Fe^{3+} + e^- \rightarrow Fe^{2+};\ E°_{Fe^{3+}/Fe^{2+}} = +0.77\,V$

(1) -0.057 V
(2) $+ 0.30$ V
(3) $- 0.30$ V
(4) $+ 0.057$ V

Sol. **1**

23. The reason for "drug induced poisoning" is :
(1) Binding irreversibly to the active site of the enzyme
(2) Binding at the allosteric sites of the enzyme
(3) Binding reversibly at the active site of the enzyme
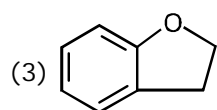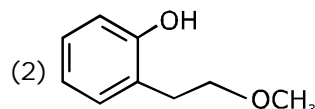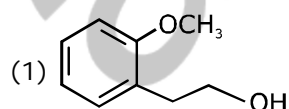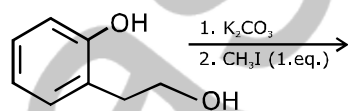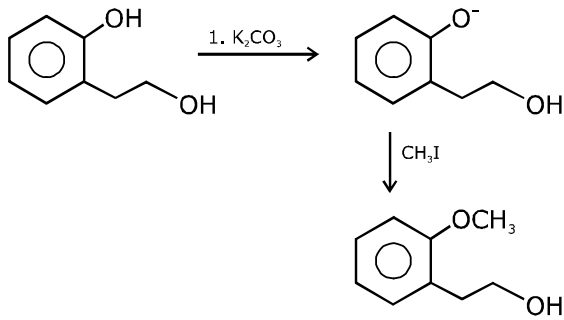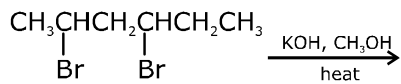(4) Bringing conformational change in the binding site of enzyme

Sol. **2**

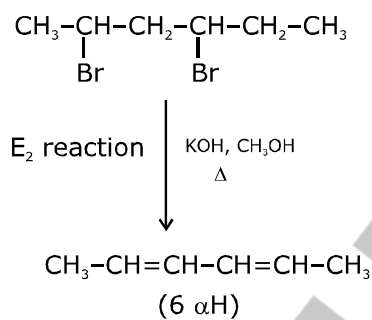**24.** The major product of the following reaction is :

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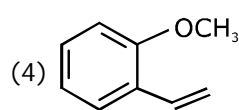
Sol. 1

25. The major product of the following reaction is :

$$\underset{\underset{Br}{\vert}}{CH_3CHCH_2}\underset{\underset{Br}{\vert}}{CHCH_2CH_3} \xrightarrow[\text{heat}]{KOH, CH_3OH}$$

(1) $CH_3CH = CH - CH = CHCH_3$

(2) $CH_2 = CHCH = CHCH_2CH_3$

(3) $CH_3CH = C = CHCH_2CH_3$

(4) $CH_2 = CHCH_2CH = CHCH_3$

Sol. 1

$$\underset{\underset{Br}{\vert}}{CH_3-CH}-CH_2-\underset{\underset{Br}{\vert}}{CH}-CH_2-CH_3$$

E_2 reaction $\Bigg\downarrow \begin{array}{c} KOH, CH_3OH \\ \Delta \end{array}$

$$CH_3-CH=CH-CH=CH-CH_3$$
$$(6\ \alpha H)$$

26. In which of the following reactions, hydrogen peroxide acts as an oxidizing agent ?

(1) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(2) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

(3) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(4) $2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

Sol. 3

$$\underset{+2}{PbS} + 4H_2O_2 \longrightarrow \underset{+4}{PbSO_4} + 4H_2O$$

27. For a reaction, $A(g) \rightarrow A(\ell)$; $\Delta H = -3RT$.

The correct statement for the reaction is :

(1) $\Delta H = \Delta U = 0$

(2) $|\Delta H| < |\Delta U|$

(3) $|\Delta H| > |\Delta U|$

(4) $\Delta H = \Delta U \neq 0$

Sol. 3

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28. The enthalpy change on freezing of 1 mol of water at 5°C to ice at –5°C is :

(Given $\Delta_{fus} H = 6$ kJ mol^{-1} at 0°C,

$C_p(H_2O, \ell) = 75.3$ J mol^{-1} K^{-1},

$C_p (H_2O, s) = 36.8$ J mol^{-1} K^{-1})

(1) 6.00 kJ mol^{-1} (2) 5.81 kJ mol^{-1}

(3) 5.44 kJ mol^{-1} (4) 6.56 kJ mol^{-1}

Sol. **D**

29. Addition of sodium hydroxide solution to a weak acid (HA) results in a buffer of pH 6. If ionisation constant of HA is 10^{-5}, the ratio of salt to acid concentration in the buffer solution will be :

(1) 10 : 1   (2) 4 : 5   (3) 5 : 4   (4) 1 : 10

Sol. **1**

30. A metal 'M' reacts with nitrogen gas to afford 'M_3N'. 'M_3N' on heating at high temperature gives back 'M' and on reaction with water produces a gas 'B'. Gas 'B' reacts with aqueous solution of $CuSO_4$ to form a deep blue compound. 'M' and 'B' respectively are :

(1) Li and NH_3 (2) Na and NH_3 (3) Ba and N_2 (4) Al and N_2

Sol. **1**

$Li + N_2 \longrightarrow Li_3N$

$\downarrow H_2O$

$LiOH + NH_3$

$\downarrow COSO_4$

$[Cu(NH_3)_4] SO_4$