CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Find out E^o_{cell} of the given cell.

$M \mid M^{2+} \parallel X^{2-} \mid X$

$E^o_{M^{2+}|M} = 0.34$ V

$E^o_{X|X^{2-}} = 0.46$ V

(1) 0.80 V (2) 0.12 V

(3) –0.12 V (4) –0.80 V

Answer (2)

Sol. $M \longrightarrow M^{2+} + 2e^-$ (Anode)

$X + 2e^- \longrightarrow X^{2-}$ (Cathode)

$M + X \longrightarrow M^{2+} + X^{2-}$

$E^o_{cell} = (E^o_{M|M^{2+}}) + (E^o_{X|X^{2-}})$

$= -0.34 + 0.46$

$= 0.12$ V

2. Which of the following is true regarding coagulation of egg?

(1) 1° structure does not change

(2) 2° structure does not change

(3) 3° structure does not change

(4) Denaturation of protein does not occur

Answer (1)

Sol. Coagulation of egg white on boiling is a common example of denaturation in which primary structure only remains intact.

3. Angular momentum of an electron in an orbit of radius R of a hydrogen atom is directly proportional to ____.

(1) R (2) $\frac{1}{R}$

(3) $\frac{1}{\sqrt{R}}$ (4) $\sqrt{R}$

Answer (4)

Sol. $\frac{mv^2}{R} = \frac{KZe^2}{R^2}$

$mv = \sqrt{\frac{KZe^2m}{R}}$

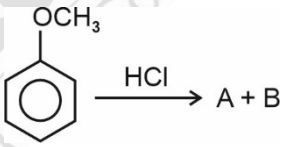
Angular momentum, L is given by

$L = mvR = R\sqrt{\frac{KZe^2m}{R}}$

$= \sqrt{KZe^2mR}$

$\propto \sqrt{R}$

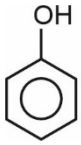
4. Consider the following sequence of reaction



A and B products respectively are :

(1)  and CH_3OH

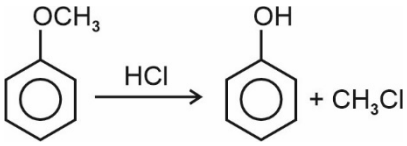
(2)  and $CH_3–Cl$

(3)  and CH_3OH

(4)  and CH_3Cl

Answer (2)

Sol.



Due to partial double bond character between oxygen and carbon atom of phenyl ring bond can't break easily.

5. Find out the value of $\frac{C_P}{C_V}$ for an ideal gas undergoing reversible adiabatic process for which $\boxed{P \propto T^3}$ is given

(1) $\frac{4}{3}$ (2) $\frac{3}{2}$

(3) $\frac{5}{4}$ (4) $\frac{5}{3}$

Answer (2)

Sol. $PT^{-3} =$ Constant (C)

$P(PV)^{-3} = C$

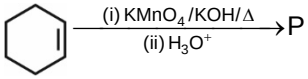
$P^1P^{-3}V^{-3} = C$

$P^{-2}V^{-3} = C$

$P^2V^3 = C$

$PV^{\frac{3}{2}} = C$

6. Consider the following reaction.



The product (P) is

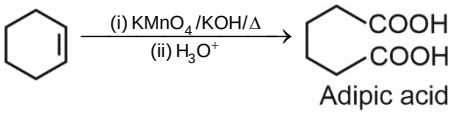
(1) Adipic acid

(2) Oxalic acid

(3) Succinic acid

(4) Benzoic acid

Answer (1)

Sol. 

Adipic acid

7. Consider the following two statements :

S-I : NH_3 is more polar than NF_3.

S-II : N – H dipole is directed towards N while in case of NF_3 towards F as F is more electronegative.

Select the correct option.

(1) Both statements are correct and Statement-II is not correct explanation of Statement-I

(2) Both statements are correct and Statement-II is correct explanation of Statement-I

(3) Statement-I and Statement-II both are incorrect

(4) Statement-I is correct and Statement-II is incorrect

Answer (2)

Sol. The direction of electric dipole is towards negative pole in case of N – H the negative pole of N while in case of N – F the negative pole is F as order of electronegativity is F > N > H.

8. From the given information, calculate enthalpy of formation of 2 moles of $C_6H_6(l)$ at 25°C.

Given:

$\Delta_cH(C_6H_6(l)) = -3264.6$ kJ/mol

$\Delta_cH(C(s)) = -393.5$ kJ/mol

$\Delta_fH(H_2O(l)) = -285.83$ kJ/mol

(1) –124.5 kJ/mol (2) –46.11 kJ/mol

(3) 46.11 kJ/mol (4) 124.5 kJ/mol

Answer (3)

Sol. Formation reaction

$$6C(s) + 3H_2(g) \rightarrow C_6H_6(l)$$

$$\Delta_fH(C_6H_6) = 6\Delta_cH(C(s)) + 3\Delta_cH(H_2(g)) - \Delta_cH(C_6H_6(l))$$

$$= 6(-393.5) + 3(-285.83) - (-3264.6)$$

$[\because \quad \Delta_fH(H_2O(l)) = \Delta_cH(H_2(g))]$

= 3264.6 – 2361 – 857.49

= 46.11 kJ/mol

9. Choose the option with correct matching for given molecules

Column A	Column B
(A) ICl	(P) T-shape
(B) ICl_3	(Q) Pentagonal Bipyramidal
(C) ClF_5	(R) Linear
(D) IF_7	(S) Square Pyramidal

(1) A → R, B → P, C → Q, D → S

(2) A → R, B → P, C → S, D → Q

(3) A → Q, B → S, C → R, D → P

(4) A → P, B → R, C → S, D → Q

Answer (2)

Sol. IF_7 $SN = \frac{7+7}{2} = 7 \longrightarrow$ P.b.p

ClF_5 $SN = \frac{7+5}{2} = 6 \longrightarrow 1$ lone pair

Square pyramidal

ICl_3 $SN = \frac{7+3}{2} = 5 \longrightarrow 2$ lone pair

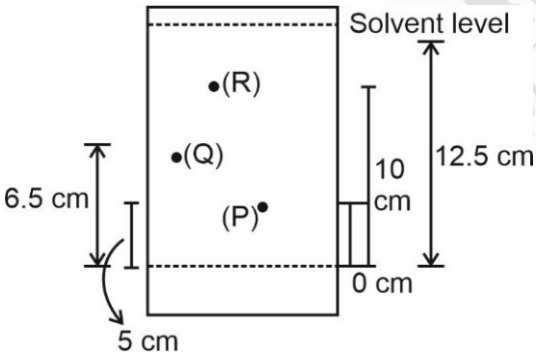
T – Shape

ICl $SN = \frac{7+1}{2} = 4 \longrightarrow 3$ lone pair

Linear

A → R, B → P, C → S, D → Q

10. The ratio of R_f value for P and R is



(1) 0.50 (2) 0.80

(3) 0.65 (4) 2

Answer (1)

Sol. $(R_f)_P = \frac{5}{12.5}$

$(R_f)_R = \frac{10}{12.5}$

Ratio of R_f value of P and R

$= \frac{5}{12.5} \times \frac{12.5}{10} = \frac{1}{2}$

11. Which of the following molecule is an acidic oxide?

(1) N_2O_3

(2) NO

(3) CO

(4) CaO

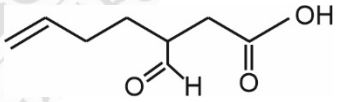
Answer (1)

Sol. N_2O_3 → Acidic oxide

NO and CO → Neutral oxide

CaO → Basic oxide

12. What is the IUPAC name of :



(1) 3-formylhept-6-enoic acid

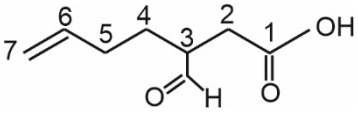
(2) 3-aldohept-7-enoic acid

(3) 3-ketohept-6-enoic acid

(4) 3-oxohept-6-enoic acid

Answer (1)

Sol.



3-formylhept-6-enoic acid

13. Which of the following metal ions can replace hydrogen ion from an acidic solution?

V^{+2}, Ti^{+2}, Cr^{+3}

(1) Only one (2) Only two

(3) All of these (4) None of these

Answer (3)

Sol. The standard reduction potential values of the given metal ions to their respective metals are negative.

$E^{\circ}_{V^{+2}/V} = -1.18$ V

$E^{\circ}_{Ti^{+2}/Ti} = -1.63$ V

$E^{\circ}_{Cr^{+3}/Cr} = -0.74$ V

Therefore, all of these metal ions will replace hydrogen ion from an acidic solution.

14. Equanil drug is used for which disease?

(1) Infertility

(2) Hypertension and depression

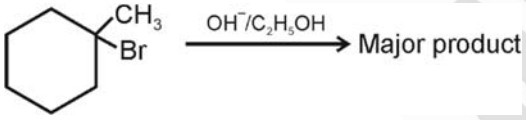
(3) Acidity

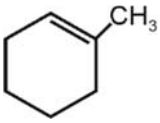
(4) Eye-itching

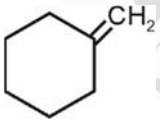
Answer (2)

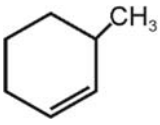
Sol. Equanil is a mild tranquilizer used to treat hypertension and depression.

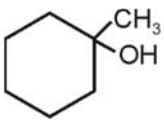
15. Consider the following reaction and identify the major product formed in it.



(1) 

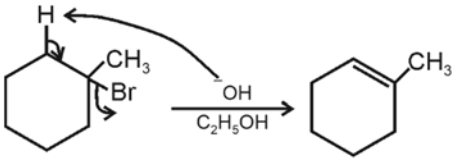
(2) 

(3) 

(4) 

Answer (1)

Sol. 1-Bromo-1-methylcyclohexane when treated with alcoholic OH^- undergoes dehydrobromination by E_2 mechanism to give 1-methylcyclohexene as the major product



(Major)

16.

17.

18.

19.

20.

SECTION - B

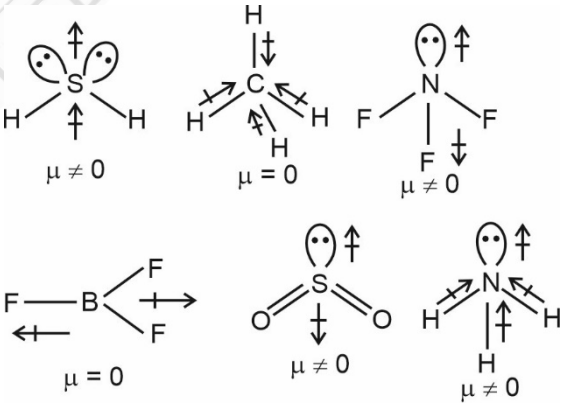
Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. How many of the following have zero dipole moment?

H_2S, CH_4, NH_3, BF_3, SO_2, NF_3

Answer (2)

Sol.

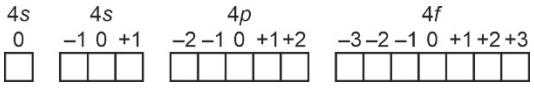


CH_4 and BF_3 have zero dipole moment

22. In an atom, how many maximum electrons that can have (i) n = 4, (ii) $m_l = 1$, (iii) $m_s = -\frac{1}{2}$?

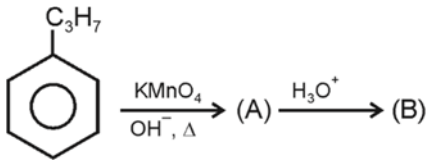
Answer (3)

Sol. In n = 4 shell,



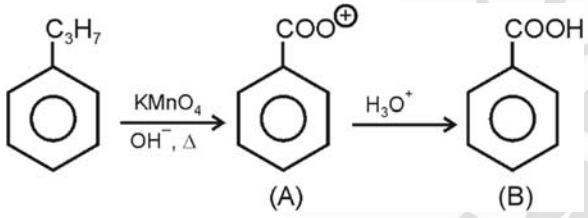
Total orbitals with $m_l = 1 \rightarrow 3$

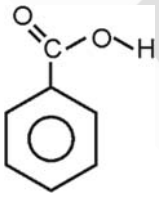
Total e^- with $m_s = -\frac{1}{2} \rightarrow 3$

23. 

Number of π bonds present in product B is:

Answer (4)

Sol. 

Number of π bonds in B:  are : 4

24. One coulomb charge is passed through $AgNO_3$ solution during electrolysis. Find mass of silver (in mg) deposited at the electrode. (nearest integer)

Answer (1)

Sol. Equivalents of charge = $\frac{1}{96500}$

Equivalents of Ag deposited = $\frac{1}{96500}$

Mass of Ag deposited = $\frac{108}{96500}$ g

= 1.12 mg

Nearest integer = 1

25. For the reaction:

$$CH_4 + O_2 \longrightarrow CO_2 + H_2O$$

How many moles of methane will be required for formation of 11 g of CO_2?

Answer (0.25)

Sol. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

1 mole of CH_4 will produce 1 mole of CO_2

So, 11 g of CO_2 will be produced by $\frac{11}{44}$ moles of CH_4

i.e., $\frac{1}{4}$ moles of CH_4 = 0.25

26. In the following reaction, HCl formed is titrated with 0.2 moles of NaOH. Calculate the mass of C_2H_5–NH_2 taken initially.

$$C_2H_5 - NH_2 + NaNO_2 \xrightarrow{HCl} A \xrightarrow{H_2O} HCl + Alcohol + N_2$$

Answer (9)

Sol.

$$C_2H_5 - NH_2 + NaNO_2 \xrightarrow{HCl} \underset{(A)}{C_2H_5 - N_2^+Cl^-} \xrightarrow{H_2O} \underset{(alcohol)}{C_2H_5 - OH} + HCl + N_2$$

1 mole of C_2H_5–NH_2 will form 1 mole of $C_2H_5 - N_2^+Cl^-(A)$ which will further reacts to form 1 mole of HCl.

$\because$ 0.2 moles of NaOH is used. So,

n_{HCl} formed = 0.2

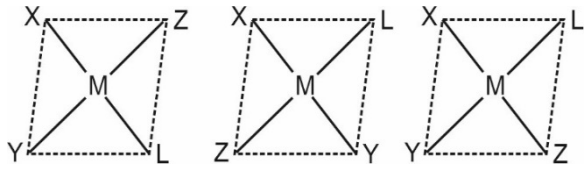
So, $n_{C_2H_5-NH_2}$ taken initial = 0.2

Mass of $C_2H_5 - NH_2$ = 0.2 × 45 = 9

27. If square planar complex [MXYZL] has all the four unidentate ligand then find out its total number of geometrical isomers.

Answer (3)

Sol. The given square planar complex has 3 geometrical isomers.



28. If λ_{max} for Lyman series of H-atom is 912 Å, then calculate λ_{min} for Balmer series of H-atom (in Å).

Answer (2736)

Sol. λ_{max} for Lyman series (E = 2 → E = 1)

$$\frac{1}{912} = R(1)^2\left(\frac{1}{1}-\frac{1}{4}\right)$$

$$\frac{1}{912} = R\times\frac{3}{4}$$

$$R = \frac{4}{912\times 3}$$

λ_{min} for Balmer series $(E = \infty \rightarrow E = 2)$

$$\frac{1}{\lambda} = R(1)\left(\frac{1}{4}\right)$$

$$= \frac{4}{912\times 3}\times\frac{1}{4}$$

$$= \frac{1}{912\times 3}$$

$\lambda = 912 \times 3$

$= 2736$ Å

29. Chromite ore + $Na_2CO_3 \xrightarrow[\text{fusion}]{\text{air}}$ A(s) + B(s) + CO_2

What is the value of sum of magnetic moment (in B.M.) of A and B? (Nearest integer)

Answer (6)

Sol. $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow$

$8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

A and B are Na_2CrO_4/CrO_4^{2-} and Fe_2O_3.

Oxidation state of Cr in CrO_4^{2-} is +6, hence it has zero electrons in its ns as well as (n – 1)d. So, the magnetic moment of chromate will be zero.

Oxidation state of Fe in Fe_2O_3 is +3, hence Fe has $(n-1)d^5\ ns^0$ electronic configuration, *i.e.*, five unpaired electron in each Fe. So, the magnetic moment of Fe will be 5.92 B.M.

Sum is 5.92 + 0.0 = 5.92

Nearest integer = 6

30. How many species have zero electron in t_2?

$TiCl_4, MnO_4^-, [FeO_4]^{2-}, [FeCl_4]^-, [CoCl_4]^-$

Answer (3)

Sol. $TiCl_4 \Rightarrow Ti^{4+} = 3d^o 4s^o \Rightarrow e^o t_2^o$

$MnO_4^- \Rightarrow Mn^{+7} = 3d^o 4s^o \Rightarrow e^o t_2^o$

$[FeO_4]^{2-} \Rightarrow Fe^{+6} = 3d^2 4s^o \Rightarrow e^2 t_2^0$

$[FeCl_4]^- \Rightarrow Fe^{+3} = 3d^5 4s^o \Rightarrow e^2 t_2^3$

$[CoCl_4]^- \Rightarrow Co^{+3} \Rightarrow 3d^6 4s^o \Rightarrow e^3 t_2^3$

$TiCl_4, MnO_4^-, [FeO_4]^{2-}$, have zero electron in t_2 orbital