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. An electron make transition from higher energy orbit (n_2) to lower energy orbit (n_1) in Li^{2+}ion such that $n_1 + n_2 = 4$ & $n_2 - n_1 = 2$. Determine the wavelength emitted in the transition (in nm)

(1) 12.9 nm (2) 11.4 nm

(3) 16.7 nm (4) 9.2 nm

Answer (1)

Sol. $n_1 + n_2 = 4$

$n_2 - n_1 = 2$

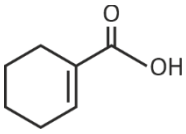
$n_2 = 2, n_1 = 1$

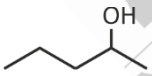
$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

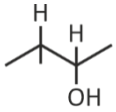
$$= 1.097 \times 10^7 \times 3^2\left(\frac{1}{1^2} - \frac{1}{3^2}\right)$$

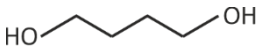
$\lambda \approx 11.39$ nm

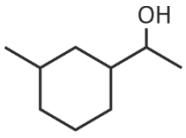
2. Which of the following molecules is secondary alcohol?

a. 

b. 

c. 

d. 

e. 

(1) b, c, e only (2) b, c, d, e only

(3) a, c, d, e only (4) a, b, d only

Answer (1)

Sol. a $\rightarrow$ carboxylic acid

b, c, e $\rightarrow$ secondary alcohol

d $\rightarrow$ primary alcohol

3. Choose the correct order of second IE of O, C, N and F.

(1) C < N < F < O (2) C < F < O < N

(3) C < N < O < F (4) C < O < F < N

Answer (1)

Sol. $O \xrightarrow{-e^-} O^+(2p^3)$

$C \xrightarrow{-e^-} C^+(2p^1)$

$N \xrightarrow{-e^-} N^+(2p^2)$

$F \xrightarrow{-e^-} F^+(2p^4)$

$IE = C^+ < N^+ < F^+ < O^+$

$IE_2 = C < N < F < O$

4. How many linear tripeptides are possible with valine (Val), Glycine (Gly) and Alanine (Ala). No amino acid should be repeated?

(1) 8 (2) 5

(3) 6 (4) 4

Answer (3)

Sol. Gly – Ala – Val

Gly – Val – Ala

Ala – Gly – Val

Ala – Val – Gly

Val – Gly – Ala

Val – Ala – Gly

5. Order of wavelength of absorbed radiation for the below given complexes is,

(a) $[Co(NH_3)_6]^{3+}$

(b) $[Co(NH_3)_5H_2O]^{3+}$

(c) $[CoF_6]^{3-}$

(d) $[Co(CN)_6]^{3-}$

(1) d > a > c > b

(2) d > a > b > c

(3) d < a < b < c

(4) d < a < c < b

Answer (3)

Sol. Strength of ligand:

$CN^- > NH_3 > H_2O > F^-$

Stronger ligand $\Rightarrow \Delta_o\uparrow \Rightarrow \lambda_{max}\downarrow$

6. Given :

ΔH_{atom} (CH_4) = x kJ mole^{-1}

ΔH_{atom} (C_2H_6) = y kJ mole^{-1}

Find out bond energy (C – C) (kJ/mole).

(1) y – x

(2) y – 4x

(3) $y-\frac{3x}{2}$

(4) y – 2x

Answer (3)

Sol. $y = (C - C) + 6\left(\frac{x}{4}\right)$

$(C - C) = y-\frac{6x}{4}$

$(C - C) = y-\frac{3x}{2}$

7. Which of the following have same bond order and are paramagnetic?

(1) O_2^+, N_2^-

(2) O_2^+, O_2^-

(3) O_2^-, N_2^-

(4) O_2^-, N_2^+

Answer (1)

Sol. $O_2^+(15e) \rightarrow$ Paramagnetic,

Bond order = $\frac{\text{Bonding e} - \text{Antibonding e}}{2}$

$=\frac{(10-5)}{2}=2.5$

$N_2^-(15e) \rightarrow$ Paramagnetic,

Bond order = $\frac{(10-5)}{2}=2.5$

$N_2^+(13e) \rightarrow$ Paramagnetic,

Bond order = $\frac{(9-4)}{2}=2.5$

$O_2^-(17e) \rightarrow$ Paramagnetic,

Bond order = $\frac{(10-7)}{2}=1.5$

Species having odd number of e are paramagnetic.

8. In fifth group of cations Ba^{2+} and Ca^{2+} are precipitated as

(1) Carbonate, sulphide

(2) Sulphide, hydroxide

(3) Carbonate, carbonate

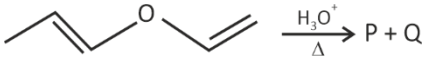
(4) Hydroxide, sulphide

Answer (3)

Sol. Group V cations precipate as carbonates

(Reagent – $NH_4Cl + (NH_4)_2CO_3$)

9. How would you distinguish between product P and Q formed in reaction given below



(1) Fehling solution test

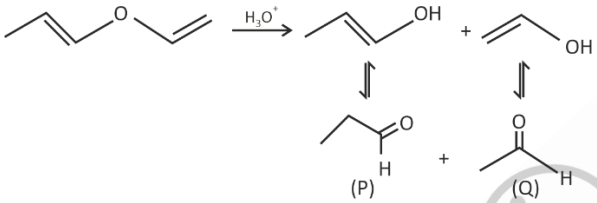
(2) Tollens test

(3) 2, 4 DNP test

(4) Iodoform test

Answer (4)

Sol.



Q can give iodoform test but (P) can't give

10. A group VII element which has a +7 oxidation state forms a salt with potassium (K). What is the colour of this salt?

(1) Green

(2) Yellow

(3) Orange

(4) Purple

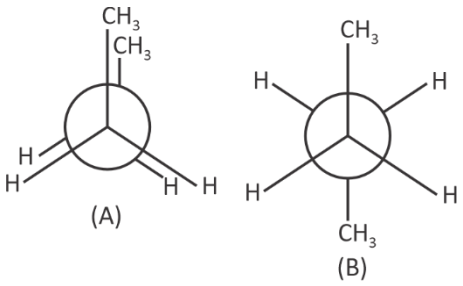
Answer (4)

Sol. In group VII, Mn is having maximum +7 oxidation state.

The salt should be $KMnO_4$.

The colour of $KMnO_4$ is purple (dark violet) due to charge transfer.

11. Given below are two statements based on structures given



Statement I : B is more stable than A.

Statement II : Dihedral angle of B is more than A.

In the light of the above two statements, choose the correct option.

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

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

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

Answer (1)

Sol. In B both $-CH_3$ group are anti, so less torsional strain.

Dihedral angle in B = 180º and in A = 0º.

12. Vapor pressures of two volatile species A and B are 55 mm Hg and 120 mm Hg respectively. If mole fraction of 'A' in liquid state is 0.8, then mole fraction of 'B' in vapor state is

(1) 0.65

(2) 0.45

(3) 0.35

(4) 0.53

Answer (3)

Sol. P_{total} = 55 × 0.8 + 120 × 0.2 = 44 + 24 = 68

$$Y_B = \frac{120\times0.2}{P_{total}} = \frac{24}{68} = 0.35$$

13. Find incorrect statement among the following

(1) C^{13} is a radioactive isotope

(2) Covalency of carbon greater than 4 is possible

(3) Carbon can exhibit +2 & +4 oxidation state

(4) In group-14, CO_2 is most acidic

Answer (2)

Sol. Maximum covalency of carbon is 4.

14. Which of the following statement is correct about resonance and resonating structures?

(1) Resonating structure with more covalent bonds is more stable

(2) The resonance structures differ in position of electrons and relative position of atoms

(3) The stability of resonance hybrid decreases with increasing number of equivalent resonating structure

(4) Electronegative atom bearing positive charge in the canonical form is more stable

Answer (1)

Sol. The resonance structures differ only in position of electrons and not in the relative position of atoms.

The stability of resonance hybrid increases with increasing number of equivalent resonating structure.

15. Consider the following reversible reaction wherein the moles of species at equilibrium is given

	P_2	+ Q_2	$\rightleftharpoons$	2PQ
$t = t_{eq}$	2 mol	2 mol		2 mol

If one mole of P_2 and one mole of Q_2 are added at equilibrium. The number of moles of P_2, Q_2 and PQ at new equilibrium, respectively are

(1) $\frac{4}{3}, \frac{4}{3}, \frac{8}{3}$

(2) $\frac{8}{3}, \frac{8}{3}, \frac{8}{3}$

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

(4) $\frac{8}{3}, \frac{8}{3}, \frac{4}{3}$

Answer (2)

Sol.

		P_2	+ Q_2	$\rightleftharpoons$	2PQ
$t = t_{eq}$		2 mol	2 mol		2 mol
$t = t'_{eq}$		$3-x$	$3-x$		$2+2x$

$$\therefore \quad K_{eq} = \frac{(2)^2}{2\times2} = 1$$

$$\therefore \quad 1 = \frac{(2+2x)^2}{(3-x)^2} \Rightarrow \frac{2+2x}{3-x} = 1$$

$$\Rightarrow \quad 2+2x = 3-x$$

$$\Rightarrow \quad 3x = 1$$

$$\Rightarrow \quad x = \frac{1}{3}$$

$$\therefore \quad n_{P_2} = 3-x = 3-\frac{1}{3} = \frac{8}{3}$$

$$\therefore \quad n_{Q_2} = 3-x = \frac{8}{3}$$

$$\therefore \quad n_{PQ} = 2+2X = 2+\frac{2}{3} = \frac{8}{3}$$

16. $\underset{(2M,2L)}{KOH} + \underset{(1mol)}{Cl_2} \longrightarrow Cl^{\ominus} + ClO^{\ominus} + K^{\oplus}$

Find the conc. of each product and choose correct option

(1) $[Cl^-] = [ClO^-] = [K^+] = 0.5$ M

(2) $[Cl^-] = [K^+] = 1.5$ M

(3) $[Cl^-] = [ClO^-] = 0.5$ M

(4) $[Cl^-] = [ClO^-] = 0.75$ M

Answer (3)

Sol. Balanced equation is n of KOH = 2 × 2 = 4 mol

$$2KOH + 1Cl_2 \rightarrow 1Cl^- + 1ClO^- + 2K^+ + 1H_2O$$

Initial →	4 mol	1 mol	0	0	0
	−2	−1	+1	+1	+2
Final→	2 mol	0	1 mol	1 mol	1 mol

Conc. of $Cl^- = \frac{mol}{v} = \frac{1}{2} = 0.5\,M$

Conc. of $ClO^- = \frac{1}{2} = 0.5\,M$

Conc. of $K^+ = \frac{2}{2} = 1\,M$

17. Given below are two statements.

Statement I: Two different aldehydes on cross aldol condensation always give four products.

Statement II: Among benzaldehyde and acetophenone, only acetophenone reacts with semicarbazide.

In the light of the above two statements, choose the correct option.

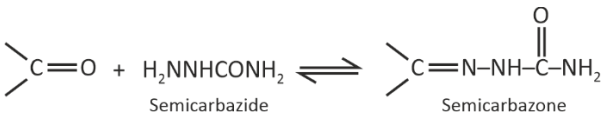
(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

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

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

Answer (2)

Sol. 

∴ Both PhCHO and $PhCOCH_3$ reacts with semicarbazide.

Two different aldehydes on cross aldol condensation can give number of products different than 4.

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. In a first order reaction, $t_{1/2}$ = 245 days of compound 'A'. After x days 75% of 'A' remains, then calculate the value of 'x'. (Take log 2 = 0.3 and log 3 = 0.48)

Answer (98)

Sol. $k = \frac{2.303 \log 2}{t_{1/2}}$

$k = \frac{0.693}{245}\,days^{-1}$

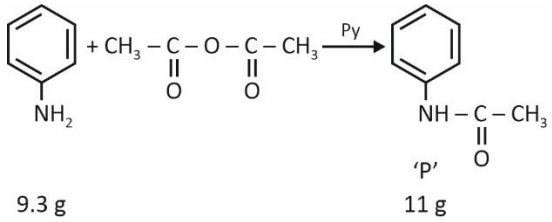
$K = \frac{2.303}{t} \log \frac{100}{75}$

$t = \frac{2.303 \times 245}{2.303 \times 0.3} \log \frac{4}{3}$

$t = \frac{245}{0.3}(0.6 - 0.48)$

$t = \frac{245 \times 0.12}{0.30} = 98$ days

22. Consider the following reaction :



If % yield of reaction is x, tvalue of $\frac{x}{10}$ is (nearest integer)

Answer (8)

Sol. Moles of aniline = $\frac{9.3}{93} = 0.1$

Moles of 'P' formed = 0.1 (if 100% yield)

Actual moles of 'P' formed = $\frac{11}{135} = 0.0814$

% yield = $\frac{0.0814}{0.1} \times 100 = 81.48\%$

x = 8

23. A compound $Cr(H_2O)_6 \cdot Cl_3$ show conductance similar to 1 : 2 electrolyte in aq. solution. 9.6 g of this complex is passed through a cation exchanger then excess of $AgNO_3$ solution is added. Find mass of AgCl precipitated in gram?

[Molar mas of Cr = 52, Cl = 35.5]

Answer (10)

Sol. Since complex is similar to 1 : 2 electrolyte

complex should be $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

Mole of complex = $\frac{9.6}{266.5}$ mol = 0.036 mol

Mole of Cl^- to be precipitated = 2 × 0.036 mol

Mole of AgCl precipitated = 0.072 mol

Mass of AgCl = 0.072 × 143.5 g

= 10.332 g

$\approx$ 10 g

24. 0.18 M HQ solution has molar conductivity $\frac{1}{30}$ times the molar conductivity of 0.02 M HZ solution. Find the value of pKa(HQ) – pKa(Hz). [Given that α <<< 1]

Assume that $\lambda_m^{\infty}Q^{\ominus} = \lambda_m^{\infty}Z^{\ominus}$

Answer (2)

Sol. $\lambda_m^{\infty}Q^{\ominus} = \lambda_m^{\infty}Z^{\ominus}$, so $\wedge_m^{\infty}HQ = \wedge_m^{\infty}HZ$ (Let it Y)

For 0.02 M HZ, let $\wedge_m = x$

Then for 0.18 M HQ, $\wedge_m = \frac{x}{30}$

For HQ $\Rightarrow$ $Ka_1 = C \times \alpha^2 = 0.18 \times \left(\frac{x}{30Y}\right)^2$ ...(I) {α <<<1}

For HZ $\Rightarrow$ $Ka_2 = C \times \alpha^2 = 0.02 \times \left(\frac{x}{Y}\right)^2$ ...(II) {α <<<1}

$$\frac{Eq(I)}{Eq(II)} \Rightarrow \frac{Ka_1}{Ka_2} = \frac{0.18 \times \left(\frac{x}{30Y}\right)^2}{0.02 \times \left(\frac{x}{Y}\right)^2} \Rightarrow \frac{Ka_1}{Ka_2} = \frac{1}{100}$$

$pKa_1 - pKa_2 = -\log\left(\frac{1}{100}\right) = 2$

So, pKa(HQ) – pKa(HZ) = 2

25.