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. Consider the following oxides, V_2O_3, V_2O_4 and V_2O_5

   Oxidation state of vanadium in amphoteric oxide is

   (1) +3 (2) +4

   (3) +5 (4) +6

Answer (2)

Sol. V_2O_5 is amphoteric, oxidation state of Vanadium is +5

2. Which has maximum oxidising power among the following?

   (1) VO_2^+ (2) $Cr_2O_7^{2-}$

   (3) MnO_4^- (4) TiO_2

Answer (3)

Sol. Oxidising power order :

$MnO_4^- > Cr_2O_7^{2-} > VO_2^+$

Due to increasing stability of the lower species to which they are reduced.

3. Which of the following compound(s) are yellow in colour?

   (a) CdS, (b) PbS, (c) CuS, (d) ZnS(cold), (e) $PbCrO_4$

   Choose the correct answer from the options given below:

   (1) (a), (c) and (e) only (2) (a) and (e) only

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

Answer (2)

Sol. CdS, $PbCrO_4 \Rightarrow$ yellow coloured

PbS, CuS $\Rightarrow$ black coloured

ZnS $\Rightarrow$ white coloured (when cold)

4. The correct order of energy of the following subshell is

   $1s$ $2s$ $3p$ $3d$

   (1) $1s < 2s < 3d < 3p$

   (2) $2s < 1s < 3p < 3d$

   (3) $1s < 3p < 2s < 3d$

   (4) $1s < 2s < 3p < 3d$

Answer (4)

Sol.: Energy of subshell will depend on n + l

	$1s$	$2s$	$3p$	$3d$
n + l	1 + 0	2 + 0	3 + 1	3 + 2
	= 1	= 2	= 4	= 5

Correct order $\boxed{3d > 3p > 2s > 1s}$

5. Which of the following complex is paramagnetic

   (1) $[NiCl_4]^{2-}$ (2) $[Ni(CO)_4]$

   (3) $[Ni(CN)_4]^{2-}$ (4) $[Fe(CO)_5]$

Answer (1)

Sol. (i) $\underset{(sp^3)}{[NiCl_4]^{2-}} \rightarrow Ni^{2+} \rightarrow 3d^8$ in weak field ligand (WFL)

$\rightarrow$ 2 unpaired e^-

(ii) $\underset{(sp^3)}{[Ni(CO)_4]} \rightarrow Ni(0) \rightarrow 3d^{10}$ in strong field ligand (SFL)

$\rightarrow$ 0 unpaired e^-

(iii) $\underset{(dsp^2)}{[Ni(CN)_4]^{2-}} \rightarrow Ni^{2+} \rightarrow 3d^8$ in SFL

$\rightarrow$ 0 unpaired e^-

(iv) $\underset{(dsp^2)}{[Fe(CO)_5]} \rightarrow Fe(0) \rightarrow 3d^8$ in SFL

$\rightarrow$ 0 unpaired e^-

6. 30 gm HNO_3 is added to a solution to prepare 75% w/w solution having density 1.25 g/mL. Volume of solution is

(1) 32 mL

(2) 48 mL

(3) 36 mL

(4) 28 mL

Answer (1)

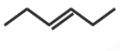
Sol. $M = \frac{10 \times \%w/w \times d}{M_0}$

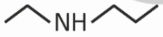
$M = \frac{10 \times 75 \times 1.25}{63}$

$M = \frac{n}{V_{mL}} \times 1000$

$\frac{10 \times 75 \times 1.25}{63} = \frac{30}{63 \times V_{mL}} \times 1000$

V_{mL} = 32 mL

7. Statement-I  and  are ring chain isomers

Statement-II  and  are functional isomers

(1) Both Statement -I and Statement -II are correct statements

(2) Statement -I is correct and Statement -II is not correct

(3) Statement -I is wrong statement and Statement -II is correct statement

(4) Both Statement -I and Statement -II are correct

Answer (1)

Sol. 1° amine and 2° amine are functional isomers

8. For an elementary reaction

$A + B \rightarrow C + D$

When volume becomes $\frac{1}{3}$rd , rate of reaction becomes

(1) 8 times

(2) 9 times

(3) 6 times

(4) 2 times

Answer (2)

Sol. For an elementary reaction

$r = k[A]^1 [B]^1$

When volume becomes $\frac{1}{3}$rd

$[A] \rightarrow 3A$

$[B] \rightarrow 3B$

$r' = k[3A]^1 [3B]^1$

$r' = k \ 3 \times 3 \ [A] \ [B]^1$

$r' = 9 \times r$

rate of reaction becomes 9 times

9. Consider the following sequence of rection

$CH_3 - C \equiv CH \xrightarrow[CaCO_3]{H_2/Pd} A \xrightarrow[H_2O]{O_3/Zn} B + C$

(1) B= CH_3CHO
C = HCHO

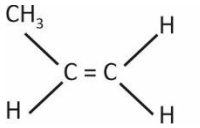
(2) B = CH_3CHO
C = HCOOH

(3) B = $CH_3 - \overset{O}{\overset{\|}{C}} - CH_3$
C = HCHO

(4) B $\Rightarrow$ HCHO
C $\Rightarrow$ CH_3COOH

Answer (1)

Sol. $CH_3 - C \equiv CH \xrightarrow[\text{hydrogenation}]{\text{Partial}}$



$\xrightarrow[Zn/H_2O]{O_3} CH_3CHO + HCHO$

10. Match the following List-I with List-II.

	List-I		List-II
(A)	$[CoF_6]^{3-}$	(i)	sp^3d^2
(B)	$[Co(NH_3)_6]^{3+}$	(ii)	d^2sp^3
(C)	$[NiCl_4]^{2-}$	(iii)	sp^3
(D)	$[Ni(CN)_4]^{2-}$	(iv)	dsp^2

Choose the correct answer from the options given below:

(1) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

(2) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)

(3) (A)-(i), (B)-(ii), (C)-(iv), (D)-(iii)

(4) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

Answer (1)

Sol.

(A) $[CoF_6]^{3-} \Rightarrow$ Cobalt in +3 O.S. with Flourine ligand. Here, F^- act as weak field ligand

$Co^{3+} \Rightarrow d^6 \Rightarrow t_{2g}^4 e_g^2 \Rightarrow$ e^- configuration.

$\therefore \left[CoF_6\right]^{3-}$ has hybridisation $\Rightarrow sp^3d^2$

(B) $[Co(NH_3)_6]^{3+} \Rightarrow Co^{3+}$, NH_3 ligand act as SFL.

$Co^{3+} \Rightarrow d^6 \Rightarrow t_{2g}^6 e_g^0 \Rightarrow$ e^- configuration.

$\therefore \left[Co(NH_3)_6\right]^{3+} \Rightarrow$ has hybridisation $\Rightarrow d^2sp^3$

(C) $[NiCl_4]^{2-} \Rightarrow Ni^{2+} \Rightarrow Cl^-$ ligand act as WFL.

$Ni^{2+} \Rightarrow d^8 \Rightarrow t_{2g}^6 e_g^2$ (No pairing by ligand)

$\therefore \left[NiCl_4\right]^{2-}$ has hybridisation sp^3

(D) $[Ni(CN)_4]^{2-} \Rightarrow Ni^{2+} \Rightarrow CN^-$ act as weak field ligand.

$Ni^{2+} \Rightarrow d^8 \Rightarrow t_{2g}^6 e_g^2 \Rightarrow$ (Pairing will occur)

$[Ni(CN)_4]^{2-}$ has hybridisation dsp^2

11. The correct name of I & II in the following process is :

$\text{Solid} \xrightarrow{\text{I}} \text{Vapours} \xrightarrow{\text{II}} \text{Solid}$

(1) I $\rightarrow$ Sublimation
II $\rightarrow$ Vaporisation

(2) I $\rightarrow$ Sublimation
II $\rightarrow$ Decomposition

(3) I $\rightarrow$ Sublimation
II $\rightarrow$ Deposition

(4) I $\rightarrow$ Deposition
II $\rightarrow$ Sublimation

Answer (3)

Sol. $\text{Solid} \xrightarrow{\text{sublimation}} \text{Vapours} \xrightarrow{\text{deposition}} \text{Solid}$

12. Which of the following biomolecules doesn't contain $C_1 - C_4$ glycosidic linkage

(1) Amylopectin

(2) Maltose

(3) Lactose

(4) Sucrose

Answer (4)

Sol. Amylopectin $\rightarrow$ branched chain polymer. The chain is formed by C_1–C_4 glycosidic linkage and C_1–C_6 glycosidic linkage

Maltose $\rightarrow$ C_1–C_4 glycosidic linkage

Lactose $\rightarrow$ C_1–C_4 glycosidic linkage

Sucrose $\rightarrow$ C_1–C_2 glycosidic linkage

13. Consider the following statements:

Statement I: In law of octaves, elements were arranged in increasing order of their atomic numbers.

Statement II: Lothar Meyer, plotted the physical properties against atomic weight.

Choose the correct answer from the options given below:

(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

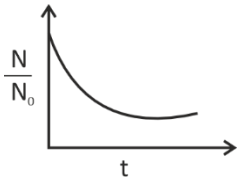
(4) Statement I is incorrect but statement II is correct

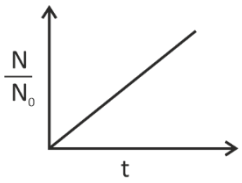
Answer (4)

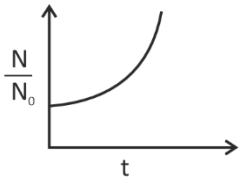
Sol. In law of octaves, elements were arranged in increasing order of their atomic weights.

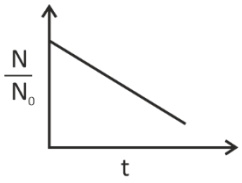
$\therefore$ Statement I is incorrect and statement II is correct statement.

14. The bacterial life grows as per 1st order kinetics. Which of the following graph is correct between $\frac{N}{N_0}$ and t

(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. $\frac{dN}{dt} = kN$

$\frac{dN}{N} = kdt$

On integrating using proper limits

$\int_{N_0}^{N} \frac{dN}{N} = k\int_{0}^{t} dt$

$[\ln N]_{N_0}^{N} = k[t]_0^t$

$\ln N - \ln N_0 = kt$

$\ln \frac{N}{N_0} = kt$

$\frac{N}{N_0} = e^{kt}$

Value of $\frac{N}{N_0}$ increases exponentially.

15. Bohr model is applicable for single electron system having atomic number Z. Frequency of rotation of electron is directly proportional to

(1) $\frac{Z}{n^2}$ (2) $\frac{Z^2}{n^3}$

(3) $\frac{n^2}{Z}$ (4) $\frac{n^3}{Z^2}$

Answer (2)

Sol. $f = \frac{v}{2\pi r} \propto \frac{\frac{Z}{n}}{\frac{n^2}{Z}} \propto \frac{Z^2}{n^3}$

16. In which of the following detection of nitrogen is not possible by Lassaigne's extract method?

(1) $NH_2–NH_2$

(2) $NH_2 - \overset{\overset{O}{||}}{C} - NH_2$

(3) Aniline

(4) Phenyl hydrazine

Answer (1)

Sol. Since, in hydrazine carbon is not present

$\therefore$ It cannot be detected by Lassaigne's test

17. Consider the following sequence of reaction

$C_6H_{12} \xrightarrow{Se/\Delta} A \xrightarrow[AlCl_3]{CH_3-Cl} B \xrightarrow[H_3O^+]{CrO_2Cl_2} C$

Choose the correct option about major product

(1) 'C' gives Fehling's solution test

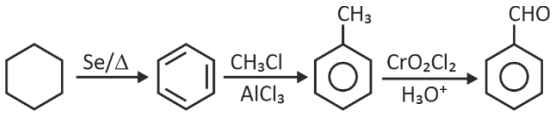
(2) 'C' can be prepared by reaction of PhMgBr with CO_2

(3) 'C' can give Tollen's test

(4) 'C' can give effervescence with $NaHCO_3$

Answer (3)

Sol.



Benzaldehyde can give Tollen's test

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. Number of paramagnetic species among the following is:

O_2, O_2^+, O_2^-, NO_2, NO, CO

Answer (5)

Sol. O_2, Number of e^- = 16, paramagnetic

O_2^+, Number of e^- = 15, paramagnetic

O_2^-, Number of e^- = 17, paramagnetic

NO_2, odd e^- specie, paramagnetic

NO, Number of e^- = 15, paramagnetic

CO, Number of e^- = 14, diamagnetic

22. How many of the following molecules are polar?

CH_4, CCl_4, CH_2Cl_2, H_2O, NH_3, H_2O_2, O_2F_2

Answer (5)

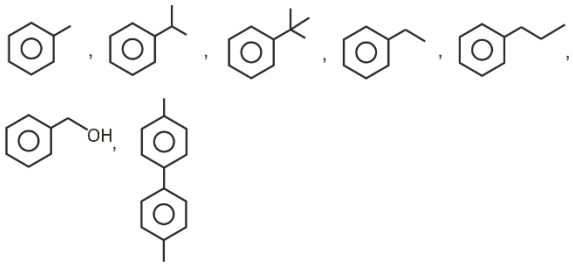
Sol. Compounds having permanent dipole moment ($\mu \neq 0$) are polar

CH_4,CCl_4 $\Rightarrow \mu = 0$

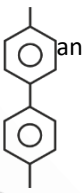
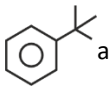
CH_2Cl_2, H_2O, NH_3, H_2O_2, O_2F_2 $\Rightarrow \mu \neq 0$

Number of polar molecules = 5

23. How many of the following will give Benzoic acid on reaction with hot alkaline $KMnO_4$?



Answer (5)

Sol. Except for  and  all will give Benzoic acid on reaction with hot alkaline $KMnO_4$.

Note : Benzylic hydrogen must be present to give Benzoic acid.

24. By passing current in 600 mL of NaCl solution pH increases to 12. Find current (i) if electrolysis occur for 10 min(assume 100% efficiency)

Answer (1)

Sol. $2H_2O + 2e^- \rightarrow 2H_2 + 2OH^-$

pH = 12 pOH = 2 $[OH^-] = 10^{-2}M$

g eq. of OH^- formed = no. of faraday of charge passed

$$10^{-2} \times \frac{600}{1000} \times 1 = \frac{i \times 10 \times 60}{96500}$$

0.965A = i

25.