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. Arrange following complexes in increasing order of CFSE (Δ_o)

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

   (b) $[Co(H_2O)_6]^{3+}$

   (c) $[Co(en)_3]^{3+}$

   (1) c > a > b

   (2) c > b > a

   (3) a > b > c

   (4) b > a > c

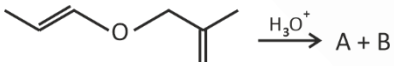
Answer (2)

Sol. H_2O is SFL with Co^{3+}, en is SFL with Co^{3+}.

Order of ligand strength en > H_2O

CFSE (Δ_o) order $\Rightarrow$ c > b > a

2. Consider the following reaction



A gives positive fehling's test. Choose the correct relation.

(1) Molar weight of A and molar weight of B is same

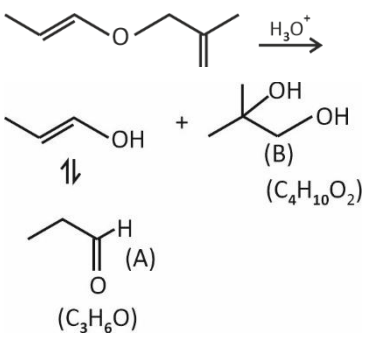
(2) Molar weight of A is greater than molar weight of B

(3) Molar weight of B is greater than molar weight of A

(4) None

Answer (3)

Sol.



3. 20 mL of 0.2 M HA (weak monoprotic acid) is titrated with 10 mL of 0.2 M NaOH solution. pH of solution at 25°C is, (pK_a of weak acid is 4.76)

   (1) 9.24 (2) 5.24

   (3) 4.76 (4) 9.76

Answer (3)

Sol. $HA + NaOH \rightarrow NaA + H_2O$

20×0.2	10×0.2		
4	2		
2	0	2	

$$pH = pk_a + \log\frac{2/V}{2/V}$$

$pH = pk_a = 4.76$

4. Molarity of H_2SO_4 solution is 4.9 M. If density of solution is 1.40 g/ml, then molality and mole fraction of solute in solution is

   (1) m = 5.34, $\chi_{solute} = 0.088$

   (2) m = 5.34, $\chi_{solute} = 0.072$

   (3) m = 5.21, $\chi_{solute} = 0.088$

   (4) m = 5.21, $\chi_{solute} = 0.072$

Answer (1)

Sol. Let volume of solution = 1000 ml, $W_{solution}$ = 1000 × 1.4 = 1400 g

$W_{solvent} = 1400 - (4.9 \times 98) = 919.8$ g, $n_{solute} = 4.9$

$$m = \frac{4.9}{919.8 \times 10^{-3}} = 5.34 \text{ mol/kg}$$

$$\chi_{solute} = \frac{4.9}{(4.9) + \left(\frac{919.8}{18}\right)} = 0.088$$

5. SF_4 is isostructural with

(I) XeO_2F_2

(II) CH_4

(III) IF_4^+

(IV) BrF_4^-

(1) (I), (III), (IV) only (2) (I), (III) only

(3) (II), (IV) only (4) (I), (II), (III), (IV)

Answer (2)

Sol. $SF_4 \Rightarrow$ see-saw shape (sp^3d)

$XeO_2F_2 \Rightarrow$ see-saw shape (sp^3d)

$CH_4 \Rightarrow$ Tetrahedral (sp^3)

$IF_4^+ \Rightarrow$ see-saw shape (sp^3d)

$BrF_4^- \Rightarrow$ square planar (sp^3d^2)

6. For the reaction $2A \rightarrow 4B + C$. At 30 minutes the total pressure is 300 mm of Hg and after infinite time the total pressure is 600 mm of Hg. Then the pressure of C at t = 30 minutes will be

(1) 20 mm Hg (2) 40 mm Hg

(3) 60 mm Hg (4) 10 mm Hg

Answer (1)

Sol.

	2A	→	4B	+	C
t = 0	P_0		0		0
t = t	$P_0 - 2p$		4p		p
t = ∞	0		$2P_0$		$\frac{P_0}{2}$

At t = ∞

total pressure = 600 mm of Hg

$$2P_0 + \frac{P_0}{2} = 600$$

$$\frac{5P_0}{2} = 600$$

$P_0 = 240$ mm of Hg

At t = 30 minutes

total pressure = $P_0 - 2p + 4p + p = 300$

$P_0 + 3p = 300$

$3p = 300 - P_0$

$3p = 300 - 240$

$3p = 60$

$p = 20$ mm of Hg

Pressure of C at t = 30 minutes = 20 mm of Hg

7. Two solutions of protein (M.Wt = 50,000 g/mol) are prepared separately

Solution A : 1 g protein in 0.5 L solution

Solution B : 2 g protein in 1.0 L solution

When these two solutions are mixed at 300 K. Find total osmotic pressure :

(R = 0.08 L-atm K^{-1} mol^{-1})

(1) 9.8×10^{-3} torr

(2) 6.5×10^{-2} torr

(3) 7.3×10^{-1} torr

(4) 5.4×10^{-4} torr

Answer (3)

Sol. $$\pi_{total} = \frac{1}{5 \times 10^4}\left[\frac{1}{1.5} + \frac{2}{1.5}\right] \times 0.08 \times 300$$

$$= \frac{1}{5 \times 10^4}\left[\frac{3}{1.5}\right] \times 0.08 \times 300$$

$= 9.6 \times 10^{-4}$ atm

$= 7.296 \times 10^{-1}$ torr

8. Given below are two statements

Statement I : Order of second ionisation energy is B > Al > Ga

Statement II : Order of first ionisation energy is B > Ga > Tl > Al > In

(1) Both statement I and statement II are correct

(2) Statement I is correct but statement II is incorrect

(3) Statement I is incorrect but statement II is correct

(4) Both statement I and statement II are incorrect

Answer (4)

Sol.

(kJ/mol)	B	Al	Ga	In	Tl
$I.E_1$:	801	577	579	558	589
$I.E_2$:	2427	1816	1979	1820	1971

9. Correct order of enthalpy of atomisation is,

(1) $N_2 > O_2 > F_2 > Cl_2 > Br_2 > I_2$

(2) $N_2 > O_2 > Cl_2 > F_2 > Br_2 > I_2$

(3) $N_2 > O_2 > Cl_2 > Br_2 > F_2 > I_2$

(4) $N_2 > O_2 > F_2 > Br_2 > Cl_2 > I_2$

Answer (3)

Sol.

	Bond energy (KJ/mol)
Cl_2	242.6
Br_2	192.8
F_2	158.8
I_2	151.1

10. Which of the ion having highest ionisation energy will give borax bead test.

(1) Fe^{2+}

(2) Fe^{3+}

(3) Cr^{3+}

(4) Zn^{2+}

Answer (2)

Sol. $Fe^{3+} \Rightarrow 3d^5$

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

$\therefore$ Fe^{3+} has higher ionisation energy than Cr^{3+}

$\therefore$ Fe^{3+} and Cr^{3+} both give borax bead test.

11. Consider the reaction, $aX \rightarrow bY$ –(1)

Rate constant $k = 3 \times 10^{-4}\ M^{-1}\ sec^{-1}$

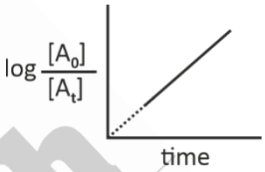
The correct statement is

(1) $t_{1/2}$ is independent of initial concentration. of 'X'

(2) Dissociation of N_2O_5 is an example of reaction

(3) When conc. of 'X' becomes 4 times then rate of reaction increases by 16 times

(4) The graph between $\log\frac{[A_0]}{[A_t]}$ v/s time is



Answer (3)

Sol. $aX \rightarrow bY$

$k = 3 \times 10^{-4}\ M^{-1}s^{-1}$

(second order reaction)

$r = k[X]^2$

$$\frac{r_1}{r_2} = \left[\frac{X_1}{X_2}\right]^2 = \left(\frac{1}{4}\right)^2$$

$16r_1 = r_2$

12. Consider the following reaction

$$X \xrightarrow{\text{aromatisation}} \text{Toluene}$$

$$X \xrightarrow{AlCl_3(anhy)/HCl} 3-\text{methylhexane}$$

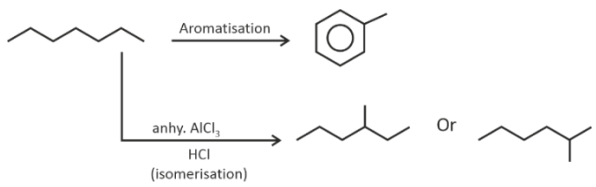
X may be

(1) 2-methylhexane (2) Heptane

(3) 3-methylhexane (4) Octane

Answer (2)

Sol.



13. Correct order of boiling point of Si, Ge, Sn and Pb is

(1) Si > Ge > Sn > Pb

(2) Pb > Sn > Ge > Si

(3) Si > Ge > Pb > Sn

(4) Pb > Ge > Sn > Si

Answer (1)

Sol. Boiling point of Si = 3550 K

Ge = 3123 K

Sn = 2896 K

Pb = 2024 K

14. Which option have acidic, basic, amphoteric and neutral oxide respectively?

(1) Na_2O, Al_2O_3, MgO, As_2O_3

(2) CO_2, Na_2O, Al_2O_3, CO

(3) As_2O_3, Al_2O_3, Na_2O, CO

(4) None of these

Answer (2)

Sol. $CO_2 \rightarrow$ acidic

$Na_2O \rightarrow$ basic

$Al_2O_3 \rightarrow$ amphoteric

$CO \rightarrow$ neutral

15. The correct order of reactivity of SN_1 is

(1) $C_6H_5C(CH_3)C_6H_5Br > C_6H_5CH_2Br > C_6H_5CHC_6H_5Br$

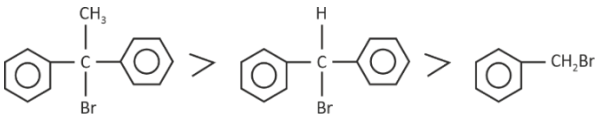
(2) $C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CHC_6H_5Br > C_6H_5CH_2Br$

(3) $C_6H_5CHC_6H_5Br > C_6H_5CH_2Br > C_6H_5C(CH_3)C_6H_5Br$

(4) $C_6H_5CH_2Br > C_6H_5CHC_6H_5Br > C_6H_5C(CH_3)C_6H_5Br$

Answer (2)

Sol. The rate of SN_1 reaction will depend on stability of carbocation



16. The thyroxine hormone is formed by the iodination of an alpha amino acids. The single letter code of that amino acid is

(1) Y

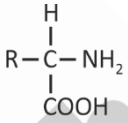
(2) T

(3) W

(4) H

Answer (1)

Sol. Thyroxine is formed by the iodination of tyrosine (Y)



R = (p) OH – C_6H_4 – CH_2 –

17.

18.

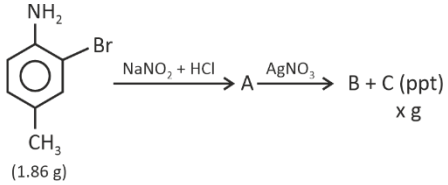
19.

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.

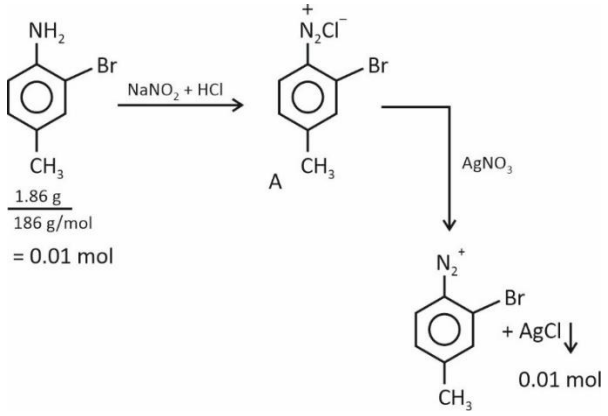
21.



'C' is a white curdy ppt. Find 10(x) (Nearest integer)

Answer (14)

Sol.



Molecular weight of the reactant

= 75 + 16 + 80 + 15 = 186 g

Mass of 'C' (x) = 0.01 × 143.5 = 1.435 g

22. The work function of Na metal is 2.3 eV. If maximum kinetic energy of emitted photoelectron is 2.8×10^{-19} J, then calculate wavelength of incident photon in nm. ($h = 6.626 \times 10^{-34}$ J-sec)

Answer (308)

Sol. $\frac{hc}{\lambda} = \phi + KE_{max}$

$$\frac{hc}{\lambda} = 2.3 \times 1.6 \times 10^{-19} + 2.8 \times 10^{-19}$$

$$\frac{hc}{\lambda} = (3.68 + 2.8) \times 10^{-19}$$

$$\frac{hc}{\lambda} = 6.48 \times 10^{-19}$$

$$\lambda = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{6.48 \times 10^{-19}}$$

$$\lambda = 3.068 \times 10^{-7}$$

$$\lambda = 306.8 \times 10^{-9} \text{ m}$$

$$\lambda = 306.8 \text{ nm} \approx 307 \text{ nm}$$

23. How many of following ions will show paramagnetism?

$Mn^{++}, Cu^{++}, Zn^{++}, Sc^{3+}, Ti^{++}, Yb^{++}, Gd^{++}, Lu^{3+}, Ce^{3+}, La^{3+}$

Answer (5)

Sol. $Mn^{2+} \rightarrow 3d^5$ (Para)

$Cu^{2+} \rightarrow 3d^9$ (Para)

$Zn^{2+} \rightarrow 3d^{10}$ (Dia)

$Sc^{3+} \rightarrow 3d^0$ (Dia)

$Ti^{2+} \rightarrow 3d^2$ (Para)

$Yb^{2+} \rightarrow 4f^{14}$ (Dia)

$Gd^{4+} \rightarrow 4f^6$ (Para)

$Lu^{3+} \rightarrow 4f^{14}$ (Dia)

$Ce^{3+} \rightarrow 4f^1$ (Para)

$La^{3+} \rightarrow 4f^0$ (Dia)

Number of paramagnetic ions is 5

24. The $[HA^-]$ concentration in a mixture containing 0.1 M H_2A and 0.1 M HCl is $x \times 10^{-9}$. Value of x is

Given : $Ka_1 = 10^{-8}$ and $Ka_2 = 10^{-13}$ for H_2A

Answer (10)

Sol. $HCl \rightarrow \underset{0.1+0.1\alpha}{H^+} + \underset{0.1}{Cl^-}$

For H_2A $Ka_1 >> Ka_2$, so second dissociation can be neglected

$$\underset{0.1(1-\alpha)}{H_2A} \rightleftharpoons \underset{0.1+0.1\alpha}{H^+} + \underset{0.1\alpha}{HA^-}$$

$$Ka_1 = \frac{[H^+][HA^-]}{[H_2A]}$$

$$10^{-8} = \frac{(0.1+0.1\alpha)[HA^-]}{0.1(1-\alpha)}$$

$\alpha << 1$

$10^{-8} = [HA^-]$

25.