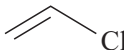
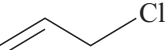
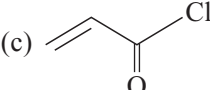



JEE (Main) Chemistry

Online Solved Paper 1—2017

- If the shortest wavelength in Lyman series of hydrogen atom is A , then the longest wavelength in Paschen series of He^+ is
 (a) $5A/9$ (b) $36A/7$ (c) $36A/5$ (d) $9A/5$
- Among the following, the essential amino acid is
 (a) Valine (b) Alanine (c) Serine (d) Aspartic acid
- Identify the pollutant gases largely responsible for the discoloured and lustreless nature of marble of the Taj Mahel.
 (a) SO_2 and O_3 (b) O_3 and CO_2 (c) SO_2 and NO_2 (d) CO_2 and NO_2
- Which of the following compounds will not undergo Friedel-Craft's reaction with benzene?
 (a)  (b)  (c)  (d) 
- Which of the following is paramagnetic?
 (a) CO (b) NO^+ (c) O_2^{2-} (d) B_2
- The rate of a reaction A doubles on increasing temperature from 300 K to 310 K. By how much the temperature of reaction B should be increased from 300 K that rate doubles if activation energy of the reaction B is twice that of a reaction A?
 (a) 4.92 K (b) 9.84 K (c) 19.67 K (d) 2.45 K
- A solution containing a group-IV cation gives a precipitate on passing H_2S . A solution of this precipitate in dilute HCl produces a white precipitate with NaOH solution and bluish-white precipitate with potassium ferrocyanide. The cation is
 (a) Mn^{2+} (b) Zn^{2+} (c) Ni^{2+} (d) Co^{2+}
- Which of the following statements is not true about partition chromatography?
 (a) Stationary phase is a finely divided solid adsorbent.
 (b) Separation depends upon equilibrium of solute between a mobile and a stationary phase
 (c) Paper chromatography is an example of partition chromatography
 (d) Mobile phase can be a gas
- Excess of $\text{NaOH}(\text{aq})$ was added to 100 mL of $\text{FeCl}_3(\text{aq})$ resulting into 2.14 g of $\text{Fe}(\text{OH})_3$. The molarity of $\text{FeCl}_3(\text{aq})$ is:
 (a) 0.3 M (b) 0.2 M (c) 0.6 M (d) 1.8 M
- 5 g of Na_2SO_4 was dissolved in the mass x 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 is ($K_f(\text{water}) = 1.86^\circ\text{C kg mol}^{-1}$).
 (a) 25 g (b) 65 g (c) 15 g (d) 45 g

JEEC.2 Complete Chemistry—JEE Main

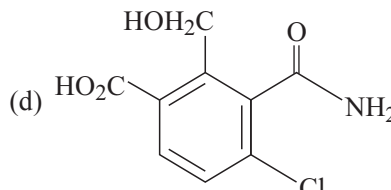
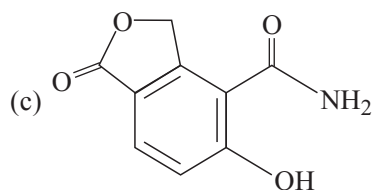
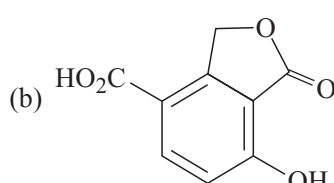
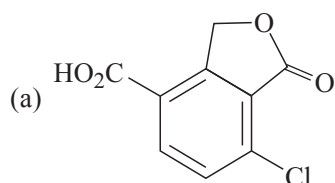
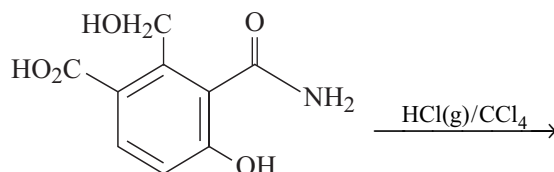
11. Consider the following standard electrode potentials in aqueous solutions:

Element	$M^{3+} M$	$M^+ M$
Al	-1.66 V	+0.55 V
Tl	+1.26 V	-0.34 V

Based on these data, which of the following statements is correct?

- (a) Tl^{3+} is more stable than Al^{3+} (b) Al^+ is more stable than Al^{3+}
 (c) Tl^+ is more stable than Al^{3+} (d) Tl^+ is more stable than Al^+

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



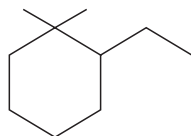
13. Among the following, the incorrect statement is

- (a) At low pressure, real gases show ideal behaviour
 (b) At very low temperature, real gases show ideal behaviour
 (c) At Boyle's temperature, real gases show ideal behaviour
 (d) At very large volume, real gases show ideal behaviour

14. The pair of compounds having metals in their highest oxidation state is:

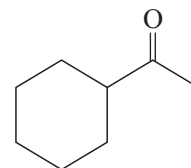
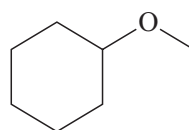
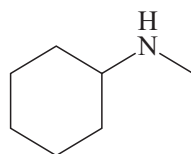
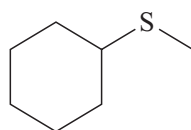
- (a) MnO_2 and CrO_2Cl_2 (b) $[Fe(CN)_6]^{3-}$ and $[Cu(CN)_4]^{2-}$
 (c) $[NiCl_4]^{2-}$ and $[CoCl_4]^{2-}$ (d) $[FeCl_4]^-$ and Co_2O_3

15. The IUPAC name of the following compound is



- (a) 2-Ethyl-1, 1-dimethylcyclohexane (b) 1, 1-Dimethyl-2-ethylcyclohexane
 (c) 2,2-Dimethyl-1-ethylcyclohexane (d) 1-Ethyl-2, 2-dimethylcyclohexane

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



(i) (IV)

(ii) (II)

(iii) (I)

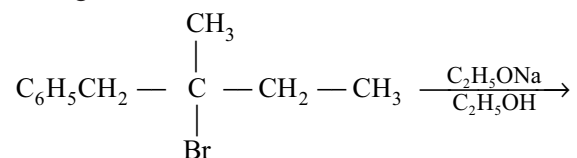
(iv) (III)

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

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

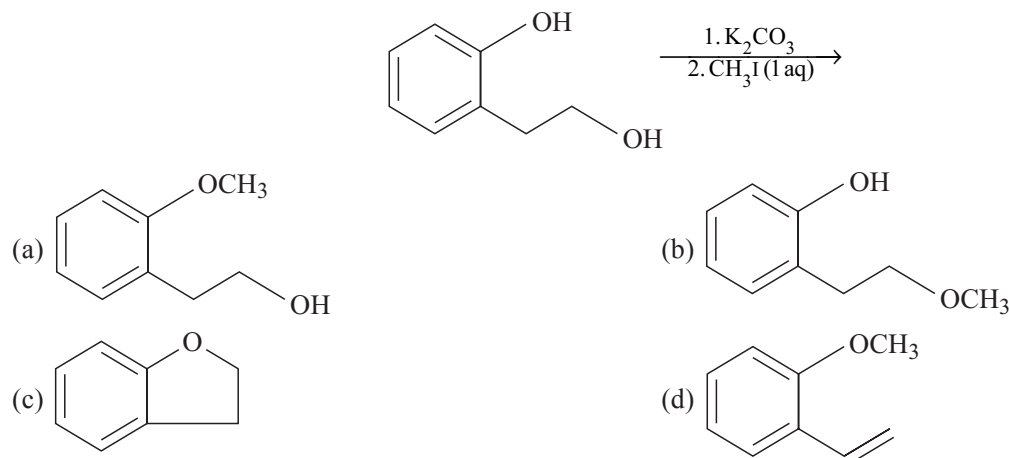
Which of the following statements is correct?

- (a) Both A and B belong to Group 1 where A comes below B
 (b) Both A and B belong to Group 2 where A comes below B
 (c) Both A and B belong to Group 1 where B comes below A
 (d) Both A and B belong to Group 2 where B comes below A.
18. sp³d² hybridization is not behaved by:
 (a) SF₆ (b) BrF₅ (c) PF₅ (d) [CrF₆]³⁻
19. The number of S = O and S — OH bonds present in peroxodisulphuric acid and pyrosulphuric acid, respectively, are
 (a) (2 and 4) and (2 and 4) (b) (4 and 2) and (4 and 2)
 (c) (4 and 2) and (2 and 4) (d) (2 and 2) and (2 and 2)
20. Among the following correct statement is:
 (a) Sol of metal sulphides are lyophilic
 (b) Brownian movement is more pronounced for smaller particles
 (c) One would expect charcoal to absorb chlorine more than hydrogen sulphide
 (d) Hardy-Schulze law states that bigger the size of the ion is, the greater is its coagulating power
21. The major product of the following reaction is:

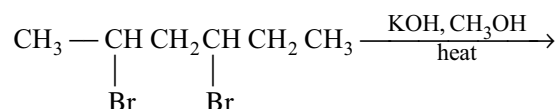


- (a) $\text{C}_6\text{H}_5\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CH}_2\text{CH}_3$ (b) $\text{C}_6\text{H}_5\text{CH}_2-\underset{\text{CH}_3}{\text{C}}=\text{CHCH}_3$
 (c) $\text{C}_6\text{H}_5\text{CH}_2-\underset{\text{OC}_2\text{H}_5}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_2\text{CH}_3$ (d) $\text{C}_6\text{H}_5\text{CH}_2-\underset{\text{CH}_2\text{CH}_3}{\text{C}}=\text{CH}_2$
22. What is the standard reduction potential (E°) for $\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$?
 Given that:
 $\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}; E^\circ_{\text{Fe}^{2+}|\text{Fe}} = -0.47 \text{ V}$
 $\text{Fe}^{3+} + \text{e}^- \rightarrow \text{Fe}^{2+}; E^\circ_{\text{Fe}^{3+}, \text{Fe}^{2+}|\text{Pt}} = 0.77 \text{ V}$
 (a) -0.057 V (b) $+0.30 \text{ V}$ (c) -0.30 V (d) $+0.057 \text{ V}$
23. The reason for drug induced poisoning is:
 (a) Binding irreversibly to the active site of the enzyme
 (b) Binding at the allosteric sites of the enzyme
 (c) Binding reversibly at the active site of the enzyme
 (d) Bringing conformational change in the binding site of the enzyme

24. The major product of the following reactions is:



25. The major product of the following reaction is



- (a) $\text{CH}_3\text{CH}=\text{CH}-\text{CH}=\text{CHCH}_3$ (b) $\text{CH}_2=\text{CHCH}=\text{CHCH}_2\text{CH}_3$
 (c) $\text{CH}_3\text{CH}=\text{C}=\text{CHCH}_2\text{CH}_3$ (d) $\text{CH}_2=\text{CHCH}_2\text{CH}=\text{CHCH}_3$
26. In which of the following reactions, hydrogen peroxide acts as an oxidizing agent?
 (a) $\text{HOCl} + \text{H}_2\text{O}_2 \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^- + \text{O}_2$ (b) $\text{I}_2 + \text{H}_2\text{O}_2 + 2\text{OH}^- \rightarrow 2\text{I}^- + 2\text{H}_2\text{O} + \text{O}_2$
 (c) $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$ (d) $2\text{MnO}_4^- + 3\text{H}_2\text{O}_2 \rightarrow \text{MnO}_2 + 3\text{O}_2 + 2\text{H}_2\text{O} + 2\text{OH}^-$
27. For a reaction, $\text{A(g)} \rightarrow \text{A(l)}$; $\Delta H = -3RT$. The correct statement for this reaction is
 (a) $\Delta H = \Delta U = 0$ (b) $|\Delta H| < |\Delta U|$ (c) $|\Delta H| > |\Delta U|$ (d) $\Delta H = \Delta U \neq 0$
28. The enthalpy change on freezing of 1 mol of water at 5°C to ice at -5°C is:
 (Given: $\Delta_{\text{fus}}H = 6 \text{ kJ mol}^{-1}$ at 0°C , $C_p(\text{H}_2\text{O, l}) = 75.3 \text{ J mol}^{-1} \text{ K}^{-1}$, $C_p(\text{H}_2\text{O, s}) = 36.8 \text{ J mol}^{-1} \text{ K}^{-1}$)
 (a) -6.0 kJ mol^{-1} (b) $-5.81 \text{ kJ mol}^{-1}$ (c) $-5.44 \text{ kJ mol}^{-1}$ (d) $-6.56 \text{ kJ mol}^{-1}$
29. Addition of sodium hydroxide solution to a weak acid (HA) results in buffer of $\text{pH} = 6$. If ionization constant of HA is 10^{-5} , the ratio of salt to acid concentration in the buffer solution will be
 (a) 10 : 1 (b) 4 : 5 (c) 5 : 4 (d) 1 : 10
30. A metal M reacts with nitrogen gas to afford M_3N . The compound M_3N on heating at high temperature gives back M and on reaction with water produces a gas B. The gas B reacts with aqueous solution of CuSO_4 to form a deep blue compound. The species M and B, respectively, are
 (a) Li and NH_3 (b) Na and NH_3 (c) Ba and N_2 (d) Al and N_2

ANSWERS

- | | | | | | |
|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (a) | 3. (c) | 4. (a) | 5. (d) | 6. (a) |
| 7. (b) | 8. (d) | 9. (b) | 10. (d) | 11. (d) | 12. (c) |
| 13. (b) | 14. (a) | 15. (a) | 16. (b) | 17. (d) | 18. (c) |
| 19. (b) | 20. (c) | 21. (a) | 22. (a) | 23. (b) | 24. (a) |
| 25. (a) | 26. (c) | 27. (c) | 28. (d) | 29. (a) | 30. (a) |



HINTS AND SOLUTIONS

1. The energy difference between two Bohr orbits is

$$\Delta E = R_{\infty}hcZ^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right). \quad \text{This gives} \quad \frac{1}{\lambda} = R_{\infty}Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

For the shortest wavelength (i.e. maximum energy difference) in the Lyman series of hydrogen atom ($Z = 1$), we have $n_1 = 1$ and $n_2 = \infty$. Thus

$$\frac{1}{\lambda_1} = R_{\infty}$$

For the longest wavelength (i.e. minimum energy difference) in the Paschen series of He^+ ion ($Z = 2$), we have $n_1 = 3$ and $n_2 = 4$

$$\text{Hence} \quad \frac{1}{\lambda_2} = R_{\infty}(2)^2 \left(\frac{1}{3^2} - \frac{1}{4^2} \right) = \frac{7R_{\infty}}{36}. \quad \text{Obviously,} \quad \lambda_2 = \frac{36}{7R_{\infty}} = \frac{36}{7} \lambda_1 \left(= \frac{36}{7} A \right)$$

2. The essential amino acids are not synthesized by human body. These have to be supplied in the human diet. Valine is an example of essential amino acid.
3. The gases are SO_2 and NO_2 .
4. The compound $\text{H}_2\text{C}=\text{CH}-\text{Cl}$ will not undergo Friedel-Craft reaction as it is unable to form carbocation (i.e. electrophile).
5. The electronic configurations of the given species are as follows.

Species	Valence electrons	Electronic configuration
CO	10	$(\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\sigma 2p_z)^2$
NO^+	10	same as CO
O_2^{2-}	14	$(\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\pi^* 2p_x)^2 (\pi^* 2p_y)^2$
B_2	6	$(\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x)^1 (\pi 2p_y)^1$

The species B_2 contains unpaired electrons, and is thus paramagnetic.

6. The variation of rate constant with change in temperature is given by the expression

$$\ln \left(\frac{k_2}{k_1} \right) = -\frac{E_a}{R} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

From the given information, we write

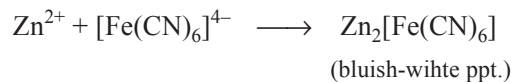
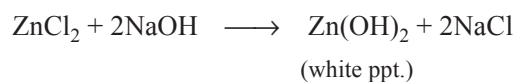
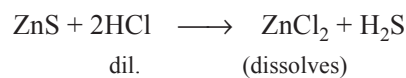
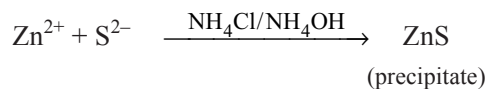
$$\frac{1}{T_{2,A}} - \frac{1}{T_{1,A}} = 2 \left(\frac{1}{T_{2,B}} - \frac{1}{T_{1,B}} \right) \quad \text{i.e.} \quad \frac{1}{310 \text{ K}} - \frac{1}{300 \text{ K}} = 2 \left(\frac{1}{T_{2,B}} - \frac{1}{300 \text{ K}} \right)$$

From this, we get

$$\frac{1}{T_{2,B}} = \frac{1}{2} \left(\frac{1}{310 \text{ K}} + \frac{1}{300 \text{ K}} \right) = \frac{(305 \text{ K})}{(310 \text{ K})(300 \text{ K})} \quad \text{i.e.} \quad T_{2,B} = \left(\frac{310 \times 300}{305} \text{ K} \right) = 304.9 \text{ K}$$

$$\Delta T_{2,B} = 304.9 \text{ K} - 300 \text{ K} = 4.9 \text{ K}$$

7. The cation is Zn^{2+} . The given reactions are as follows.



JEEC.6 Complete Chemistry—JEE Main

8. The choice (d) is not true

9. The reaction is $\text{FeCl}_3 + 3\text{NaOH} \longrightarrow \text{Fe(OH)}_3 + 3\text{NaCl}$

Molar mass of Fe(OH)_3 , $M = (56 + 3 \times 17) \text{ g mol}^{-1} = 107 \text{ g mol}^{-1}$

Amount of Fe(OH)_3 obtained, $n = \frac{m}{M} = \frac{2.14 \text{ g}}{107 \text{ g mol}^{-1}} = 0.02 \text{ mol}$

From the stoichiometry of chemical equation, we find that

Amount of $\text{FeCl}_3 = \text{Amount of Fe(OH)}_3 = 0.02 \text{ mol}$

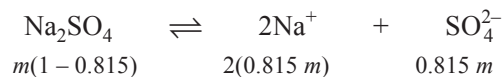
Molarity of ferric chloride is $M = \frac{n}{V} = \frac{0.02 \text{ mol}}{0.1 \text{ L}} = 0.2 \text{ mol L}^{-1}$

10. Molar mass of Na_2SO_4 , $M = (2 \times 23 + 32 + 4 \times 16) \text{ g mol}^{-1} = 142 \text{ g mol}^{-1}$

Amount of Na_2SO_4 , $n = \frac{m}{M} = \frac{5 \text{ g}}{142 \text{ g mol}^{-1}} = \frac{5}{142} \text{ mol}$

Molality of Na_2SO_4 , $m = \frac{5}{142 \times x} \text{ mol}$

Since Na_2SO_4 is 81.5% ionized, we will have



Total molality in the solution

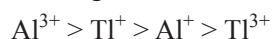
$$m_{\text{total}} = m(1 - 0.815) + 2(0.815 m) + 0.815 m = 2.63 m = (2.63) \left(\frac{5}{142 \times x} \text{ mol} \right)$$

Now, since, $-\Delta T_f = K_f m_{\text{total}}$, we have

$$(3.82 \text{ }^\circ\text{C}) = (1.86 \text{ }^\circ\text{C kg mol}^{-1}) \left(\frac{5 \times 2.63}{142 \times x} \text{ mol} \right)$$

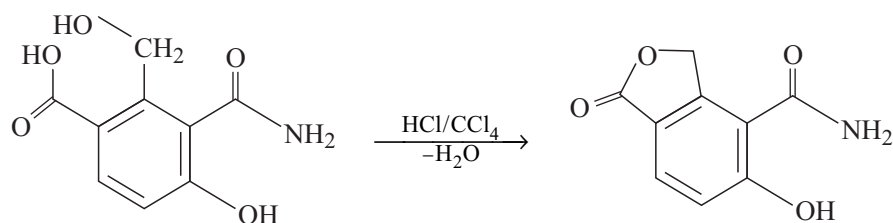
This gives $x = \left(\frac{1.86 \times 5 \times 2.63}{3.82 \times 142} \right) \text{ kg} = 0.045 \text{ kg} = 45 \text{ g}$

11. Larger the negative reduction potential, lesser the tendency of reduction of ion and is thus more stable towards reduction. From the given reduction potentials, the stability of ions follows the order:



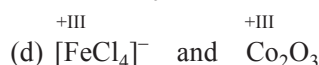
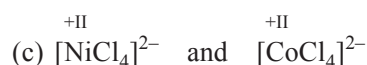
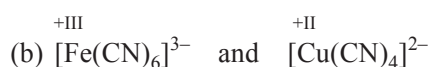
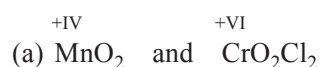
The choice (d) satisfies the above order.

12. The reaction is:



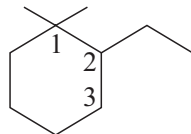
13. The choice (b) is incorrect. Real gases behave ideally at high temperature and low pressure (i.e. high volume).

14. The oxidation states of metals are:



Of the given metals, the choice (a) has the highest oxidation states.

15. The numbering in the given compound goes as follows.



The compound is named as 2-ethyl-1, 1-dimethylcyclohexane.

16. The compound (II) goes into aqueous layer because it contains basic NH group.
 17. The expected electronic configurations of Groups 1 and 2 are:

Group 1 (Inert gas) $(ns)^1$

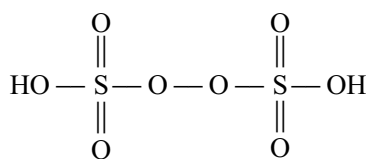
Group 2 (Inert gas) $(ns)^2$

For Group 1, 2nd ionization enthalpy is expected to be large while for Group 2, 3rd ionization enthalpy is expected to be larger. Moreover, ionization enthalpy decreases on descending a group.

Thus, both A and B belong to Group 2 with element B comes below A (choice d).

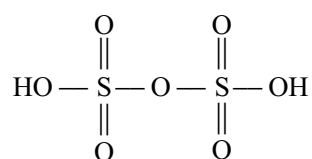
18. The molecule PF_5 does not have sp^3d^2 hybridization as there are five pairs of electrons around P leading to sp^3d hybridization
 19. The given acids are:

Peroxodisulphuric acid



Four S = O bonds
 Two S — OH bonds

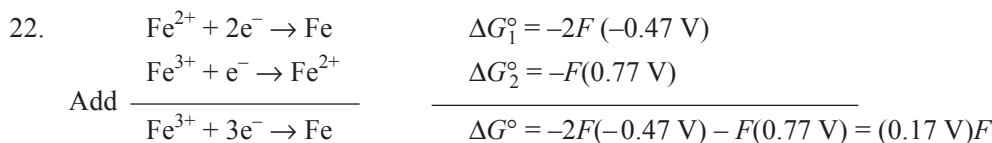
Pyrosulphuric acid



Four S = O bonds
 Two S — OH bond

20. Sols of metal sulphides are lyophobic. Brownian movement is more pronounced for bigger particles such as colloidal particles.
 Hardy-Schulze rule states that the larger is the charge on ion, larger is the coagulation power.
 The choice (c) is correct. Charcoal is expected to absorb chlorine more than hydrogen sulphide.

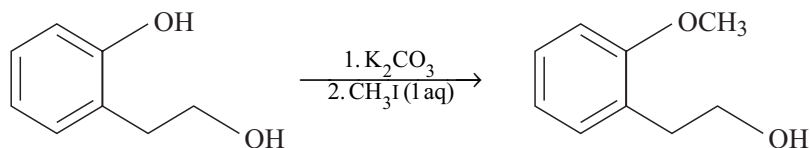
21. The product is $\text{C}_6\text{H}_5\text{CH}=\underset{\text{CH}_3}{\text{C}}-\text{CH}_2\text{CH}_3$ as the double bond is in conjugation with C_6H_5 group.



$$E_{\text{Fe}^{3+}|\text{Fe}}^\circ = -\frac{\Delta G^\circ}{3F} = -0.057 \text{ V}$$

23. The choice (b) is correct. Binding of the drug at the allosteric site changes the shape of the active site making the enzyme to be inactive.

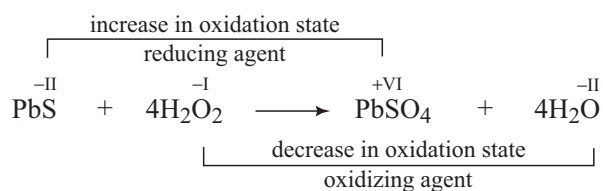
24. The reaction is



Phenolic hydrogen is more acidic than hydroxyl hydrogen and is thus extracted by base K_2CO_3 .

25. The product is $CH_3CH=CH-CH=CHCH_3$. It contains extended configuration.

26. H_2O_2 in the reaction of choice (c) acts as an oxidizing agent



27. For the given reaction, $\Delta v_g = -1$

Hence $\Delta H = \Delta U + (\Delta v_g)RT$ gives

$$\Delta U = \Delta H - (\Delta v_g)RT = -3RT - (-1)RT = -2RT. \text{ Obviously, } |\Delta H| > |\Delta U|$$

28. Water at $5^\circ C \xrightarrow{(i)}$ Water at $0^\circ C \xrightarrow{(ii)}$ Ice at $0^\circ C \xrightarrow{(ii)}$ Ice at $-5^\circ C$

The enthalpy changes in the above processes are:

Step (i) $\Delta H = C_p(l)\Delta T = (75.3 \text{ J mol}^{-1} \text{ K}^{-1})(-5 \text{ K}) = -376.5 \text{ J mol}^{-1}$

Step (ii) $\Delta H = \Delta_{\text{freez}}H = -\Delta_{\text{fus}}H = -6 \text{ kJ mol}^{-1}$

Step (iii) $\Delta H = C_p(s)\Delta T = (36.8 \text{ J K}^{-1} \text{ mol}^{-1})(-5 \text{ K}) = -184.0 \text{ J mol}^{-1}$

The total enthalpy change is

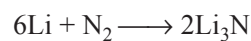
$$\Delta H = (-376.5 - 6000 - 184.0) \text{ J mol}^{-1} = -6560.5 \text{ J mol}^{-1} = -6.56 \text{ kJ mol}^{-1}$$

29. Using Henderson equation

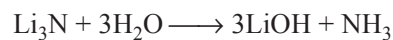
$$pH = pK_a + \log\left(\frac{[\text{salt}]}{[\text{acid}]}\right) \text{ gives } \log\left(\frac{[\text{salt}]}{[\text{acid}]}\right) = pH - pK_a = 6 - 5 = 1$$

Hence $[\text{salt}] : [\text{acid}] :: 10 : 1$

30. Species M and B, respectively, are Li and NH_3 as is evident from the following reactions.



(M)



(B)

