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. Increasing order of bond length from the following

(1) O_2^+, O_2, O_2^{2-}, O_2^-

(2) O_2^-, O_2^{2-}, O_2^+, O_2

(3) O_2^+, O_2, O_2^-, O_2^{2-}

(4) O_2^{2-}, O_2^-, O_2, O_2^+

Answer (3)

Sol. Lesser the bond order, more will be the bond length

	BO
O_2^{2-}	1
O_2^-	1.5
O_2	2
O_2^+	2.5

2. If $E^o_{Fe^{2+}/Fe}$ is xV and $E^o_{Fe^{3+}/Fe}$ is yV.

Then calculate $E^o_{Fe^{2+}/Fe^{3+}}$ in V.

(1) (2x – 3y)

(2) (2x + 3y)

(3) (x – y)

(4) (x + y)

Answer (1)

Sol. (i) $\ldots. Fe^{+2} + 2e^- \rightarrow Fe, E^o_1 = xV$

(ii) $\ldots. Fe^{3+} + 3e^- \rightarrow Fe, E^o_2 = yV$

(iii) $\ldots. Fe^{2+} \rightarrow Fe^{3+} + e^-, E^0 = ?$

(i) + reverse (ii) $\rightarrow$ (iii)

$-1 \times F \times E^0 = -2 \times F \times x + 3 \times F \times y$

$\Rightarrow E^0 = 2x - 3y$

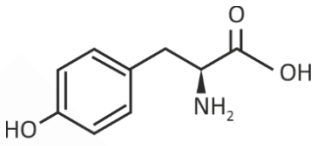
3. Which of the following amino acid gives violet color complex with neutral $FeCl_3$ solution?

(1) Threonine (2) Serine

(3) Tyrosine (4) Cysteine

Answer (3)

Sol. Tyrosine contains a p-hydroxy phenyl group (a phenolic ring), Phenol on reaction with neutral $FeCl_3$ form a violet color complex



Tyrosine

4. Match List-I with List-II

	List-I (n = 2)		List-II (IE in kJ/mol)
(A)	ns^2	(1)	1402
(B)	ns^2np^1	(2)	899
(C)	ns^2np^3	(3)	2080
(D)	ns^2np^6	(5)	801

(1) A $\rightarrow$ 2, B $\rightarrow$ 4, C $\rightarrow$ 3, D $\rightarrow$ 1

(2) A $\rightarrow$ 4, B $\rightarrow$ 2, C $\rightarrow$ 1, D $\rightarrow$ 3

(3) A $\rightarrow$ 2, B $\rightarrow$ 4, C $\rightarrow$ 1, D $\rightarrow$ 3

(4) A $\rightarrow$ 4, B $\rightarrow$ 2, C $\rightarrow$ 3, D $\rightarrow$ 1

Answer (3)

Sol.

	IE (kJ/mol)
$ns^2 \rightarrow Be$	899
$ns^2np^1 \rightarrow B$	801
$ns^2np^3 \rightarrow N$	1402
$ns^2np^6 \rightarrow Ne$	2080

5. Consider the following

$X_2 + Y_2 \rightleftharpoons 2XY;\ K_1 = 25 \times 10^{-6}$

$XY + \frac{1}{2}Z_2 \rightleftharpoons XYZ;\ K_2 = 5 \times 10^{-3}$

What is K_3 for $\frac{1}{2}X_2 + \frac{1}{2}Y_2 + \frac{1}{2}Z_2 \rightleftharpoons XYZ$

(1) 5×10^{-4}

(2) 2.5×10^{-5}

(3) 1×10^{4}

(4) 2.5×10^{-4}

Answer (2)

Sol.
$$\frac{1}{2}X_2 + \frac{Y_2}{2} \rightleftharpoons XY;\ K_1' = 5\times10^{-3}$$
$$XY + \frac{1}{2}Z_2 \rightleftharpoons XYZ;\ K_2 = 5\times10^{-3}$$
$$\frac{1}{2}X_2 + \frac{1}{2}Y_2 + \frac{1}{2}Z_2 \rightleftharpoons XYZ;\ K_3 = K_1' \times K_2$$

$K_3 = 5 \times 10^{-3} \times 5 \times 10^{-3}$

$= 25 \times 10^{-6}$

$= 2.5 \times 10^{-5}$

6. Bromine trifluoride auto ionises to form BrF_2^+ and BrF_4^-. The shapes of cation and anion are respectively

(1) Linear, square planar

(2) Bent, See-Saw

(3) Bent, square planar

(4) Linear, tetrahedral

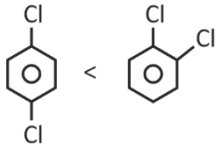
Answer (3)

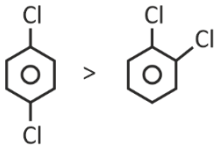
Sol. $BrF_2^+ \rightarrow$ Bent shape

$BrF_4^- \rightarrow$ Square planar

7. Given below are two statements.

Statement I : Boiling point follows the order $CH_3CH_2CH_2I > CH_3CH_2I > CH_3I$.

Statement II : Melting point : 

Boiling point : 

Choose the correct statements.

(1) Both Statement I and Statement II are correct

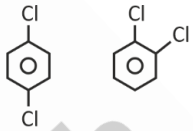
(2) Statement I is correct but Statement II is incorrect

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

(4) Both Statement I and Statement II are incorrect

Answer (2)

Sol. Statement I is correct.



m.p $\Rightarrow$ 323 K > 256 K

b.p $\Rightarrow$ 448 K < 453 K

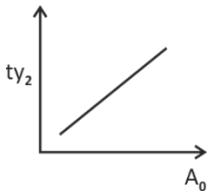
(due to symmetry $\Rightarrow$ better packing in para)

Statement II is incorrect.

8. Given below are two statements

Statement I : Given E_a = 12.6 K cal; then at room temperature, the rate constant double for a rise for a rise of 10°C

Statement II : In a first order reaction



Choose the correct option.

(1) Both statement I and statement II are true

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

(3) Statement I is true but statement II is false

(4) Both statement I and statement II are false

Answer (3)

Sol. $\log\frac{k_2}{k_1}=\frac{12600}{2.303\times2}\left[\frac{10}{298\times308}\right)$

$\log\frac{k_2}{k_1}=0.3$

$\log\frac{k_2}{k_1}=\log2$

$\frac{k_2}{k_1}=2$

$k_2 = 2k_1$

For first order reaction $t_{1/2}$ is independent of initial concentration

9. Given below are two statements

Statement I : 30% (w/w) Solution of CCl_4 in Benzene has mole fraction of CCl_4 to be 0.033.

Statement II : A mixture of CCl_4 and ethanol shows positive deviation.

In light of above statements, choose the correct option.

(1) Both statement-I and statement-II are correct
(2) Statement-I is correct statement-II is incorrect
(3) Statement-I is incorrect statement-II is correct
(4) Both statement-I and statement-II are incorrect

Answer (3)

Sol. • $X_{CCl_4}=\frac{\frac{30}{154}}{\frac{30}{254}+\frac{70}{78}}=0.178$

• Mixture of CCl_4 and ethanol will show positive deviation

10. Match the following.

	List-I (Mass of molecules)		List-II (Number of molecules)
(P)	1.8 mg H_2O	(I)	0.5 × 10^{-4} N_A
(Q)	1.8 mg carbon	(II)	1.5 × 10^{-4} N_A
(R)	4.9 mg H_2SO_4	(III)	2 × 10^{-4} N_A
(S)	11.7 mg NaCl	(IV)	1 × 10^{-4} N_A

(1) (P) → (III), (Q) → (IV), (R) → (I), (S) → (II)
(2) (P) → (VI, (Q) → (II), (R) → (I), (S) → (III)
(3) (P) → (I), (Q) → (II), (R) → (III), (S) → (IV)
(4) (P) → (II), (Q) → (III), (R) → (I), (S) → (IV)

Answer (2)

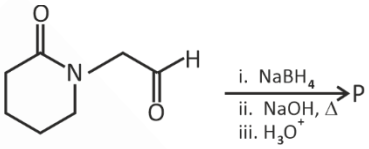
Sol. $n_{H_2O}=\frac{1.8\times10^{-3}}{18}=0.1\times10^{-3}\ N_A=1\times10^{-4}\ N_A$

$n_e=\frac{1.8\times10^{-3}}{12}=0.15\times10^{-3}\ N_A=1.5\times10^{-4}\ N_A$

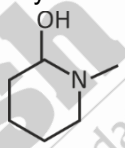
$n_{H_2SO_4}=\frac{4.9\times10^{-3}}{98}=\frac{1}{2}\times10^{-4}\Rightarrow 0.5\times10^{-4}\ N_A$

$n_{NaCl}=\frac{11.7\times10^{-3}}{58.5}=0.2\times10^{-3}\Rightarrow 2\times10^{-4}\ N_A$

11. Consider the reaction sequence :



Identify P.

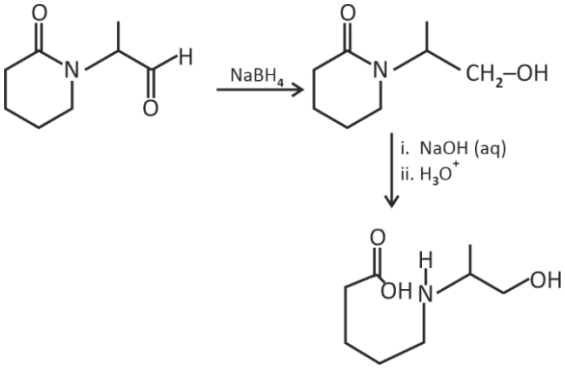
(1) 

(2) OHC–$(CH_2)_4$ – NH – CH_2 – OH

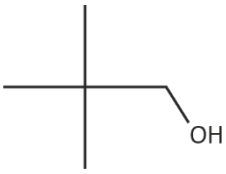
(3) $HO_2C-(CH_2)_4-NH-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-OH$

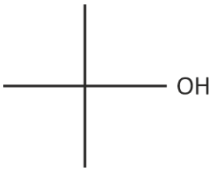
(4) $OHC-(CH_2)_4-NH-\underset{\displaystyle CH_2-OH}{\underset{|}{CH_2}}$

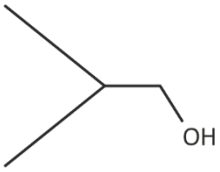
Answer (3)

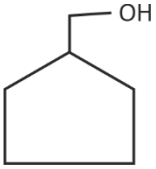
Sol. 

12. Which of the following does not undergo rearrangement of carbocation

(1) 

(2) 

(3) 

(4) 

Answer (2)

Sol. 

Will not undergo rearrangement

13. **Statement I :** Reducing character decreases from NH_3 to BiH_3.

Statement II : Tendency to donate a lone pair of e^- decreases from NH_3 to BiH_3.

Statement III : Stability of hydrides decreases from NH_3 to BiH_3.

Statement IV : The $H\hat{E}H$ bond angle of NH_3 is greater than SbH_3.

Which of the following is correct statements.

(1) S_I, S_{II} and S_{III} only

(2) S_{II} and S_{IV} only

(3) S_{II}, S_{III} and S_{IV} only

(4) S_I and S_{III} only

Answer (3)

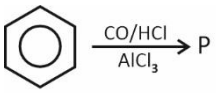
Sol. Down the group E – H bond strength decreases therefore reducing character increases.

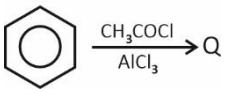
NH_3 is strong Lewis base than BiH_3

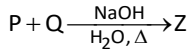
$NH_3 \Rightarrow BA = 107.8^oC$

$SbH_3 \Rightarrow BA \Rightarrow 91.3^o$

14. Consider the following reaction







The number of π bonds is (Z) is

(1) 8

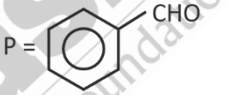
(2) 10

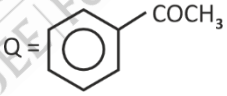
(3) 12

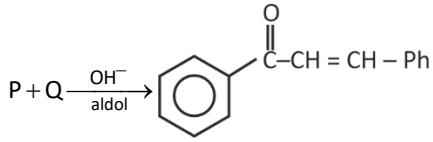
(4) 5

Answer (1)

Sol.







Number of π bonds = 3 + 3 + 2 = 8

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. Given $\lambda_1 = 3000Å$ and $\lambda_2 = 6000Å$ then find the ratio of E_1 and E_2

Answer (2)

Sol. $E = \frac{hc}{\lambda}$

$E_2 = \frac{hc}{\lambda_2}$

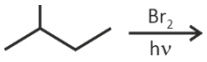
$E_1 = \frac{hc}{\lambda_1}$

$\frac{E_2}{E_1} = \frac{\lambda_1}{\lambda_2}$

$\frac{E_2}{E_1} = \frac{3000}{6000} = \frac{1}{2}$

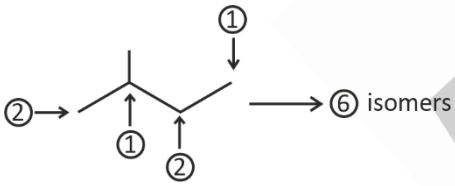
$\frac{E_2}{E_1} = 2$

22. The number of monobrominated products in the following reaction is (including stereoisomers)

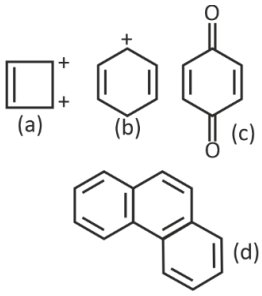


Answer (6)

Sol.



23. The number of aromatic compounds from the following is



Answer (2)

Sol. a, d are aromatic

24. Number of paramagnetic complexes among the following is

$[MnBr_4]^{2-}$,$[NiCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Ni(CO)_4]$, $[CoF_6]^{3-}$, $[Fe(CN)_6]^{4-}$, $[Ti(CN)_6]^{3-}$

Answer (4)

Sol. $[MnBr_4]^{2-} \Rightarrow Br^- \Rightarrow$ WFL $\Rightarrow$ Paramagnetic

$[NiCl_4]^{2-} \Rightarrow Cl^{\ominus} \Rightarrow$ WFL $\Rightarrow$ Para

$[Ni(CN)_4]^{2-} \Rightarrow CN^- \Rightarrow$ SFL $\Rightarrow$ Dia

$[Ni(CO)_4] \Rightarrow CO \Rightarrow$ SFL $\Rightarrow$ Dia

$[CoF_6]^{3-} \Rightarrow F^- \Rightarrow$ WFL $\Rightarrow$ Para

$[Fe(CN)_6]^{4-} \Rightarrow CN^- \Rightarrow$ SFL $\Rightarrow$ Dia

$[Ti(CN)_6]^{3-} \Rightarrow CN^{\ominus} \Rightarrow$ SFL $\Rightarrow$ 1 unpaired $e^- \Rightarrow$ Para

25. Solid C, CaO and $CaCO_3$ are mixed and allowed to attain equilibrium at 'T' K such that,

$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $\quad K_{p_1} = 0.08$ atm

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$ $\quad K_{p_2} = 2$ atm

Partial pressure of CO at equilibrium is $x \times 10^{-1}$ atm. x is _____.

Answer (4)

Sol. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $\quad K_{p_1} = 0.08$ atm

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$ $\quad K_{p_2} = 2$ atm

$K_{p_1} = (p_{CO_2})_e = 0.08$ atm

Now, $\frac{(p_{CO})^2}{0.08} = 2$

$(p_{CO})^2 = 0.16 \Rightarrow p_{CO} = 0.4$ atm $= 4 \times 10^{-1}$ atm