CHEMISTRY

SECTION-A

1. Which one of the following set of elements can be detected using sodium fusion extract ?

(1) Sulfur, Nitrogen, Phosphorous, Halogens

(2) Phosphorous, Oxygen, Nitrogen, Halogens

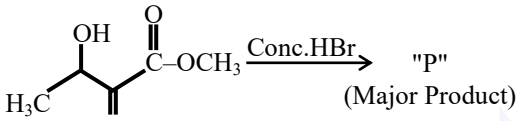
(3) Nitrogen, Phosphorous, Carbon, Sulfur

(4) Halogens, Nitrogen, Oxygen, Sulfur

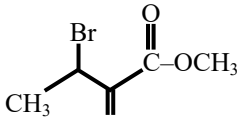
Official Ans. by NTA (1)

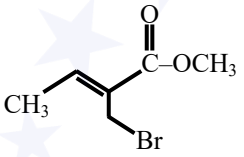
Sol. By sodium fusion extract we can detect sulphur, nitrogen, Phosphorous and halogens, because they are converted in to their ionic form with sodium metal.

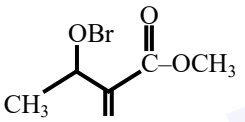
2.

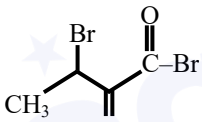


Consider the above reaction, the major product "P" formed is :-

(1) 

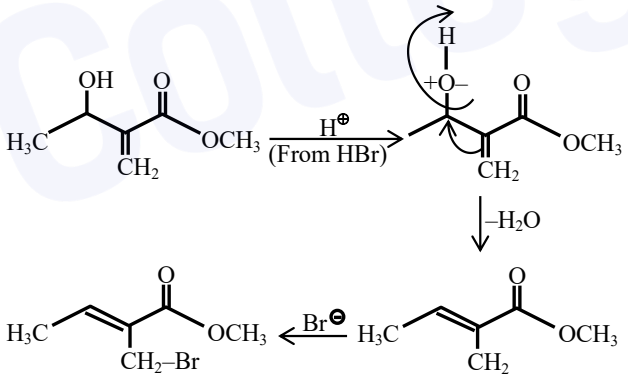
(2) 

(3) 

(4) 

Official Ans. by NTA (2)

Sol.



3. The number of neutrons and electrons, respectively, present in the radioactive isotope of hydrogen is :-

(1) 1 and 1 (2) 3 and 1

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

Official Ans. by NTA (3)

Sol. Radioactive isotope of hydrogen is Tritium $\left({}_{1}^{3}T\right)$

No. of neutrons (A–Z) = 3 – 1 = 2

No. of electrons = 1

4. Match List - I with List II :

List - I		List - II	
(a)	Li	(i)	photoelectric cell
(b)	Na	(ii)	absorbent of CO_2
(c)	K	(iii)	coolant in fast breeder nuclear reactor
(d)	Cs	(iv)	treatment of cancer
		(v)	bearings for motor engines

Choose the **correct** answer from the options given below :

(1) (a) - (v), (b) - (i), (c) - (ii), (d) - (iv)

(2) (a) - (v), (b) - (ii), (c) - (iv), (d) - (i)

(3) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

(4) (a) - (v), (b) - (iii), (c) - (ii), (d) - (i)

Official Ans. by NTA (4)

Sol. Li makes alloy with Lead to make white metal bearings for motor engines

Liquid Na metal is used as coolant in fast breeder nuclear reactor

K is a very absorbent of CO_2

Cs is used in making photoelectric cell

5. Given below are two statement : one is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : $SO_2(g)$ is adsorbed to a large extent than $H_2(g)$ on activated charcoal.

Reason R : $SO_2(g)$ has a higher critical temperature than $H_2(g)$.

In the light of the above statements, choose the most appropriate answer from the options given below.

(1) Both **A** and **R** are correct but **R** is not the correct explanation fo **A**

(2) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(3) **A** is not correct but **R** is correct.

(4) **A** is correct but **R** is not correct.

Official Ans. by NTA (2)

Sol. Gases having higher critical temperature absorb to a greater extent.

6. The **CORRECT** order of first ionisation enthalpy is :

(1) Mg < S < Al < P (2) Mg < Al < S < P

(3) Al < Mg < S < P (4) Mg < Al < P < S

Official Ans. by NTA (3)

Sol. Mg Al P S $\rightarrow$ IE. order $\Rightarrow$ Al< Mg < S < P

Valence $[N_e]$: $\overset{Mg}{3s^2}$ $\overset{A\ell}{3s^2 3p^1}$ $\overset{P}{3s^2 3p^3}$ $\overset{S}{3s^2 3p^4}$

$\uparrow$ $\uparrow$

Full Filled Stable — Half Filled Stable

7. Given below are two statements :

Statement I : Hyperconjugation is a permanent effect.

Statement II : Hyperconjugation in ethyl cation $\left(CH_3-\overset{+}{C}H_2\right)$ involves the overlapping of $C_{sp^2}-H_{1s}$ bond with empty 2p orbital of other carbon.

Choose the **correct** option :

(1) Both **statement I** and **statement II** are false

(2) **Statement I** is incorrect but **statement II** is true

(3) **Statement I** is correct but **statement II** is false

(4) Both **Statement I** and **statement II** are true.

Official Ans. by NTA (3)

Sol. **Statement I :** It is correct statement

Statement II : $CH_3-\overset{\oplus}{C}H_2$ involve $C_{sp^3}-H_{1s}$ bond with empty 2p orbital hence given statement is false.

8. Given below are two **statements** :

Statement I : $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.

Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) **Statement I** is correct but **statement II** is false

(2) Both **statement I** and **statement II** are false

(3) **Statement I** is incorrect but **statement II** is true

(4) Both **statement I** and **statement II** are are true

Official Ans. by NTA (4)

Sol. $[Mn(CN)_6]^{3-}$ $[Fe(CN)_6]^{3-}$ $[Co(C_2O_4)_3]^{3-}$

$\Downarrow$

Mn^{3+} CN^- Fe^{3+}, CN^- Co3+, $C_2O_4^{2-}$

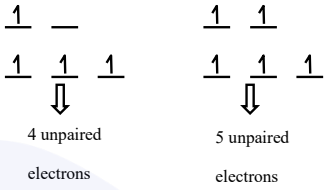
d^4 configuration, SFL d^5 configuration, SFL d^6 configuration, Chelating ligand

$\Rightarrow$ All will have larger splitting hence d^2sp^3 hybridisation

$[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$

d^4 configuration, Cl^- d^5 configuration, F^-

WFL WFL



9. To an aqueous solution containing ions such as Al^{3+}, Zn^{2+}, Ca^{2+}, Fe^{3+}, Ni^{2+}, Ba^{2+} and Cu^{2+} was added conc. HCl, followed by H_2S.

The total number of cations precipitated during this reaction is/are :

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

Official Ans. by NTA (1)

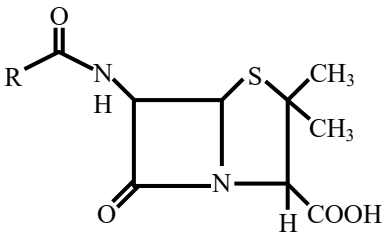
Sol. Al^{3+} and Fe^{3+} sulphides hydrolyse in water.

Ni^{2+} and Zn^{2+} require basic medium with H_2S to form ppt Ca^{2+} and Ba^{2+} sulphides are soluble hence we will receive only CuS ppt.

10. Given below are two **statements** :

Statement I : Penicillin is a bacteriostatic type antibiotic.

Statement II : The general structure of Penicillin is:



Choose the correct option :

(1) Both **statement I** and **statement II** are false

(2) **Statement I** is incorrect but **statement II** is true

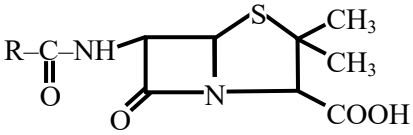
(3) Both **statement I** and **statement II** are true

(4) **Statement I** is correct but **statement II** is false

Official Ans. by NTA (2)

Sol. **Statement I**: Pencillin is bactericidal not bacteriostatic hence given statement is false.

Statement II: Structure of pencilline given is correct



11. Compound **A** gives D-Galactose and D-Glucose on hydrolysis. The compound **A** is :

(1) Amylose (2) Sucrose

(3) Maltose (4) Lactose

Official Ans. by NTA (4)

Sol. **Lactose :** It is a disaccharide of β–D–Galactose and β–D–Glucose with C_1 of galactose and C_4 of glucose link.

Lactose : β–D–Galactose + β–D–Glucose

12. $R - CN \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL-H} R - Y$

Consider the above reaction and identify "Y"

(1) $-CH_2NH_2$ (2) $-CONH_2$

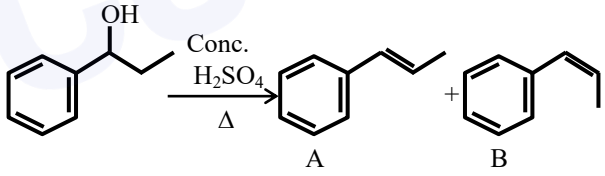
(3) –CHO (4) –COOH

Official Ans. by NTA (3)

Sol. $R-C\equiv N \xrightarrow[(2)\ H_2O]{(1)\ DiBAL-H} R-\underset{\underset{O}{\|}}{C}-H$

Here Y is $-\underset{\underset{O}{\|}}{C}-H$ Aldehyde

13.



consider the above reaction, and choose the correct statement :

(1) The reaction is not possible in acidic medium

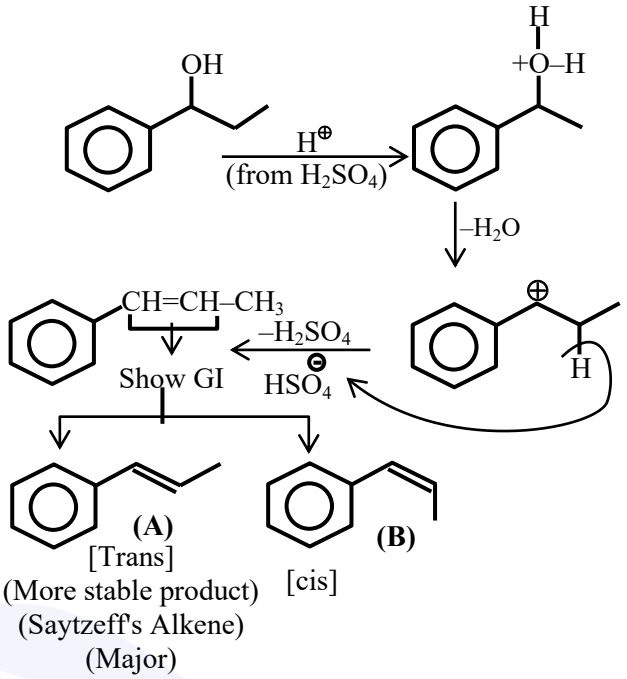
(2) Both compounds **A** and **B** are formed equally

(3) Compound **A** will be the major product

(4) Compound **B** will be the major product

Official Ans. by NTA (3)

Sol.



(A) [Trans] (More stable product) (Saytzeff's Alkene) (Major)

(B) [cis]

14. Match List - I with List - II :

List - I (compound)		List - II (effect/affected species)	
(a)	Carbon monoxide	(i)	Carcinogenic
(b)	Sulphur dioxide	(ii)	Metabolized by pyrus plants
(c)	Polychlorinated biphenyls	(iii)	Haemoglobin
(d)	Oxides of Nitrogen	(iv)	Stiffness of flower buds

Choose the **correct** answer from the options given below :

(1) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

(2) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

(3) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

(4) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

Official Ans. by NTA (1)

15. If the Thompson model of the atom was correct, then the result of Rutherford's gold foil experiment would have been :

(1) All of the α-particles pass through the gold foil without decrease in speed.

(2) α-Particles are deflected over a wide range of angles.

(3) All α-particles get bounced back by 180°

(4) α-Particles pass through the gold foil deflected by small angles and with reduced speed.

Official Ans. by NTA (4)

Sol. As in Thomson model, protons are diffused (charge is not centred) α- particles deviate by small angles and due to repulsion from protons, their speed decreases.

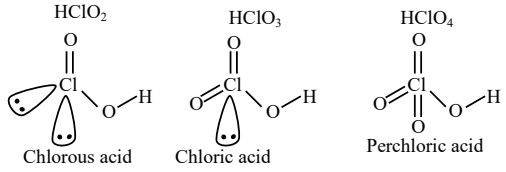
16. Number of Cl = O bonds in chlorous acid, chloric acid and perchloric acid respectively are :

(1) 3, 1 and 1 (2) 4, 1 and 0

(3) 1, 1 and 3 (4) 1, 2 and 3

Official Ans. by NTA (4)

Sol. Number of Cl = O bonds



17. Select the correct statements.

(A) Crystalline solids have long range order.

(B) Crystalline solids are isotropic.

(C) Amorphous solid are sometimes called pseudo solids.

(D) Amorphous solids soften over a range of temperatures.

(E) Amorphous solids have a definite heat of fusion.

Choose the most appropriate answer from the options given below.

(1) (A), (B), (E) only

(2) (B), (D) only

(3) (C), (D) only

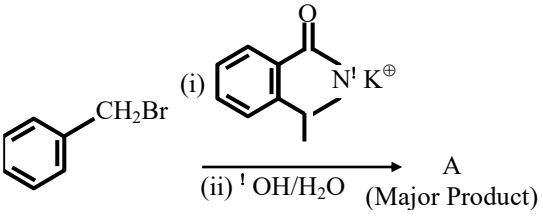
(4) (A), (C), (D) only

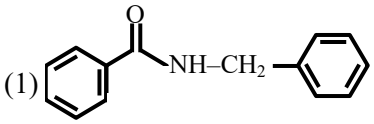
Official Ans. by NTA (4)

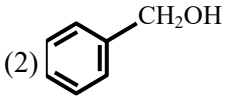
Sol. (A) Crystalline solids have definite arrangement of constituent particles and have long range order.

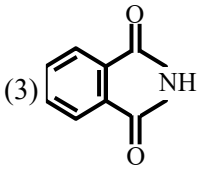
(C), (D) Different constituent particles of an amorphous solid have different bond strengths and soften over a range of temperatures.

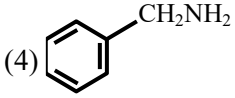
18. What is A in the following reaction ?



(1) 

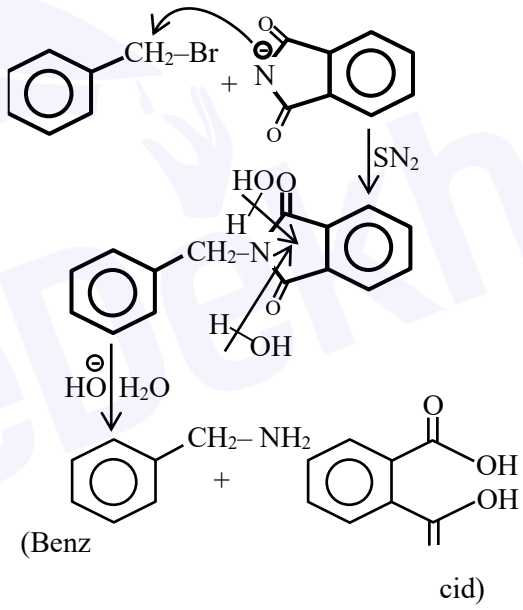
(2) 

(3) 

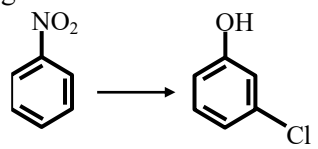
(4) 

Official Ans. by NTA (4)

Sol.



19. The correct sequence of correct reagents for the following transformation is :-



(1) (i) Fe, HCl (ii) Cl_2, HCl, (iii) $NaNO_2$, HCl, 0°C (iv) H_2O/H^+

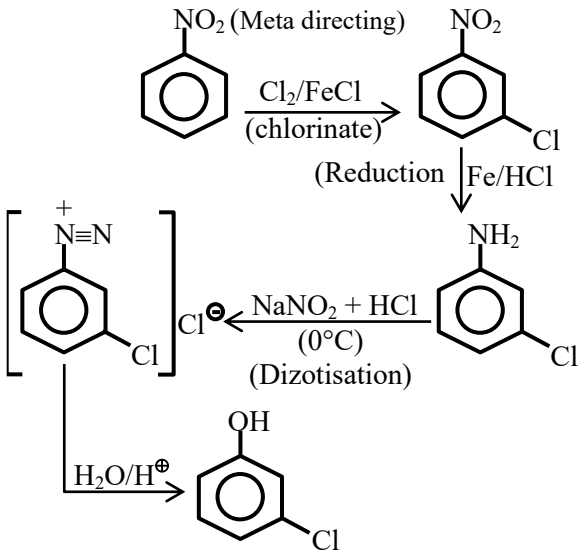
(2) (i) Fe, HCl (ii) $NaNO_2$, HCl, 0°C (iii) H_2O/H^+ (iv) Cl_2, $FeCl_3$

(3) (i) Cl_2, $FeCl_3$ (ii) Fe, HCl (iii) $NaNO_2$, HCl, 0°C (iv) H_2O/H^+

(4) (i) Cl_2, $FeCl_3$ (ii) $NaNO_2$, HCl, 0°C (iii) Fe, HCl (iv) H_2O/H^+

Official Ans. by NTA (3)

Sol.



20. The addition of silica during the extraction of copper from its sulphide ore :-

(1) converts copper sulphide into copper silicate
(2) converts iron oxide into iron silicate
(3) reduces copper sulphide into metallic copper
(4) reduces the melting point of the reaction mixture

Official Ans. by NTA (2)

Sol. Silica is used to remove FeO impurity from the ore of copper

$$FeO + SiO_2 \rightarrow \underset{\text{iron silicate (Slag)}}{FeSiO_3}$$

SECTION-B

1. The equilibrium constant for the reaction

$$A(s) \rightleftharpoons M(s) + \frac{1}{2}O_2(g)$$

is $K_p = 4$. At equilibrium, the partial pressure of O_2 is _____ atm. (Round off to the nearest integer)

Official Ans. by NTA (16)

Sol. $k_p = Po_2^{1/2} = 4$

$\therefore \quad Po_2 = 16 \text{ bar} = 16 \text{ atm}$

2. When 400 mL of 0.2M H_2SO_4 solution is mixed with 600 mL of 0.1 M NaOH solution, the increase in temperature of the final solution is _____ $\times 10^{-2}$ K. (Round off to the nearest integer).

[Use : $H^+(aq) + OH^-(aq) \rightarrow H_2O$:

$\Delta_\gamma H = -57.1 \text{ kJ mol}^{-1}$]

Specific heat of $H_2O = 4.18 \text{ J K}^{-1} \text{ g}^{-1}$

density of $H_2O = 1.0 \text{ g cm}^{-3}$

Assume no change in volume of solution on mixing.

Official Ans. by NTA (2)

Ans. (82)

Sol. $n_{H^+} = \frac{400 \times 0.2}{1000} \times 2 = 0.16$

$n_{OH^-} = \frac{600 \times 0.1}{1000} = 0.06 \text{ (L.R)}$

Now, heat liberated from reaction

= heat gained by solutions

or, $0.06 \times 57.1 \times 10^3$

$= (1000 \times 1.0) \times 4.18 \times \Delta T$

$\therefore \Delta T = 0.8196 \text{ K}$

$= 81.96 \times 10^{-2} \text{ K} \approx 82 \times 10^{-2} \text{ K}$

3. $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

The above reaction is carried out in a vessel starting with partial pressure $P_{SO_2} = 250 \text{ m bar}$, $P_{O_2} = 750 \text{m}$ bar and $P_{SO_3} = 0 \text{ bar}$. When the reaction is complete, the total pressure in the reaction vessel is _____ m bar. (Round off of the nearest integer).

Official Ans. by NTA (875)

Sol.

	$2SO_2(g)$	+ $O_2(g)$	$\rightarrow$ $2SO_3(g)$
Initial	250 m bar	750 m bar	O
		(L. R.)	
Final	–250 m bar	– 125 m bar	250 m bar
	0	625 m bar	250 m bar

$\therefore$ Final total pressure = 625 + 250 = 875 m bar

4. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is ..... $\times 10^{-2}$ g/L.

(Round off to the nearest integer)

Official Ans. by NTA (1575)

Sol. $n_{eq}\ KMnO_4 = n_{eq}\ H_2C_2O_4 . 2H_2O$

$$\text{or}, \frac{10\times 0.05}{1000}\times 5 = \frac{10\times M}{1000}\times 2$$

$\therefore$ Conc. of oxalic acid solution = 0.125 M

$= 0.125 \times 126$ g /L = 15.75 g/L

$= 1575 \times 10^{-2}$ g/L

5. The total number of electrons in all bonding molecular orbitals of O_2^{2-} is ..... .

(Round off to the nearest integer)

Official Ans. by NTA (10)

Sol. M. O. Configuration of O_2^{2-} $(18\bar{e})$

$$\sigma 1s^2\ \overset{*}{\sigma} 1s^2 \sigma 2s^2\ \overset{*}{\sigma} 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2$$

$$\overset{*}{\pi} 2p_x^2 = \overset{*}{\pi} 2p_y^2$$

Total B.M.O electrons = 10

6. 3 moles of metal complex with formula $Co(en)_2Cl_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is _____.

(Round off to the nearest integer)

Official Ans. by NTA (6)

Sol. $3\left[Co(en)_2Cl_2\right]C\ell + \underset{\text{(excess)}}{AgNO_3} \rightarrow \underset{\text{(white ppt.)}}{3AgCl}$

Secondary valency of Co = 6

(C. N.)

7. In a solvent 50% of an acid HA dimerizes and the rest dissociates. The van't Hoff factor of the acid is _____ $\times 10^{-2}$.

(Round off to the nearest integer)

Official Ans. by NTA (125)

Sol. $2HA \rightleftharpoons H_2A_2 \quad HA \rightleftharpoons H^+ + A$

Initial moles	$a\times\frac{50}{100}$	0	$a\times\frac{50}{100}$	0	0
Final moles	0	0.25 a	0	0.5a	0.5a

Now, $i = \frac{\text{final moles}}{\text{initial moles}} = \frac{0.25a + 0.5a + 0.5a}{0.5a + 0.5a}$

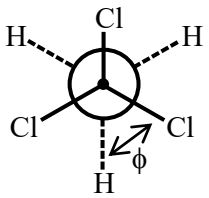
$= 1.25 = 125 \times 10^{-2}$

8. The dihedral angle in staggered form of Newman projection of 1, 1, 1-Trichloro ethane is ..... degree. (Round off to the nearest integer)

(Round off to the nearest integer)

Official Ans. by NTA (60)

Sol. 1,1,1–Trichloro ethane [CCl_3–CH_3]



Dihedral angle(ϕ) = 60°

(Newmonns stqqared form)

9. For the first order reaction A $\rightarrow$ 2B, 1 mole of reactant A gives 0.2 moles of B after 100 minutes. The half life of the reaction is ..... min. (Round off to the nearest integer).

[Use : ln 2 = 0.69, ln 10 = 2.3

Properties of logarithms : $\ln x^y = y \ln x$;

$$\ln\left(\frac{x}{y}\right) = \ln x - \ln y]$$

(Round off to the nearest integer)

Official Ans. by NTA (300)

Sol.

	A	$\longrightarrow$	2B
t = 0	1 mole		0
t = 100 min	1 – x		2x
	= 0.9mol		= 0.2mol

Now, $t = \frac{t_{1/2}}{\ln 2}\times\frac{[A_0]}{[A_t]}$

$100 = \frac{t_{1/2}}{\ln 2} \times \ln\frac{1}{0.9} \Rightarrow t_{1/2} = 690$ min.

(taking ln 3 = 1.11)

10. For the cell

$Cu(s) \mid Cu^{2+}(aq)\ (0.1M) \parallel Ag^+\ (aq)\ (0.01M) \mid Ag(s)$

the cell potential $E_1 = 0.3095$ V

For the cell

$Cu(s) \mid Cu^{2+}\ (aq)\ (0.01\ M) \parallel Ag^+(aq)\ (0.001\ M) \mid Ag(s)$

the cell potential = _____ $\times 10^{-2}$ V. (Round off the Nearest Integer).

$$[\text{Use} : \frac{2.303\ RT}{F} = 0.059\ ]$$

Official Ans. by NTA (28)

Sol. Cell reaction is :

$$Cu(s) + 2\,Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$$

Now, $E_{cell} = E^{o}_{Cell} - \frac{0.059}{2}\log\frac{\left[Cu^{2+}\right]}{\left[Ag^{+}\right]^{2}}$ .... (1)

$\therefore E_1 = 0.3095 = E^{o}_{Cell} - \frac{0.059}{2}.\log\frac{0.01}{(0.001)^{2}}$ ... (2)

From (1) and (2) , $E_2 = 0.28\ V = 28 \times 10^{-2}\ V$