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. Which of the following ions has spin only magnetic moment of 4.9 BM?

(1) Mn^{2+} (2) Cr^{2+}

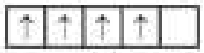
(3) Fe^{2+} (4) Co^{2+}

Answer (2)

Sol. $\mu_{spin\ only} = \sqrt{n(n+2)}$ BM

n = number of unpaired electrons

$Cr^{2+} = 3d^4 4s^0$



$3d^4$

n = 4

$\mu_{spin\ only} = \sqrt{4(4+2)}$ BM

$= \sqrt{24}$ BM

= 4.9 BM

Cr^{2+} has spin only magnetic moment = 4.9 BM

2. Which among the following element has highest atomic number.

(1) Po (2) Pt

(3) Pr (4) Pb

Answer (1)

Sol. Po → Polonium (Z = 84)

Pt → Platinum (Z = 78)

Pr → Praseodymium (Z = 59)

Pb → Lead (Z = 82)

∴ Of the given metals Po has the highest atomic number

3. Match the following List-I with List-II and choose the correct option.

	List-I (Compounds)		List-II (Shape and Hybridisation)
(A)	PF_5	(I)	Tetrahedral and sp^3
(B)	SF_6	(II)	Square planar and dsp^2
(C)	$Ni(CO)_4$	(III)	Octahedral and sp^3d^2
(D)	$[PtCl_4]^{2-}$	(IV)	Trigonal bipyramidal and sp^3d

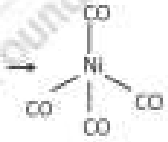
(1) A-IV, B-III, C-I, D-II (2) A-III, B-IV, C-I, D-II

(3) A-III, B-IV, C-II, D-I (4) A-IV, B-III, C-II, D-I

Answer (1)

Sol. PF_5 →  Trigonal bipyramidal and sp^3d

SF_6 →  → Octahedral and sp^3d^2

$Ni(CO)_4$ →  → Tetrahedral and sp^3

$[PtCl_4]^{2-}$ →  → Square planar and dsp^2

4. 2 moles each of ethylene glycol and glucose are mixed with 500 g of water. Find the boiling point of solution. (K_b = 0.52 K kg/mol)

(1) 377.16 K (2) 368.84 K

(3) 376.16 K (4) 369.84 K

Answer (1)

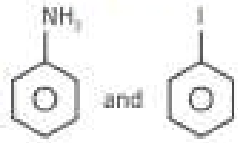
Sol. $\Delta T_b = i \times K_b \times m$

$$= 0.52 \times \left[(2+2) \times \frac{1000}{500}\right] = 4.16 \text{ K}$$

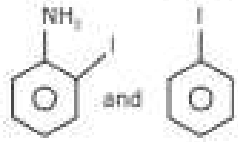
∴ Boiling point of solution = 377.16 K

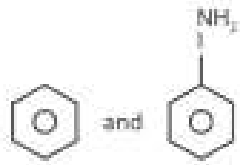
5. Observe the following reaction sequence.

Which of the following options has correct structure of (A) and (B) respectively.

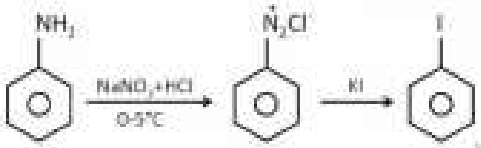
(1) 

(2) 

(3) 

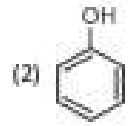
(4) 

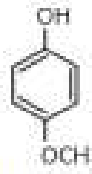
Answer (1)

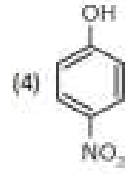
Sol. 

6. Which one of the following compounds is most acidic?

(1) 

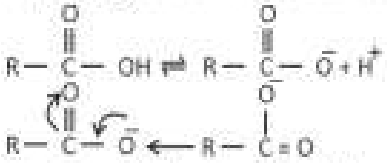
(2) 

(3) 

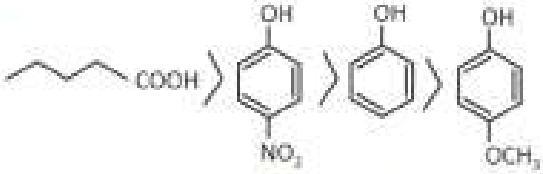
(4) 

Answer (1)

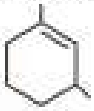
Sol. Carboxylic acid is more acidic than phenol and the given phenol derivatives because carboxylate anion has two equi-energetic resonating structures

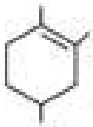


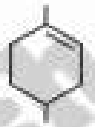
The correct acidic strength order is

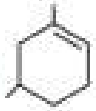


7. 3-methyl-6-oxoheptanal, will be formed after ozonolysis of

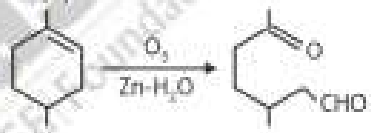
(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. 

(3-methyl-6-oxoheptanal)

8. The following reaction is at equilibrium starting with only PCl_5

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$.

when Xe gas is added to the above system at constant pressure, then which of the following is correct?

(1) Concentration of PCl_3 will become more than Cl_2

(2) PCl_3 and Cl_2 will have same concentration at new equilibrium.

(3) Concentration of Cl_2 will be more than PCl_5

(4) PCl_3 will be 30% and Cl_2 will be 70% at new equilibrium

Answer (2)

Sol. Addition of inert gas at constant pressure will result in increase in volume, which will increase gaseous moles and hence equilibrium will shift in forward direction.

Same amount of $PCl_5(g)$ and $Cl_2(g)$ will be formed.

9. Consider the following statements

Statement I: N–N has less bond strength than P–P

Statement II: All group-15 elements in +3 oxidation state undergo disproportionation.

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

(1) Statement I and statement II both are correct

(2) Statement I and statement II both are incorrect

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

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

Answer (3)

Sol. Due to small size of nitrogen interelectronic repulsion takes place and N–N bond strength is less than P–P bond strength. Statement I is correct.

Not all group-15 elements undergo disproportionation in +3 oxidation state. Statement II is incorrect.

10. Which of the following property shows irregular trend in group 16?

(1) Electronegativity (2) Atomic radius

(3) Electron affinity (4) Ionisation enthalpy

Answer (3)

Sol. Down the group electron affinity decreases, but O has the lowest value due to $e^- - e^-$ repulsion.

Electron gain enthalpy

O	S	Se	Te	Po	
−141	−200	−195	−190	−174	$\left(\frac{kJ}{mol}\right)$

11. Which of the following statement(s) is/are incorrect?

I. NO_2 dimerises easily

II. NF_5 does not exist but PF_5 exists

III. The oxides N_2O_3 and P_2O_3 are purely acidic but As_2O_3 and Sb_2O_3 are basic

IV. Nitrogen cannot form $d\pi$-$p\pi$ bond as the heavier elements can

(1) Only I, II and IV (2) Only III

(3) Only III and IV (4) Only I and II

Answer (2)

Sol. N_2O_3 and $P_2O_3 \Rightarrow$ Purely acidic

As_2O_3 and $Sb_2O_3 \Rightarrow$ Amphoteric

$Bi_2O_5 \rightarrow$ Basic

All other statements are correct.

12. Consider the following complex ions

(a) $[Co(NH_3)_6]^{3+}$ (b) $[Co(NH_3)_5Cl]^{2+}$

(c) $[Co(NH_3)_5H_2O]^{3+}$ (d) $[Co(CN)_6]^{3-}$

Choose the correct order of wavelength absorbed by complex ions

(1) a > b > c > d (2) b > c > a > d

(3) b > a > c > d (4) d > c > b > a

Answer (2)

Sol. More the crystal field splitting energy (Δ_o) more will be energy absorbed by complex.

$\Delta_o \propto$ ligand filed strength

Order of ligand filed strength

$CN^- > NH_3 > H_2O > Cl^-$

Order of Δ_o for complex ions

d > a > c > b

Order of wavelength absorbed

b > c > a > d

13. Arrange the following metal ions in the decreasing order of their molar conductivity in aqueous solution.

Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}

(1) $Na^{+} > K^{+} > Ca^{2+} > Mg^{2+}$

(2) $Mg^{2+} > Ca^{2+} > Na^{+} > K^{+}$

(3) $Ca^{2+} > Mg^{2+} > K^{+} > Na^{+}$

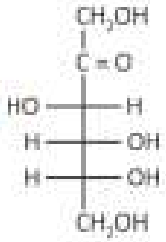
(4) $Mg^{2+} > Ca^{2+} > K^{+} > Na^{+}$

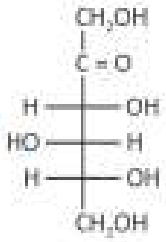
Answer (3)

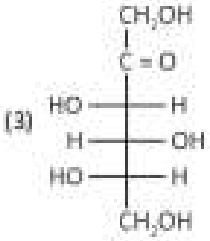
Sol. Molar conductivity of a metal ion in aqueous solution is directly proportional to charge on the ion and inversely proportional to the size of hydrated ion. Molar conductivity of M^{2+} is expected to be higher than that of M^{+}. The extent of hydration of Mg^{2+} will be higher than that of Ca^{2+}, so its mobility will be slower and hence molar conductivity of $Mg^{2+}(aq)$ will be lower than that of $Ca^{2+}(aq)$. Similarly, molar conductivity of $K^{+}(aq)$ will be higher than that of $Na^{+}(aq)$. The correct order of molar conductivity of the given metal ions in aqueous solution is

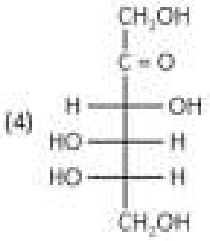
$Ca^{2+} > Mg^{2+} > K^{+} > Na^{+}$

14. Which of the following represents the L-form of fructose?

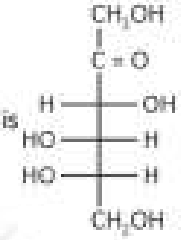
(1)


(2)


(3)


(4)


Answer (4)

Sol. L-form of fructose is


15. Which of the following is/are correct?

(a) $CH_3CH_2CH_2-COCH_3$ and $CH_3-CH_2-COCH_2CH_3$ metamers

(b) $CH_3CH_2CH_2CH_2OH$ and $CH_3CH_2CH_2-CH(OH)-CH_3$ position isomers

(c) $CH_3CH_2CH_2CH_2NH_2$ and $CH_3-CH_2NH-CH_2CH_3$ homologues

(d) $CH_3CH_2CH_2CH_2CN$ and $CH_3CH_2CH_2CH_2NC$ functional isomers

(1) (a) and (d)

(2) (a) and (c)

(3) (b) and (c)

(4) (b) and (d)

Answer (1)

Sol.

(1) $CH_3-CH_2-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$ $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$ are metamers.

(2) $CH_3CH_2CH_2-CH_2-OH$ and $CH_3-CH_2-CH_2-\underset{\underset{OH}{|}}{CH}-CH_3$ are different compounds (homologues)

(3) $CH_3-CH_2-CH_2-CH_2$ and $CH_3-CH_2-\overset{\overset{H}{|}}{N}-CH_2-CH_3$ are functional isomers

(4) $CH_3CH_2CH_2-CH_2-CN$ and $CH_3CH_2-CH_2-CH_2-NC$ are functional isomers.

16. Correct set of four quantum numbers for last electron of Cr^{3+} ion is

(1) $n = 4, l = 1, m = 0, s = +\frac{1}{2}$

(2) $n = 4, l = 2, m = 0, s = +\frac{1}{2}$

(3) $n = 3, l = 2, m = 0, s = +\frac{1}{2}$

(4) $n = 3, l = 2, m = -1, s = 0$

Answer (3)

Sol. Chromium = Atomic number 24.

$\therefore$ It has 24 protons and 24 electrons.

$Cr = 24e^-$, $\therefore$ $Cr^{3+} = 21e^-$

$Cr^{3+} \Rightarrow$ electronic configuration

$\Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^0 3d^3$

Four Quantum numbers decided on the basis of $3d^3 \Rightarrow$

1	1	1		

$n = 3$

$l = 2$

$m = 0$

$S = +\frac{1}{2}$

17. Given below are two statements about X-ray spectra of elements:

Statement (I) : A plot of $\sqrt{\nu}$ (ν = frequency of X-rays emitted) vs atomic mass is a straight line

Statement (II): A plot of ν (ν = frequency of X-rays emitted) vs atomic number is a straight line.

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

(1) **Statement I** is true but **Statement II** is false

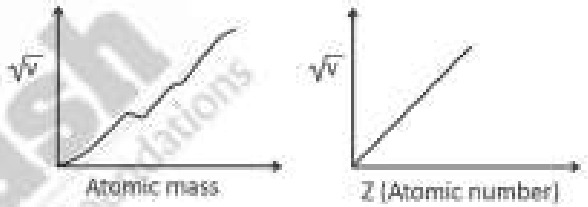
(2) **Statement I** is false but **Statement II** is true

(3) Both **Statement I** and **Statement II** are false

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

Answer (3)

Sol.



[Graphs plotted by Henry Moseley]

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. 0.5 g of an organic compound gives 1.46 g CO_2 and 0.9 g H_2O. What is the % of carbon in organic sample?

Answer (80)

Sol. $n_{CO_2} = \frac{1.46}{44} = n_C = 0.033$ mol

Mass of carbon = $0.033 \times 12 = 0.398$ g

% of carbon = $\frac{0.398}{0.5} \times 100$

= 79.6 %

≈ 80%

22. In two first order reactions initial concentration of $[A]_0 = 8[B]_0$. Find the time after which concentration of A and B become equal. Given that $(t_{1/2})_A = 20$ min and $(t_{1/2})_B = 80$ min.

Answer (80)

Sol. Let initial concentration of [B] = 1 mol/L

$\therefore$ Initial concentration of [A] = 8 mol/L

	A	$\xrightarrow{20'}$	A	$\xrightarrow{20'}$	A	$\xrightarrow{20'}$	A	$\xrightarrow{20'}$ A
mol/L	8		4		2		1	0.5

	B	$\xrightarrow{80'}$	B
mol/L	1		0.5

$\therefore$ After 80 min, both (A) and (B) will have same concentrations.

23. How many of the following statements are correct?

(a) First ionisation energy of Boron is more than that of Beryllium.

(b) Lithium is strongest reducing agent.

(c) Electronegativity of carbon is 2.5 (approx.) in CCl_4.

(d) Removal of electron from isolated gaseous atom is endothermic and addition of electron to isolated gaseous atom is generally exothermic.

Answer (3)

Sol. IE_1 of Be > B

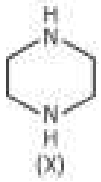
Li is strongest reducing agent.

Electronegativity of 'C' in CCl_4 is 2.5.

Removal of electron is endothermic and addition of electron is generally exothermic.

Statements (b), (c) and (d) are correct.

24. 0.42 g of the following compound (X) is subjected to analysis for estimation of volume of N_2 gas by Duma's method



(X)

What is the volume of N_2 gas evolved in mL at STP (1 atm pressure and 273 K temperature) to the nearest integer

Answer (109)

Sol. Mass of (X) = 0.42 g

No of moles of (X) $\frac{0.42}{86}$

Volume of N_2 gas at STP

$= \frac{0.42}{86} \times 22.400$ mL

= 109.4

≈ 109 mL

25.