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. The plot of $\log_{10}k$ vs $\frac{1}{T}$ gives a straight line. The intercept and slope respectively are

(1) c = logA

$$m = -\frac{E_a}{2.303R}$$

(2) $c = -\frac{E_a}{2.303R}$

m = logA

(3) c = –logA

$$m = -\frac{E_a}{2.303R}$$

(4) c = logA

$$m = \frac{E_a}{2.303R}$$

Answer (1)

Sol. $k = Ae^{-\frac{E_a}{RT}}$

$$\log k = \log A - \frac{E_a}{2.303RT}$$

y = c + mx

c = intercept = logA

m = slope = $-\frac{E_a}{2.303R}$

2. Consider the following electromagnetic waves :

Wavelength of A = 400 nm

Frequency of B = 10^{16} s^{-1}

Wave number of C = 10^4 cm^{-1}

Order of energies is

(1) A > B > C (2) B > A > C

(3) B > C > A (4) C > A > B

Answer (2)

Sol. $\lambda_A = 400 \times 10^{-9}$ m = 4×10^{-7} m

$\lambda_B = 3 \times 10^{-8}$ m

$\lambda_C = 10^{-6}$ m

$\lambda_C > \lambda_A > \lambda_B$

Energy order will be opposite.

3. Which of the following order is correct.

(1) HF > HI > HBr > HCl (Boiling point)

(2) HF > HI > HBr > HCl (Melting point)

(3) HI > HF > HBr > HCl (Boiling point)

(4) HI > HBr > HF > HCl (Melting point)

Answer (1)

Sol.

	HF	HCl	HBr	HI
B.P. (K)	293	189	206	238
MP (K)	190	159	185	222

4. Match the isostructural species

	Column-I		Column-II
(a)	XeO_3	(p)	BrF_5
(b)	XeF_2	(q)	NH_3
(c)	XeO_2F_2	(r)	I_3^-
(d)	$XeOF_4$	(s)	SF_4

(1) a – q, b – r, c – s, d – p

(2) a – p, b – q, c – s, d – p

(3) a – q, b – r, c – p, d – s

(4) a – p, b – q, c – r, d – s

Answer (1)

Sol. XeO_3 and NH_3 are trigonal pyramidal

XeF_2 and I_3^- are linear

XeO_2F_2 and SF_4 are see-saw

$XeOF_4$ and BrF_5 are square pyramidal

5. Consider a reaction $A \rightleftharpoons B$. At 'T' K, the equilibrium concentration of A and B are 0.3 M and 0.315 M. Now, 0.1 mol of A is added to the flask of 1 L, then equilibrium constant and equilibrium concentration of B are

(1) 1.05, 0.35 M (2) 0.95, 0.37 M

(3) 1.05, 0.37 M (4) 0.95, 0.35 M

Answer (3)

Sol.

	A	$\rightleftharpoons$	B
t_{eq}	0.3 M		0.315 M

$$K_{eq} = \frac{0.315}{0.3}$$

Now 0.1 mole of A is added,

	A	$\rightleftharpoons$	B
$t = 0$	$0.3 + 0.1 = 0.4$		
$t = t_{eq}$	$0.4 - x$		$0.315 + x$

$$1.05 = \frac{0.315 + x}{0.4 - x}$$

$1.05 \times 0.4 - 1.05x = 0.315 + x$

$0.42 - 0.315 = 2.05x$

$0.105 = 2.05x$

$x = 0.051$

[B] = 0.366 M

6. Diamagnetic species among the following complexes is

(1) $[MnBr_4]^{2-}$

(2) $[Cu(H_2O)_6]^{2+}$

(3) $[Ni(CN)_4]^{2-}$

(4) $[Ni(H_2O)_6]^{2+}$

Answer (3)

Sol. $[MnBr_4]^{2-} \Rightarrow Mn^{2+} \Rightarrow 3d^5$

$\Rightarrow sp^3$ hybridised

$\Rightarrow$ paramagnetic (n = 5)

$[Cu(H_2O)_6]^{2+} \Rightarrow Cu^{2+} \Rightarrow 3d^9$

$\Rightarrow sp^3d^2$ hybridised

$\Rightarrow$ paramagnetic (n = 1)

$[Ni(CN)_4]^{2-} \Rightarrow Ni^{2+} \Rightarrow 3d^8$

$\Rightarrow dsp^2$ hybridised

$\Rightarrow$ diamagnetic (n = 0)

$[Ni(H_2O)_6]^{2+} \Rightarrow Ni^{2+} \Rightarrow 3d^8$

$\Rightarrow sp^3d^2$ hybridised

$\Rightarrow$ paramagnetic (n = 2)

7. Correct statement about $-NO_2$ group is

(A) Ring deactivating group in electrophilic substitution

(B) Ring activating group in electrophilic substitution

(C) Activating for aromatic nucleophilic substitution in aryl halides

(D) Deactivating for aromatic nucleophilic substitution in aryl halides.

(1) A, C are correct statement

(2) B, D are correct

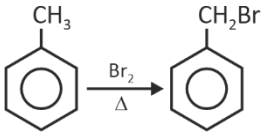
(3) A, D are correct

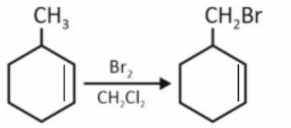
(4) B, C are correct

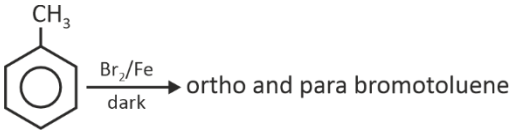
Answer (1)

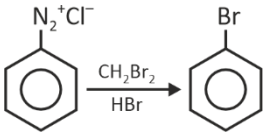
Sol. It shows –R and –I effect.

8. The major organic product of which of the following reaction is incorrectly represented?

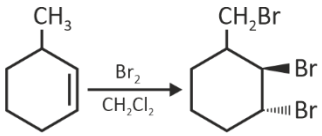
(1) 

(2) 

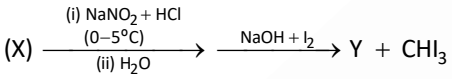
(3) 

(4) 

Answer (2)

Sol. 

9. Consider the following reaction sequence



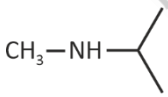
X has %C = 65.75

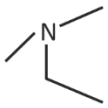
%H = 15.25

%N = 19

Identify (X)

(1) 

(2) 

(3) 

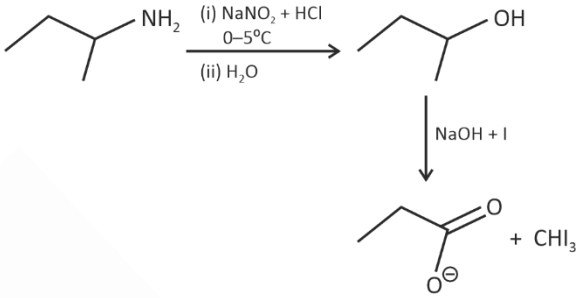
(4) 

Answer (4)

Sol.

	mole	molar ratio
C = 65.75 $\Rightarrow$	$\frac{65.75}{12}=5.5$	= 4
H = 15.25 $\Rightarrow$	$\frac{15.25}{1}=15.25$	= 11
N = 19 $\Rightarrow$	$\frac{19}{14}=1.35$	= 1

MF = $C_4H_{11}N$



10. Which of the following compounds on reacting with Heinsberg reagent form an alkali insoluble product.

(A) Ethanamine

(B) N-methylaniline

(C) N-Ethyl-N-Methylaniline

(D) N-Methylethanamine

(E) N-Phenylaniline

(F) Aniline

(1) A, C, D, E only

(2) B, C, D & E only

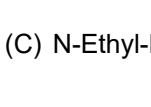
(3) B, D, and E only

(4) A, C, F only

Answer (3)

Sol. (A) Ethanamine $\Rightarrow$ $CH_3CH_2NH_2$ (1°)

(B) N-Methylaniline $\Rightarrow$ Ph–NH–CH_3 (2°)

(C) N-Ethyl-N-methylaniline $\Rightarrow$  (3°)

(D) N-Methyethanamine $\Rightarrow CH_3CH_2NHCH_3$ (2°)

(E) N-Phenylaniline $\Rightarrow$ Ph–NH–Ph (2°)

(F) Aniline $\Rightarrow$ Ph–NH_2 (1°)

2° Amines react with Heinsberg reagent to form an alkali insoluble product.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The sum of valence e^- in element with most and least metallic character among the following is :

Na, P, Cl, S, O and F

Answer (8)

Sol. Element with most metallic character $\Rightarrow$ Na

Element with least metallic character $\Rightarrow$ F

Sum of valence e^- in Na and F = 1 + 7 = 8

22. In 'S' estimation, 0.314 g of organic compound gave 0.4813 g of barium sulphate. What is % of 'S' in organic compound?

(Report to nearest integer).

Answer (21)

Sol. $$\% \text{ of } S = \frac{\frac{0.4813}{233} \times 32}{0.314} \times 100$$

$$= 21.05$$

23. Among Sc^{3+}, Cr^{2+}, Mn^{3+}, Co^{3+} number of isoelectronic species are 'n'.

'n' moles of AgCl is obtained upon reaction with excess of $AgNO_3$ with 1 mol of $Co(en)_2NH_3Cl_3$. Number of t_{2g} electrons in the complex are

Answer (6)

Sol. $Sc^{3+} \Rightarrow 3d^0$

$Cr^{2+} \Rightarrow 3d^4$

$Mn^{3+} \Rightarrow 3d^4$

$Co^{3+} \Rightarrow 3d^6$

n = 2

2 mol of AgCl is precipitated.

Hence, complex should be $[Co(en)_2(NH_3)Cl]Cl_2$

complex is inner orbital octahedral complex with hybridisation d^2sp^3

$Co^{3+} \Rightarrow 3d^6$

$t_{2g}^6 e_g^0$

24. An alpha particle and proton are accelerated in a discharge tube under same potential difference of 200 KeV. The de Broglie wavelength of proton is $x\sqrt{2}$ times of de Broglie wavelength of α-particle. The value of x is

Answer (2)

Sol. $$\lambda = \frac{h}{\sqrt{2m(qV)}}$$

$$\frac{\lambda_P}{\lambda_\alpha} = \left[\frac{\frac{h}{\sqrt{2\times1\times1\times200\times1000}}}{\frac{h}{\sqrt{2\times4\times2\times200\times1000}}}\right]$$

$$\frac{\lambda_P}{\lambda_\alpha} = \sqrt{8} = 2\sqrt{2}$$

25.