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 reactions

$$S(s)+\frac{3}{2}O_2(g)\rightarrow SO_3(g)+2x\ kJ$$

$$SO_2(g)+\frac{1}{2}O_2(g)\rightarrow SO_3(g)+y\ kJ$$

Calculate ΔH_r for following reaction based on above information

$$S(s)+O_2\rightarrow SO_2(g)$$

(1) $-(x+y)$ (2) $-(2x+y)$

(3) $\frac{x}{y}$ (4) $y-2x$

Answer (4)

Sol. $\Delta H_1 = -2x$ kJ

$\Delta H_2 = -y$ kJ

$\Delta Hr = \Delta H_1 - \Delta H_2$

$\Delta H_r = -2x + y$

2. The conditions and consequences that favour the $t_{2g}^3 e_g^1$ configuration in a metal complex are

(1) Strong field ligand; High spin complex

(2) Weak field ligand; High spin complex

(3) Strong field ligand; Low spin complex

(4) Weak field ligand; Low spin complex

Answer (2)

Sol. The electronic configuration of $t_{2g}^3 e_g^1$ for central metal ion in a complex implies $\Delta_0 < P$ i.e., weak field ligand and High spin complex.

3. When ethane-1, 2-diammine is progressively added to aqueous solution of Nickel (II) chloride, the sequence of colour change observed will be:

(1) Pale Blue $\rightarrow$ Blue $\rightarrow$ Green $\rightarrow$ Violet

(2) Violet $\rightarrow$ Blue $\rightarrow$ Pale Blue $\rightarrow$ Green

(3) Pale Blue $\rightarrow$ Blue $\rightarrow$ Violet $\rightarrow$ Green

(4) Green $\rightarrow$ Pale Blue $\rightarrow$ Blue $\rightarrow$ Violet

Answer (4)

Sol. If the bidentate ligand, ethane-1, 2-diammine(en) is progressively added in the molar ratio en: Ni 1 : 1, 2 : 1, 3 : 1, the following series of reactions and their associated colour changes occur:-

$$\underset{\text{(Green)}}{\left[Ni(H_2O)_6\right]^{2+}}(aq.)+(en)(aq.)\longrightarrow\underset{\text{(Pale Blue)}}{\left[Ni(H_2O)_4(en)\right]^{2+}}(aq.)+2H_2O$$

$$\underset{\text{(Pale Blue)}}{\left[Ni(H_2O)_4(en)\right]^{2+}}(aq.)+(en)(aq.)\longrightarrow\underset{\text{(Blue/Purple)}}{\left[Ni(H_2O)_2(en)_2\right]^{2+}}(aq.)+2H_2O$$

$$\underset{\text{Blue/Purple}}{\left[Ni(H_2O)_2(en)_2\right]^{2+}}(aq.)+(en)(aq.)\longrightarrow\underset{\text{Violet}}{\left[Ni(en)_3\right]^{2+}}(aq.)+2H_2O$$

4. S-I :- The first ionisation energy of Pb is greater than that of Sn.

S-II:- The first ionisation energy of Ge is greater than that of Si.

(1) S-I and S-II both are correct

(2) S-I is correct and S-II incorrect

(3) S-I is incorrect and S-II correct

(4) S-I and S-II both are incorrect

Answer (2)

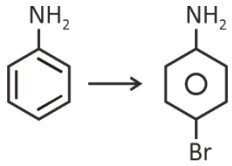
Sol. IE_1 of Pb = 715 kJ/mol

IE_1 of Sn = 708 kJ/mol

IE_1 of Si = 786 kJ/mol

IE_1 of Ge = 761 kJ/mol

SI is correct and S-II is incorrect

5. 

Above conversion can be done by using which reagents among the following.

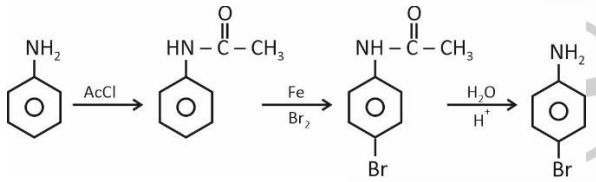
(1) Fe/Br_2, $H_2O(\Delta)$, H_2SO_4

(2) AcOH, H_2SO_4, Br_2, NaOH

(3) AcCl, Fe/Br_2, H_2O/H^+

(4) AcOH, Br_2/Fe, NaOH

Answer (3)

Sol. 

6. Match Column-I with the Column-II and select the correct option.

	Column-I (Ionic species)		**Column-II (Spin only magnetic moment (BM))**
A.	Sc^{3+}	(P)	2.84
B.	Ti^{2+}	(Q)	0
C.	V^{2+}	(R)	5.92
D.	Mn^{2+}	(S)	3.87

(1) A → (P), B → (Q), C → (R), D → (S)

(2) A → (R), B → (S), C → (P), D → (Q)

(3) A → (Q), B → (P), C → (S), D → (R)

(4) A → (Q), B → (P), C → (R), D → (S)

Answer (3)

Sol. $Sc^{3+} \rightarrow 0$ BM

$Ti^{2+} \rightarrow 2.84$ BM

$V^{2+} \rightarrow 3.87$ BM

$Mn^{2+} \rightarrow 5.92$ BM

7. If a compound contains 54.2% carbon, 9.2% hydrogen and the rest is oxygen. What is molecular formula of the compound, if molecular mass is 132 g/mol?

(1) $C_6H_{12}O_3$

(2) $C_4H_{12}O_3$

(3) $C_4H_{12}O_6$

(4) $C_6H_{13}O_6$

Answer (1)

Sol. Let mass of compound be 100 g

	Mass (g)	**Mole**	**Molar ratio**
C	54.2	$\frac{54.2}{12} = 4.52$	2
H	9.2	$\frac{9.2}{1} = 9.2$	4
O	36.6	$\frac{36.6}{16} = 2.3$	1

Empirical formula = C_2H_4O

$\Rightarrow$ MF = n(EF)

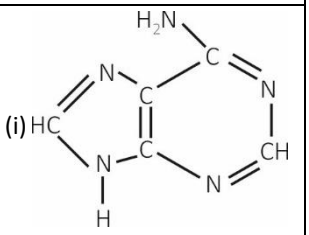
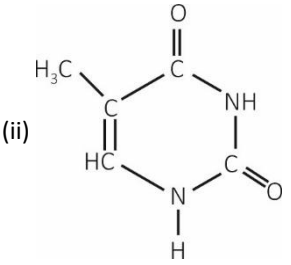
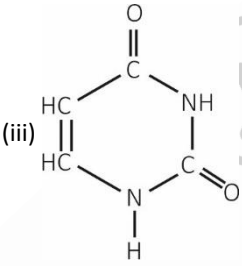
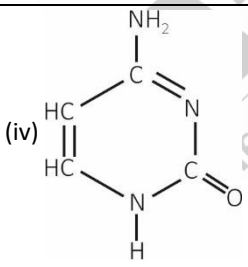
$n = \frac{\text{MF mass}}{\text{EF mass}}$

$\frac{132}{44} = 3$

MF = $3(C_2H_4O)$

= $C_6H_{12}O_3$

8. Match the following nitrogenous bases present in List-I with their structures present in List-II.

List-I	List-II
A. Thymine	(i) 
B. Adenine	(ii) 
C. Cytosine	(iii) 
D. Uracil	(iv) 

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

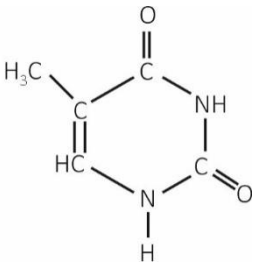
(2) A-(ii), B-(i), C-(iv), D-(iii)

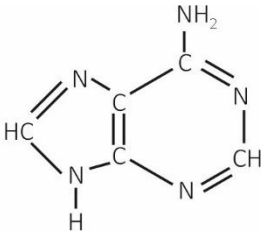
(3) A-(ii), B-(i), C-(iii), D-(iv)

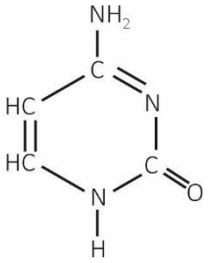
(4) A-(iii), B-(iv), C-(i), D-(ii)

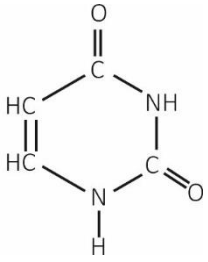
Answer (2)

Sol. Correct structure of

Thymine ⇒ 

Adenine ⇒ 

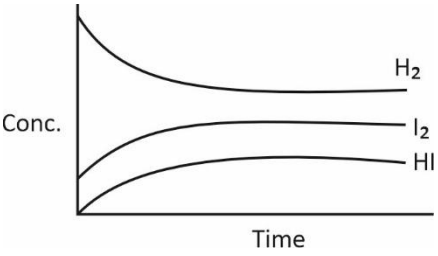
Cytosine ⇒ 

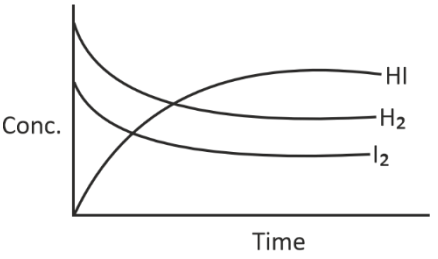
Uracil ⇒ 

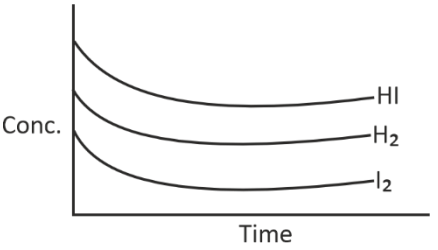
9. Consider the following gaseous reaction

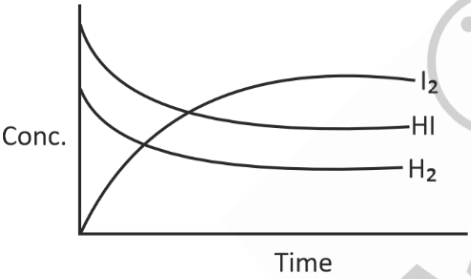
$$H_2(g) + I_2(g) \longrightarrow 2HI$$

The above reaction is started with 'a' moles of H_2 and 'b' moles of I_2 in a closed container at a certain temperature T(K) till the equilibrium is established. Which one of the following plots correctly describes the progress of reaction?

(1)


(2)


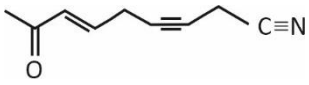
(3)


(4)


Answer (2)

Sol. The reaction is started with certain concentrations of H_2 and I_2 to form HI. The concentrations of H_2 and I_1 decrease with time while the concentration of HI increases with time till their concentrations become constant at equilibrium.

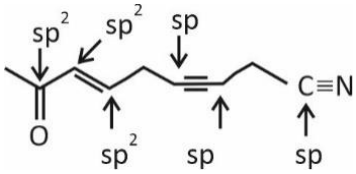
10. In the given compound no. of sp and sp^2 hybridised carbon are



(1) 4 and 5 (2) 4 and 6

(3) 3 and 6 (4) 3 and 3

Answer (4)

Sol.


11. The successive ionisation energy (I.E.) of an element 'X' is given

	$I.E_1$	$I.E_2$	$I.E_3$	$I.E_4$	$I.E_5$
X →	500	600	2000	2200	2600

Data given in KJ/mol.

Find out the group number of element X.

(1) Group → 3 (2) Group → 14

(3) Group → 2 (4) Group → 13

Answer (3)

Sol. Since the ratio of $\frac{IE_3}{IE_2}$ is maximum, so the element X belongs to group 2.

12. Consider the following statements :

Statement-I : Oxygen-oxygen bond in O_3 is greater than O_2.

Statement-II : O – O bond order in O_3 is 1.5 and O – O bond order in O_2 is 2.

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

(2) Both Statement-I and Statement-II are incorrect

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

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

Answer (1)

Sol. $O=\overset{+}{O}-O^- \leftrightarrow {}^-O-\overset{+}{O}=O$

Bond order = $\frac{3}{2}=1.5$

O = O

Bond order = 2

13.

14.

15.

16.

17.

18.

19.

20.

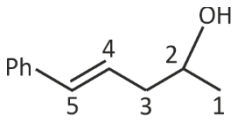
SECTION - B

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. How many stereoisomers are possible for 5-Phenylpent-4-en-2-ol.

Answer (4)

Sol.



There are two centre which can show stereoisomers, one chiral centre and one geometrical centre.

For unsymmetrical compound

Total isomers = 2^n

n = 2

$= 2^2$

= 4

22. A hydrocarbon X which has molar mass 80 g contains 90% carbon by mass. Find degree of unsaturation in X

Answer (3)

Sol. Mass of C-atom $= \frac{90}{100} \times 80$ g

= 72 g

Moles of C-atom $\frac{72}{12}$ = 6 mol C

Mass of H-atom = $\frac{10}{100} \times 80$ = 8 g

Moles of H-atom = $\frac{8}{1}$ = 8 mol H

$\therefore$ Molecular formula of X $\rightarrow C_6H_8$

$$D.U = C + 1 - \frac{H}{2}$$

$$= 6 + 1 - \frac{8}{2}$$

$$= 7 - 4 = 3$$

Degree of unsaturation $\rightarrow$ 3

23. In Carius method of estimation of halogen, 0.25 g of an organic compound gave 0.16 g of AgBr. What is the percentage of bromine in the organic compound (Given molar mass of Ag = 108, Br = 80)

Answer (27)

Sol. Moles of AgBr $= \frac{0.16}{188}$ moles

Mass of Br $= \frac{0.16}{188} \times 80$ g

= 0.068 g

$$\% \text{ of Br} = \frac{0.068}{0.25} \times 100$$

= 27%

24. Let k_1, k_2 and k_3 be the rate constant of reaction and $k = \sqrt{\frac{k_1 k_3}{k_2}}$. Then find activation energy of overall reaction. (Given : $E_{a_1} = 10$ kJ/mol, $E_{a_2} = 30$ kJ/mol, $E_{a_3} = 60$ kJ/mol)

Answer (20)

Sol. $(E_a)_{overall} = \frac{1}{2}[E_{a_1} + E_{a_3} - E_{a_2}]$

$$= \frac{1}{2}[10 + 60 - 30]$$

= 20 kJ/mole

25.