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July
2021

CHEMISTRY
20th July 2021 [SHIFT – 2]
QUESTION WITH SOLUTION

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SECTION -A

1. Which one of the following gases is reported to retard photosynthesis ?
 (1) CO (2) CFCs (3) NO₂ (4) CO₂

Sol. (3)

According to NCERT only NO₂ from the given options can retard the photosynthesis process in plants.

2. Which one of the following species doesn't have a magnetic moment of 1.73 BM. (spin only value) ?

(1) CuI (2) [Cu(NH₃)₄]Cl₂ (3) O₂⁺ (4) O₂⁻

Sol. (1)

Species must not contain single unpaired

$$O_2^+ \rightarrow \sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2pz}^2 < \pi_{2px}^2 = \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^{*1}$$

unpaired e⁻ = 1 ∴ μ = 1.73 BM

$$(1) \quad Cu^+ I^- \quad Cu^+ \rightarrow [Ar] 3d^{10} \therefore \text{unpaired } e^- = 0$$

$$I^- \rightarrow [Xe] \therefore \text{unpaired } e^- = 0$$

therefore μ = 0

$$3. \quad [Cu(NH_3)_4]Cl_2$$

$$Cu \rightarrow [Ar] 3d^9 \therefore \text{unpaired } = 1 \therefore \mu = 1.73 \text{ BM}$$

$$4. \quad O_2^- \rightarrow d$$

$$\sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2px}^2 < \pi_{2px}^2 = \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^{*1}$$

(11e⁻)

∴ unpaired ∴ μ = 1.73 BM

O

NH₂ KBr A
(major product)

Br

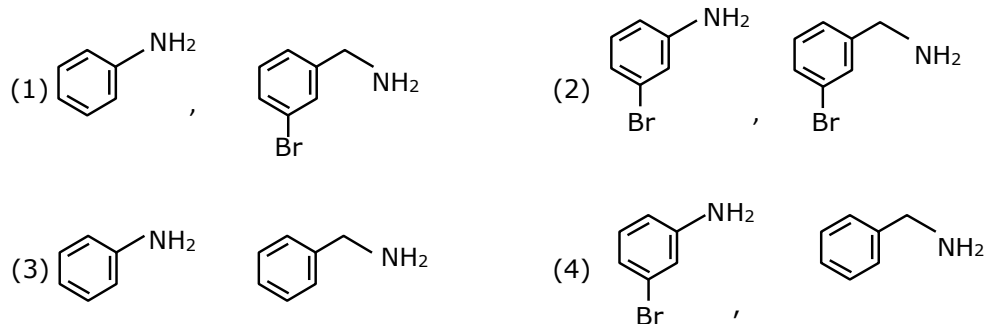
O

3.

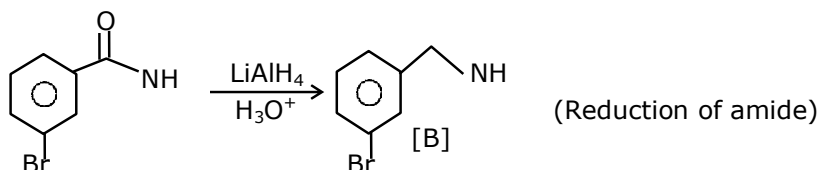
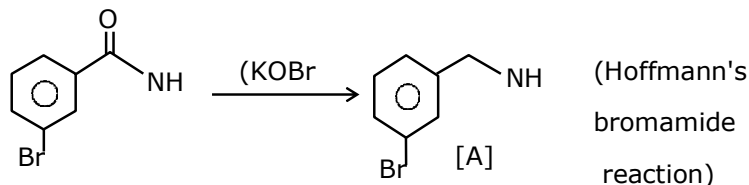
NH₂ LiAlH₄ B
H₃O⁺ (major product)

Br

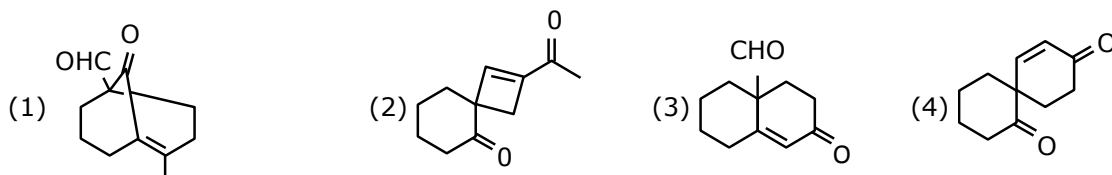
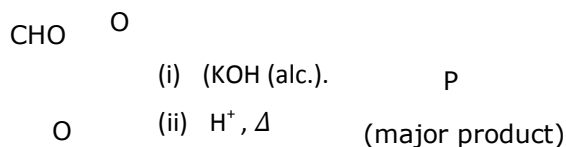
In the above reactions, product A and product B respectively are :



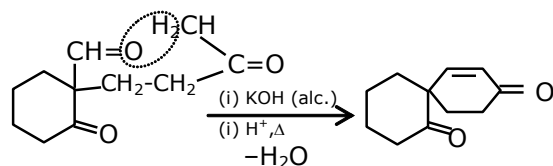
Sol. (2)



4. The major product (P) in the following reaction is :



Sol. (4)



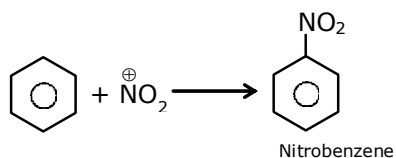
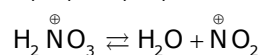
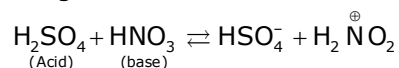
Intramolecular aldol condensation

5. Benzene on nitration gives nitrobenzene in presence of HNO_3 and H_2SO_4 mixture, where :

- (1) HNO_3 acts as an acid and H_2SO_4 acts as a base
- (2) both H_2SO_4 and HNO_3 act as a bases
- (3) HNO_3 acts as a base and H_2SO_4 acts as an acid
- (4) both H_2SO_4 and HNO_3 act as an acids

Sol. (3)

Reagent for nitration of Benzene



Nitrobenzene

6. Metallic sodium does not react normally with:

- (1) tert-butyl alcohol (2) But-2-yne
(3) Ethyne (4) gaseous ammonia

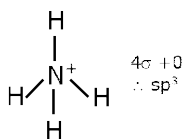
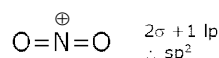
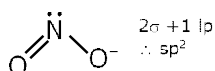
Sol. (2)

Metallic sodium do not react with 2-butyne because 2-butyne does not have acidic hydrogen

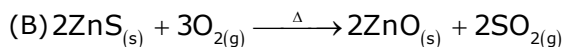
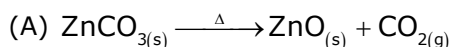
7. The hybridisations of the atomic orbitals of nitrogen in NO_2^- , NO_2^+ and NH_4^+ respectively are.

- (1) sp^2 , sp and sp^3 (2) sp , sp^2 and sp^3
(3) sp^3 , sp and sp^2 (4) sp^3 , sp^2 and sp

Sol. (1)



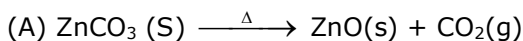
8. Consider two chemical reactions (A) and (B) that take place during metallurgical process:



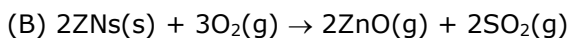
The **correct** option of names given to them respectively is:

- (1) (A) is roasting and (B) is calcination
(2) (A) is calcination and (B) is roasting
(3) Both (A) and (B) are producing same product so both are calcination
(4) Both (A) and (B) are producing same product so both are roasting

Sol. (2)



Heating in absence of oxygen in calcination.



heating in presence of oxygen in roasting

Hence (A) is calcination while (B) in roasting

9. The single largest industrial application of dihydrogen is :

- (1) Rocket fuel in space research (2) Manufacture of metal hydrides
(3) In the synthesis of ammonia (3) In the synthesis of nitric acid.

Sol. (3)

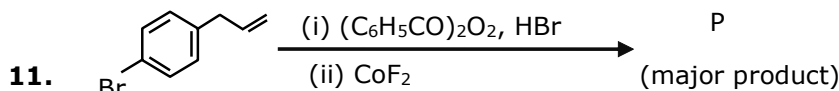
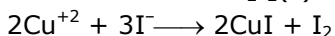
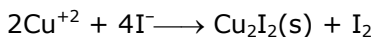
Informative, according to ncert uses of di hydrogen.

In fact NH_3 largest production in used to manufacture nitrogenous fertilisers.

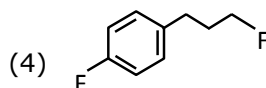
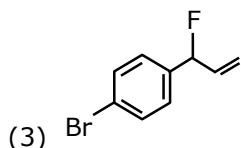
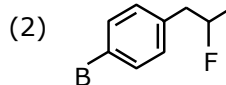
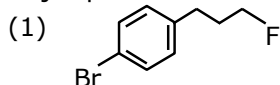
- 10.** Cu^{2+} salt reacts with potassium iodide to give :
 (1) Cu_2I_3 (2) CuI (3) Cu_2I_2 (4) $\text{Cu}(\text{I}_3)_2$

Sol. (3)

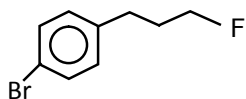
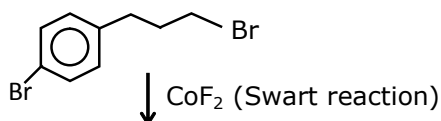
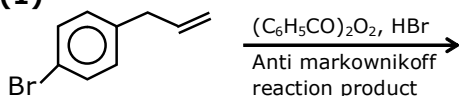
Motion 2 & 3



Major product P of above reaction, is :



Sol. (1)

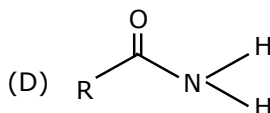
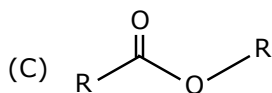
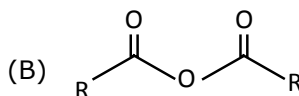
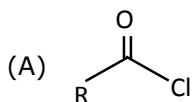


- 12.** Which one of the following statements is not true about enzymes ?
 (1) Enzymes work as catalysts by lowering the activation energy of a biochemical reaction.
 (2) The action of enzymes is temperature and pH specific.
 (3) Almost all enzymes are of proteins.
 (4) Enzymes are non-specific for a reaction and substrate.

Sol. (4)

Enzymes are highly specific both in the reactions that they catalyzed and in their choice of reactions, which are called substrates.

13.



The correct order of their reactivity towards hydrolysis at room temperature is :

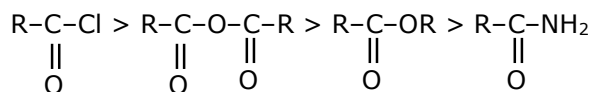
(1) (D) > (B) > (A) > (C)

(2) (D) > (A) > (B) > (C)

(3) (A) > (B) > (C) > (D)

(4) (A) > (C) > (B) > (D)

Sol. (3)



Reactivity towards Hydrolysis A > B > C > D

14. Spin only magnetic moment of an octahedral complex of Fe^{2+} in the presence of a strong field ligand in B.M. is

(1) 4.89

(2) 0

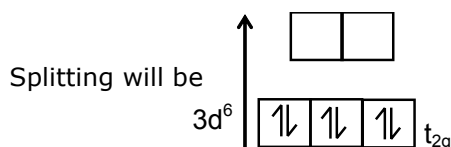
(3) 2.82

(4) 3.46

Sol. (2)

In presence of SFL $\Delta_0 > P$ means pairing occurs therefore

For Fe^{+2} $3d^6$



\therefore No of unpaired e^- (s) = 0

$\therefore \mu = \sqrt{n(n+2)} \text{ BM} = 0$

[n = No of unpaired e^- (s)]

In NiCl_2 Ni^{+2} is having configuration $3d^8$

\therefore Number of unpaired electron = 2

After formation of oxidised product

$[\text{Ni}(\text{CN})_6]^{-2}$ Ni^{+4} is obtained

$\text{Ni}^{+4} \Rightarrow 3d^6$ and CN^- is strong field ligand

\therefore number of unpaired electrons = 0

\therefore The charge is $2 - 0 = 2$

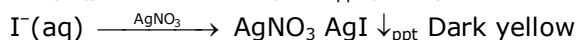
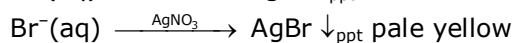
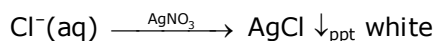
- 15.** In Carius method, halogen containing organic compound is heated with fuming nitric acid in the presence of :

(1) AgNO_3 (2) HNO_3 (3) BaSO_4 (4) CuSO_4

Sol. (1)

Organic compound is heated with fuming nitric acid in the presence of silver nitrate in carius method.

Lunar caustic (AgNO_3) is used as reagent here to distinguish Cl^- , Br^- and I^- respectively as follows.



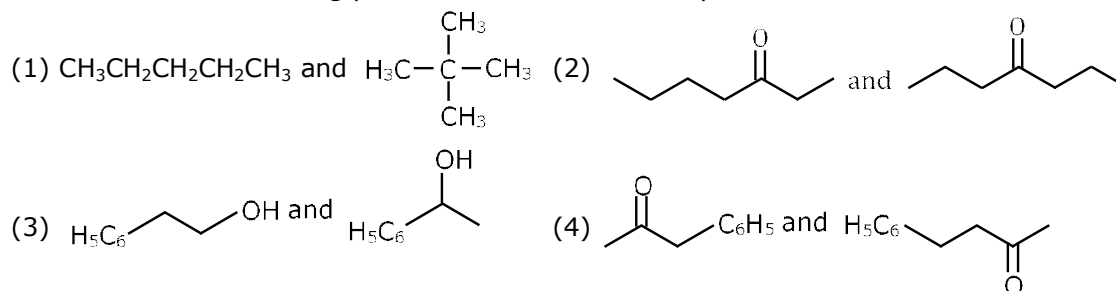
- 16.** Bakelite is a cross-linked polymer of formaldehyde and :

(1) Buna-S (2) Dacron (3) Novolac (4) PHBV

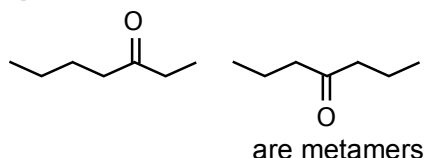
Sol. (3)

Novolac (phenol formaldehyde Resin) \rightarrow Bakelite

- 17.** Which one of the following pairs of isomers is an example of metamerism ?



Sol. (2)



- 18.** A solution is 0.1 M in Cl^- and 0.001 M in CrO_4^{2-} . Solid AgNO_3 is gradually added to it. Assuming that the addition does not change in volume and $K_{\text{sp}}(\text{AgCl}) = 1.7 \times 10^{-10} \text{ M}^2$ and $K_{\text{sp}}(\text{Ag}_2\text{CrO}_4) = 1.9 \times 10^{-12} \text{ M}^3$.

Select correct statement from the following :

- (1) AgCl will precipitate first as the amount of Ag^+ needed to precipitate is low.
 (2) AgCl precipitates first because its K_{sp} is high.
 (3) Ag_2CrO_4 precipitates first because the amount of Ag^+ needed is low.
 (4) Ag_2CrO_4 precipitates first as its K_{sp} is low.

Sol. (1)

(i) $[\text{Ag}^+]$ required to ppt $\text{AgCl}(\text{s})$

$$K_{\text{sp}} = \text{IP} = [\text{Ag}^+][\text{Cl}^-] = 1.7 \times 10^{-10}$$

$$[\text{Ag}^+] = 1.7 \times 10^{-9}$$

(ii) $[\text{Ag}^+]$ required to ppt $\text{Ag}_2\text{CrO}_4(\text{s})$

$$K_{\text{sp}} = \text{IP} = [\text{Ag}^+]^2[\text{CrO}_4^{2-}] = 1.9 \times 10^{-12}$$

$$[\text{Ag}^+] = 4.3 \times 10^{-5}$$

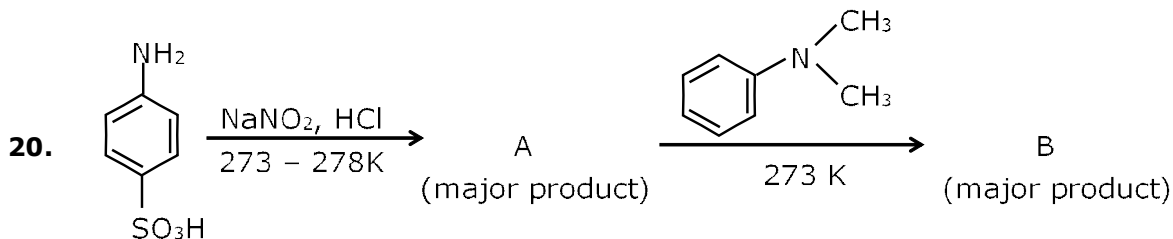
$[\text{Ag}^+]$ required to ppt AgCl is low so AgCl will ppt 1st.

19. Outermost electronic configuration of a group 13 element, E, is $4s^2, 4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is :

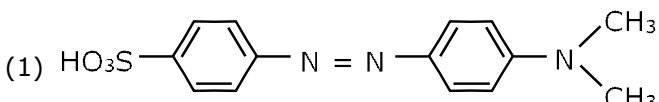
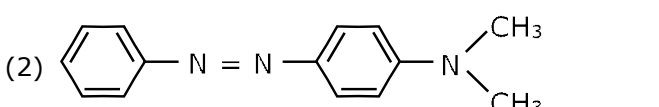

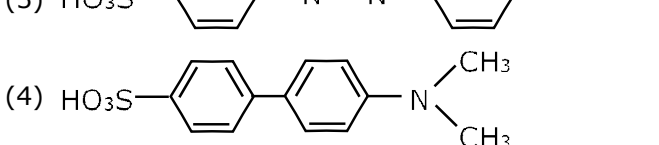
- (1) $[\text{Xe}] 5d^{10} 6s^2 6p^2$ (2) $[\text{Kr}] 4d^{10} 5s^2 5p^2$
 (3) $[\text{Kr}] 3d^{10} 4s^2 4p^2$ (4) $[\text{Ar}] 3d^{10} 4s^2 4p^2$

Sol. (2)

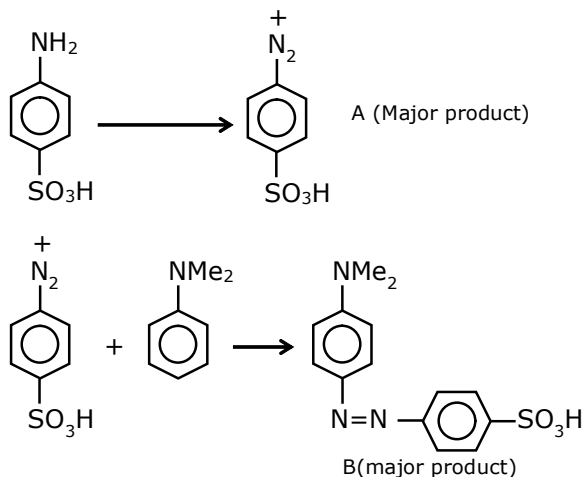
The element E is Ga and the diagonal element of 5th period is $_{50}\text{Sn}$ having outer electronic configuration will be $[\text{Kr}] 5s^2 4d^{10} 5p^2$.



Consider the above reaction, compound B is :

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

Sol. (1)



SECTION -B

1. For a given chemical $A \rightarrow B$ at 300 K the free energy change is $-49.4 \text{ kJ mol}^{-1}$ and the enthalpy of reaction is 51.4 kJ mol^{-1} . The entropy change of the reaction is _____ $\text{J K}^{-1} \text{ mol}^{-1}$.

Sol. (360) NTA, (336) Motion

Given chemical reaction:



$$\Delta H_{\text{rxn}} = 51.4 \text{ kJ/mol}$$

$$\Delta S_{\text{rxn}} = ?$$

$$\Rightarrow \text{From the relation } [\Delta G]_{p,T} = \Delta H - T\Delta S$$

$$\begin{aligned} \Rightarrow \Delta S_{\text{rxn}} &= \frac{\Delta H_{\text{rxn}} - [\Delta G]_{p,T}}{T} \\ &= \frac{[51.4 - (-49.4)] \times 100}{300} \frac{\text{J}}{\text{mol K}} \end{aligned}$$

$$\Rightarrow \Delta S_{\text{rxn}} = 336 \frac{\text{J}}{\text{mol K}}$$

2. 100 ml of 0.0018% (w/v) solution of Cl^- ion was the minimum concentration of Cl^- required to precipitate a negative sol in one h. The coagulating value of Cl^- ion is _____. (Nearest integer)

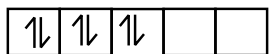
Sol. (1) NTA, (Bonus) Motion,

3. An aqueous solution of NiCl_2 was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[\text{Ni}(\text{CN})_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____.

Sol. (2)



$\text{Ni}^{+4} \rightarrow d^6$ strong field ligand



Pairing will be there zero unpaired electron



→ two unpaired e^-

Change = 2

4. When 0.15 g of an organic compound was analyzed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is _____. (Nearest integer)

[Atomic mass : Silver = 108, Bromine = 80]

Sol. (68)

Moles of Br = Moles of AgBr obtained

$$\Rightarrow \text{Mass of Br} = \frac{0.2397}{188} \times 80g$$

therefore % Br in the organic compound

$$\begin{aligned} &= \frac{W_{\text{Br}}}{W_{\text{T}}} \times 100 \\ &= \frac{0.2397 \times 80}{188 \times 0.15} \times 100 = 0.85 \times 80 \\ &= 68 \end{aligned}$$

\Rightarrow Nearest integer is '68'

5. The vapour pressures of A and B at 25°C are 90 mm Hg and 15 mm Hg respectively. If A and B are mixed such that the mole fraction of A in the mixture is 0.6, then the mole fraction of B in the vapour phase is $x \times 10^{-1}$. The value of x is _____. (Nearest integer)

Sol. (1)

Given $P_A^\circ = 90$ mm Hg, at 25°C

$P_B^\circ = 15$ mm Hg

$$\begin{aligned} \text{and } \left. \begin{array}{l} X_A = 0.6 \\ X_B = 0.4 \end{array} \right\} P_T &= X_A P_A^\circ + X_B P_B^\circ \\ &= (0.6 \times 90) + (0.4 \times 15) \\ &= 54 + 6 = 60 \text{ mm} \end{aligned}$$

Now mol fraction of B in the vapour phase

$$\text{i.e. } Y_B = \frac{P_B}{P_T} = \frac{X_B P_B^\circ}{60} = 0.1 = 1 \times 10^{-1}$$

Therefore: $x = 1$

6. Dimond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is _____.

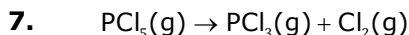
Sol. (8)

Carbon atoms occupy FCC lattice points as well as half of the tetrahedral voids

From face z = 4

From 50 % o.v. z = 4

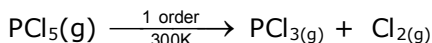
Total = 8



In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K. The rate constant for the reaction at 300 K is $X \times 10^{-2} \text{ min}^{-1}$. The value of x is _____.

[Given $\log 5 = 0.6989$]

Sol. (1)



$$t = 0 \quad 50 \text{ M}$$

$$t = 120 \text{ min } 10 \text{ M}$$

$$\Rightarrow K = \frac{2.303}{t} \log \frac{[A_0]}{[A_t]}$$

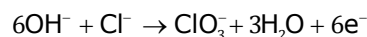
$$\Rightarrow K = \frac{2.303}{t} \log \frac{50}{10}$$

$$\Rightarrow K = \frac{2.303}{120} \times 0.6989 = 0.013413 \text{ min}^{-1}$$

$$= 1.3413 \times 10^{-2} \text{ min}^{-1}$$

$$1.34 \Rightarrow \text{Nearest integer} = 1$$

8. Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.

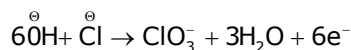


A current of xA has to be passed for 10h to produce 10.0 g of potassium chlorate. The value of x is _____. (Nearest integer)

(Molar mass of $\text{KClO}_3 = 122.6 \text{ g mol}^{-1}$, $F = 96500 \text{ C}$)

Sol. (1)

Given balanced equation is



$$\rightarrow 10 \text{ g KClO}_3 \Rightarrow \frac{10}{122.6} \text{ mol KClO}_3 \text{ is obtained}$$

→ From the above reaction, it is concluded that by 6F charge 1 mol KClO_3 is obtained.

→ By the passage of 6F charge = 1 mol KClO_3

$$\therefore \text{By the passage of } \frac{x \times 10 \times 60 \times 60}{96500} \text{ F charge}$$

$$= \frac{1}{6} \times \frac{x \times 10 \times 60 \times 60}{96500}$$

$$\text{Now } \frac{x \times 10 \times 60 \times 60}{6 \times 96500} = \frac{10}{122.6}$$

$$\Rightarrow x = \frac{10 \times 965}{60 \times 122.6} = \frac{965}{735.6} = 1.311 \approx 1$$

OR

$$W = \frac{E}{F} \times I \times t$$

$$10 = \frac{122.6}{96500 \times 6} \times x \times 10 \times 3600$$

$$X = 1.311$$

Ans.(1)

9. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is $X \times 10^{-12}$ m. The value of x is _____. (Nearest integer)

Given : Mass of electrons = 9.1×10^{-31} kg

Charge on an electron = 1.6×10^{-19} C

Planck's constant = 6.63×10^{-34} Js

Sol. (6)

De-broglie-wave length of electron:

$$\lambda_c = \frac{h}{\sqrt{2m(KE)}} \left\{ \begin{array}{l} \because e \text{ is accelerated} \\ \text{from rest} \\ \Rightarrow KE = q \times V \end{array} \right.$$

$$\lambda = \frac{h}{\sqrt{2mqv}}$$

$$= \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 1.6 \times 10^{-19} \times 9.1 \times 10^{-31} \times 40 \times 10^3}}$$

$$= 0.614 \times 10^{-11} \text{ m}$$

$$= 6.16 \times 10^{-12} \text{ m}$$

Nearest integer = 6

OR

$$\lambda = \frac{12.3}{\sqrt{V}} \text{ \AA}$$

$$= \frac{12.3}{200} = 6.15 \times 10^{-12} \text{ m}$$

Ans is 6

10. 4g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3 . The value of x is _____ g. (Nearest integer)

Sol. (1)

Total mass = 4g

Now

$$\text{NaOH} : a \text{ mol} \quad W_{\text{NaOH}} + W_{\text{Na}_2\text{CO}_3} = 4$$

$$\text{Na}_2\text{CO}_3 : 'a' \text{ mol} \quad \Rightarrow 40a + 106 a = 4$$

$$\Rightarrow a = \frac{4}{146} \text{ mol}$$

$$\begin{aligned} \Rightarrow \text{therefore mass of NaOH is : } & \frac{4}{146} \times 40 \text{ g} \\ & = 1.095 \approx 1 \end{aligned}$$

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