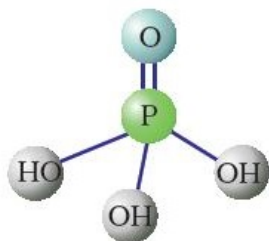


**Solution**  
**Class 12 - Chemistry**  
**2020-2021 - Paper-7**

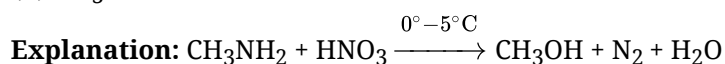
**Section A**

1. i. (b) phosphorus pentachloride
- ii. (d) all of these
- iii. (d)  $4\text{AgNO}_3 + 2\text{H}_2\text{O} + \text{H}_3\text{PO}_2 \longrightarrow 4\text{Ag} + 4\text{HNO}_3 + \text{H}_3\text{PO}_4$
- iv. (a) one P=O and one P-OH bond



2. i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion.
- ii. (c) Assertion is correct but reason is wrong statement.
- iii. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion.
- iv. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- v. (c) Assertion is correct but reason is wrong statement.

3. (d)  $\text{CH}_3\text{OH}$



4. (d) Cellulose

**Explanation:** Cellulose occurs exclusively in plants and it is the most abundant organic substance in plant kingdom. It is a predominant constituent of cell wall of plant cells.

OR

- (c) Cellulose

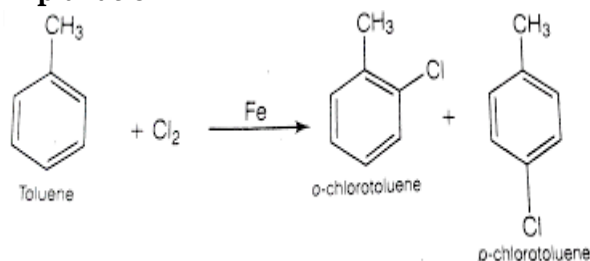
**Explanation:** Cellulose occurs exclusively in plants and it is the most abundant organic substance in plant kingdom. It is a predominant constituent of cell wall of plant cells. Cellulose cannot be hydrolysed in human digestive system because the enzymes required to digest it are not present in human body.

5. (a) increases with increase in temperature.

**Explanation:** Value of Henry's law constant increases with an increase in temperature.

6. (a) Mixture of and

**Explanation:**



The reaction of aromatic arenes with chlorine in the presence of Lewis acid catalysts like iron (III) chloride gives ortho and para isomers of haloarenes by an electrophilic substitution reaction.  $\text{Cl}_2$  forms a coordination complex with  $\text{FeCl}_3$ , forming  $\text{Cl}^+\text{FeCl}_4^-$  complex, which gives a slight positive charge to Cl, and

$\text{FeCl}_4^-$  is negatively charged. This  $\text{Cl}^+$  then reacts with the aromatic double bonds of the toluene molecule to form an addition product, followed by deprotonation to form a mixture of o- p- and m- isomers of the chlorotoluene. The m- isomer is very unstable, so the product form is o-Halotoluene and p-Halotoluene.

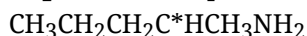
OR

(d) b, c

**Explanation:** Chiral molecules (the object which is non-superimposable on their mirror image) contains one carbon atom surrounded by four non-identical species. All straight-chain molecules cannot be chiral because of the presence of two or more identical groups like hydrogens. Even the carbons with double or triple bonds to a group cannot be considered as a chiral carbon. An asymmetric carbon needs to be surrounded by four species different from each other through covalent bonds. Hence, the atoms b and c are asymmetric.

7. (b) 2 – pentanamine

**Explanation:** 2-pentanamine will have a chiral centre, therefore it can be resolved into enantiomers.

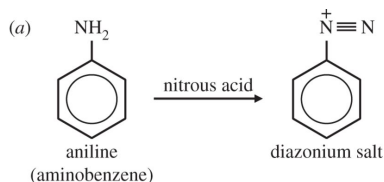


The  $\text{C}^*$  in 2-pentanamine is the chiral center.

OR

(b) diazonium chloride

**Explanation:** Aniline reacts with  $\text{NaNO}_2$  and  $\text{HCl}$  to produce  $\text{HNO}_2$  (nitrous acid).  $\text{HNO}_2$  reacts with aniline at low temperature to give benzene diazonium chloride which is stable and the reaction is called diazotization reaction.



8. (a) 6

**Explanation:** Oxalate i.e.  $\text{C}_2\text{O}_4^{2-}$  is a didentate ligand as it can bind through 2 O atoms. In given complex there are 3 oxalate ligands bound to Fe. So that means Fe has a coordination number 6.

OR

(b)  $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$

**Explanation:** On getting ionised this complex gives 3  $\text{Cl}^-$  (ions outside the square brackets are ionisable) and a  $[\text{Pt}(\text{NH}_3)_5\text{Cl}]^+$  i.e. 4 ions are produced per molecule of the compound.

9. (a)  $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

**Explanation:** The given option is correct because it is a double salt (a double salt dissociates into simple ions completely when dissolved in water) whereas others are complexes which don't dissociate completely into solution.

10. (a)  $\text{Cl}^- < \text{Br}^- < \text{I}^-$

**Explanation:** Nucleophilicity means the tendency of a nucleophile to attack a center of a positive charge. As the size of the nucleophile increases, its basicity decreases, and hence its nucleophilicity increases. As we move down the group 17 size of the anions increases and thus the nucleophilicity increases as  $\text{Cl}^- < \text{Br}^- < \text{I}^-$

11. (b) Isotropic

**Explanation:** Crystalline solids are anisotropic in nature.

12. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

**Explanation:** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

13. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

**Explanation:** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

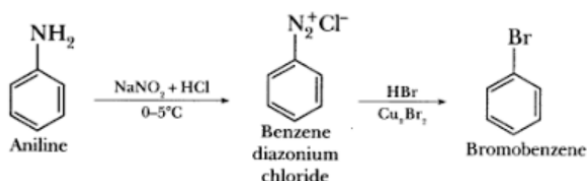
14. (a) Assertion and reason both are correct statements and reason is the correct explanation for the assertion.  
**Explanation:** Molarity changes with temperature because volume changes with a change in temperature.

OR

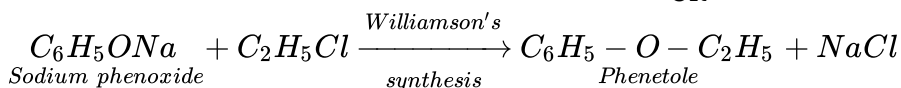
- (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.  
**Explanation:** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
15. (d) The assertion is wrong statement but the reason is the correct statement.  
**Explanation:** Phenols give o, p-nitrophenol on nitration with dil.  $\text{HNO}_3$  and with conc.  $\text{HNO}_3 + \text{conc. H}_2\text{SO}_4$ , phenol gives 2, 4, 6-trinitrophenol (Known as Picric Acid). Since phenol is very reactive towards the electrophilic substitution reaction so in the nitration reaction even it can react with the dilute nitric acid.
16. (a) Assertion and reason both are correct and the reason is the correct explanation of assertion.  
**Explanation:** Tert-Butyl bromide undergoes Wurtz reaction to give 2, 2, 3, 3-tetramethyl butane because in the tertiary butyl bromide reacts with NaI in dry ether and thus form 2, 2, 3, 3-tetramethyl butane.

### Section B

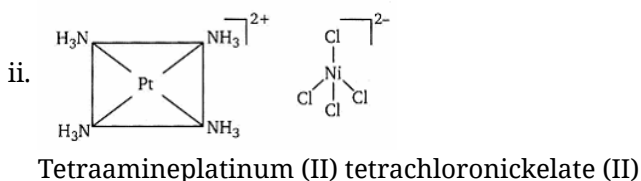
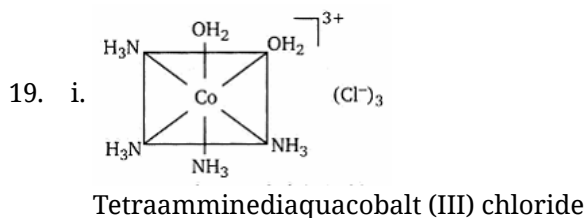
17.



OR

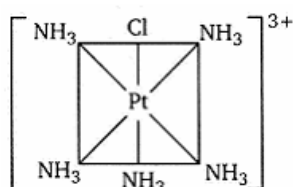


18. i. Rate law for the reaction is  $= k [\text{H}_2\text{O}_2] [\text{I}^-]$   
 ii. Overall order of reaction is = 2  
 iii. Out of steps (1) and (2), step 1 is rate determining step.



OR

IUPAC name. Pentaamminechlorido platinum (IV) chloride.  
 It has octahedral structure



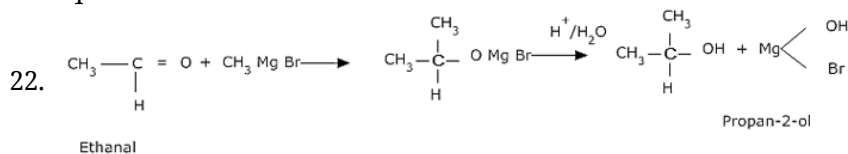
20. Suppose the initial concentration of reactant be  $\text{mol L}^{-1}$  and the time required for completion of the reaction be  $t_{1/n}$ .

$$t_{1/n} = \frac{2.303}{k} \log \frac{a}{a-x} \left[ \because x = \frac{a}{n} \right]$$

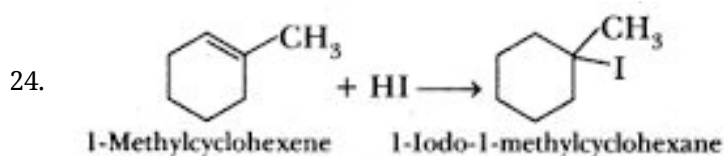
$$t_{1/n} = \frac{2.303}{k} \log \frac{a}{a - \frac{a}{n}}$$

$$t_{1/2} = \frac{2.303}{k} \log \frac{n}{n-1}$$

21. The rate law can be determined by measuring the rate of this reaction as a function of initial concentration by keeping the concentration of one of the reactants constant and changing the concentration of other reactants or by changing the concentration of both the reactants. From the concentration dependence of rate, rate law can be determined. The rate law for any reaction cannot be predicted by merely looking at balanced chemical equation.



23. As the oxidation state of the element increases, the size of transition metal cations decreases its charge increases. According to Fajans rules, as the charge of the metal ion increases covalent character increases because the positively charged cation attracts the electron cloud on the anion towards itself.



25. It is given that density of the element,  $d = 2.7 \times 10^3 \text{ kg m}^{-3}$

Molar mass of the element is,  $M = 2.7 \times 10^{-2} \text{ kg mol}^{-1}$

Edge length of the element,  $a = 405 \text{ pm} = 405 \times 10^{-12} \text{ m} = 4.05 \times 10^{-10} \text{ m}$

It is known that, Avogadro's number,  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

$$d = \frac{z \cdot M}{a^3 \cdot N_A}$$

$$z = \frac{d \cdot a^3 \cdot N_A}{M}$$

$$= \frac{2.7 \times 10^3 \text{ kg m}^{-3} \times (4.05 \times 10^{-10} \text{ m})^3 \times 6.022 \times 10^{23} \text{ mol}^{-1}}{2.7 \times 10^{-2} \text{ kg mol}^{-1}}$$

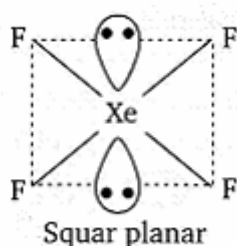
$$= 4.004$$

$$= 4$$

Applying the relation, this implies that four atoms of the element are present per unit cell. Hence, the unit cell is face-centered cubic (fcc) or cubic close-packed (ccp).

### Section C

26. The square planar structure of  $\text{XeF}_4$  is shown below:



OR

Due to small size and high electron gravity, oxygen forms  $p\pi - p\pi$  multiple bonds. As a result oxygen exists as diatomic ( $\text{O}_2$ ) molecules. These molecules are held together by weak van der waal's forces of attraction which can be easily overcome by collisions of the molecules at room temperature. Therefore,  $\text{O}_2$  is a gas at room temperature. Sulphur, on the other hand, is octa atomic ( $\text{S}_8$ ) has high intermolecular force of attraction, that's why sulphur is solid at room temperature.

27. i.  $\text{AgCl}$  forms a complex with methylamine  

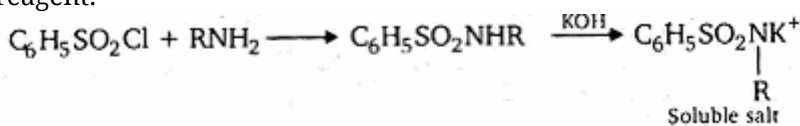
$$\text{AgCl} + 2\text{CH}_3\text{NH}_2 \rightarrow [\text{Ag}(\text{CH}_3\text{NH}_2)_2]^+ \text{Cl}^-$$
*So lub le*

ii. Tertiary amines do not undergo acylation because they do not have hydrogen attached to nitrogen.

- iii. In aniline, -NH<sub>2</sub> group is electron releasing, therefore, it increases electron density at o- and p-positions. Therefore, it forms 2, 4, 6- tribromoaniline.

OR

Primary, secondary and tertiary amines can be identified by Hinsberg's reagent (Benzenesulphonyl chloride C<sub>6</sub>H<sub>5</sub>SO<sub>2</sub>Cl). Primary amines react with Hinsberg's reagent to form sulphonamides soluble in alkali whereas secondary amines form sulphonamides insoluble in alkali. Tertiary amines do not react with Hinsberg's reagent.



28. Given, Atomic mass of Na, (M) = 23.0 amu

Density of sodium,  $d = 0.9623 \text{ g cm}^{-3}$ ; Edge length (a) =  $430 \times 10^{-10} \text{ cm}$ .

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

By applying density formula, we have

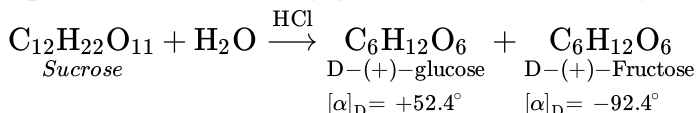
$$d = \frac{Z \times M}{a^3 \times N_A}$$

$$\Rightarrow 0.9623 = \frac{Z \times 23}{(430 \times 10^{-10})^3 \times 6.022 \times 10^{23}}$$

$$\Rightarrow Z = \frac{(0.9623 \text{ g/cm}^3)(430 \times 10^{-10} \text{ cm})^3 (6.022 \times 10^{23} \text{ mol}^{-1})}{(23 \text{ g/mol})}$$

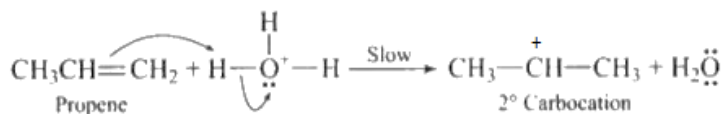
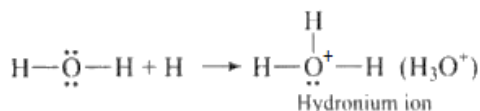
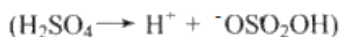
Hence,  $Z = 2$

29. Sucrose is dextrorotatory having  $[\alpha]_D = +66.5^\circ$ . On hydrolysis with dilute acids or enzymes, it gives equimolar dextrorotatory glucose and laevorotatory-fructose

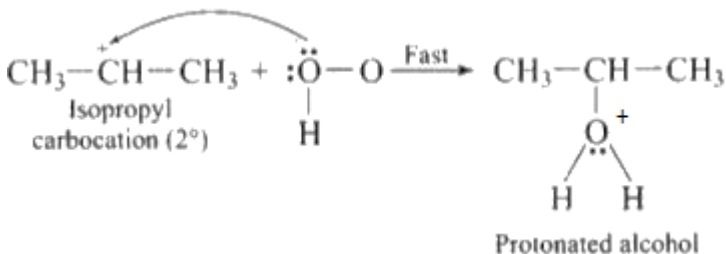


Hence, Dextrorotation of glucose +52.5 is less than laevorotation of fructose -92.5 therefore, the mixture is laevorotatory.

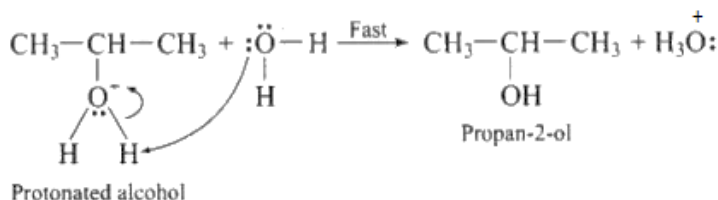
30. The mechanism of acid-catalyzed addition of water (hydration) to alkenes involves the following three steps:  
Step 1: Electrophilic attack by hydronium ion (H<sub>3</sub>O<sup>+</sup>) on alkene gives an intermediate, carbocation.



Step 2: Nucleophilic attack by water on carbocation to yield protonated alcohol.



Step 3: Deprotonation (loss of proton) to form an alcohol.



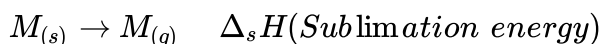
## Section D

31. i. Transition metals show paramagnetic behaviour. Paramagnetism arises due to the presence of one or more unpaired electrons in them. For example Mn(Z=25) has configuration  $3d^5 4s^2$  and has 5 unpaired electrons.
- ii. Transition elements have high effective nuclear charge and a large number of valence electrons. They form strong metallic bonds. As the number of unpaired electrons increases strength of metallic bonding increases. When interatomic force increases, enthalpy of atomization also increases. Therefore the enthalpy of atomization of transition metals is high.
- iii. Most of the complexes of transition metals are coloured. This is because of the absorption of radiation from visible light region to promote an electron from lower energy d-orbitals to higher energy d orbital. In the presence of ligands, the d-orbitals split up into two sets of orbitals having different energies. Therefore, the transition of electrons can take place from lower energy set to higher energy set. The energy required for these transitions is quite small and falls in the visible region of radiation. The ions of transition metals absorb the radiation of a particular wavelength and get excited and on de excitation they emit light in visible region on spectrum, imparting colour to the solution.
- iv. The catalytic activity of the transition elements can be explained by
- Their ability to show variable oxidation states and to form complexes- Transition metals form unstable intermediate compounds. Thus, they provide a new path with lower activation energy for the reaction.
  - Transition metals also provide a suitable surface for the reactions to occur.

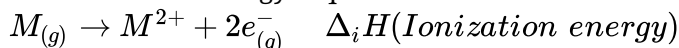
OR

The  $E^\theta (M^{2+}/M)$  value of a metal depends on the energy changes involved in the following:

- i. Sublimation: The energy required for converting one mole of an atom from the solid state to the gaseous state.



- ii. Ionization: The energy required to take out electrons from one mole of atoms in the gaseous state.

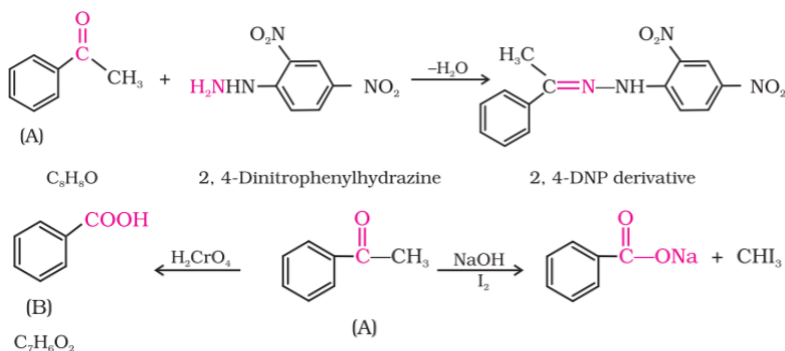


- iii. Hydration: The energy released when one mole of ions are hydrated.

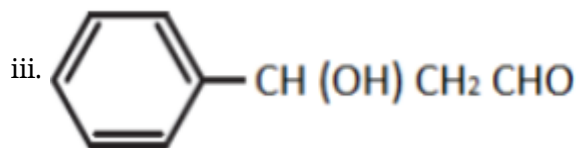
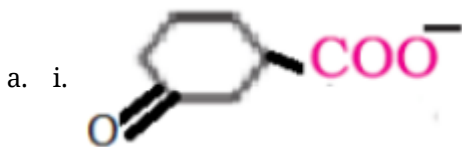


Now, copper has a high energy of sublimation and very high sum of first two ionization energy values and low hydration energy. Hence, the  $E^\theta (M^{2+}/M)$  value for copper is positive.

32. An organic compound (A) with molecular formula  $C_8H_8O$  forms an orange-red precipitate with a 2,4-DNP derivative. Therefore, it is an aldehyde or a ketone. Since it does not reduce Tollens' or Fehling reagent, (A) must be a ketone. (A) responds to the iodoform test. Therefore, it should be a methyl ketone. The molecular formula of (A) indicates a high degree of unsaturation, yet it does not decolourise bromine water or Baeyer's reagent. This indicates the presence of unsaturation due to an aromatic ring.
- Compound (B), being an oxidation product of a ketone should be a carboxylic acid. The molecular formula of (B) indicates that it should be benzoic acid and compound (A) should, therefore, be a monosubstituted aromatic methyl ketone. The molecular formula of (A) indicates that it should be phenyl methyl ketone (acetophenone). Reactions are as follows:



OR



b. Chemical test to distinguish between acetophenone and benzophenone:

On adding NaOH / I<sub>2</sub> and heat, acetophenone forms yellow ppt. of iodoform(CHI<sub>3</sub>) whereas benzophenone does not.

c. Due to resonance stabilisation of conjugate base of carbonyl compound, alpha(α) hydrogen of carbonyl compounds are acidic in nature.

33. i. For the given reaction, the Nernst equation can be given as:

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{[\text{Mg}^{2+}]}{[\text{Cu}^{2+}]} \\ &= \{0.34 - (-2.36)\} - \frac{0.0591}{2} \log \frac{.001}{.0001} \\ &= 2.7 - \frac{0.0591}{2} \log 10 \\ &= 2.7 - 0.02955 = 2.67 \text{ V (approximately)} \end{aligned}$$

ii. For the given reaction, the Nernst equation can be given as:

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{[\text{Fe}^{2+}]}{[\text{H}^+]^2} \\ &= \{0 - (-0.44)\} - \frac{0.0591}{2} \log \frac{0.001}{1^2} \\ &= 0.44 - 0.02955(-3) \\ &= 0.52865 \text{ V} = 0.53 \text{ V (approximately)} \end{aligned}$$

iii. For the given reaction, the Nernst equation can be given as:

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{[\text{Sn}^{2+}]}{[\text{H}^+]} \\ &= \{0 - (-0.14)\} - \frac{0.0591}{2} \log \frac{0.050}{(0.020)^2} \\ &= 0.14 - 0.0295 \times \log 125 \\ &= 0.14 - 0.062 \\ &= 0.078 \text{ V} \\ &= 0.08 \text{ V (approximately)} \end{aligned}$$

iv. For the given reaction, the Nernst equation can be given as:

$$\begin{aligned} E_{\text{cell}} &= E_{\text{cell}}^0 - \frac{0.0591}{n} \log \frac{1}{[\text{Br}^-][\text{H}^+]^2} \\ &= (0 - 1.09) - \frac{0.0591}{2} \log \frac{1}{(0.010)^2(0.030)^2} \\ &= -1.09 - 0.02955 \times \log \frac{1}{0.0000009} \\ &= -1.09 - 0.02955 \times \log \frac{1}{9 \times 10^{-8}} \\ &= -1.09 - 0.02955 \times \log(1.11 \times 10^7) \\ &= -1.09 - 0.02955(0.0453 + 7) \\ &= -1.09 - 0.208 \\ &= -1.298 \text{ V} \end{aligned}$$

OR

i. Electrolyte X is a strong electrolyte and Y is a weak electrolyte.

ii. Molar conductivity,  $\Lambda_m$  of X (strong electrolysis) increases slowly with dilution. This is because interionic forces of attraction decreases on dilution, although the number of ions remain the same. As a result ions move freely and hence  $\Lambda_m$  increases with dilution. On the other hand, for Y (weak electrolyte)  $\Lambda_m$  increases sharply with dilution. This is because degree of dissociation increases on dilution resulting in greater number of ions on dilution. Hence  $\Lambda_m$  increases.

iii. For X,  $\Lambda_m^\infty$  can be obtained by extrapolation to zero concentration.