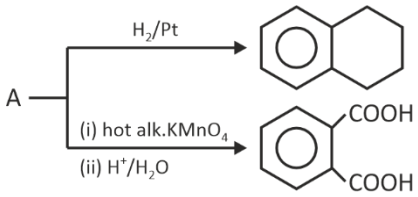
CHEMISTRY

SECTION - A

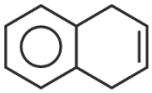
Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

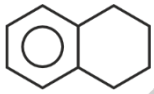
Choose the correct answer :

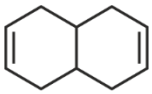
1. Consider the following reaction :

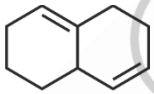


Then 'A' will be

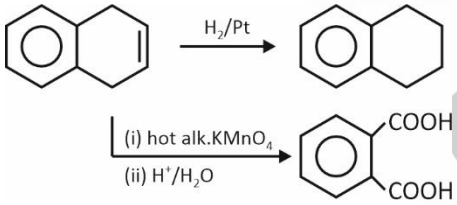
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

2. In Sulphur estimation, 0.7 g of an organic compound gives 1 g of $BaSO_4$ by Carius method. What is the % of 'S' in compound?

(1) 19.61

(2) 23.85

(3) 27.93

(4) 14.57

Answer (1)

Sol. $$\% \text{ of } S = \frac{\frac{1}{233}\times 32}{0.7}\times 100 = 19.61\%$$

3. Which of the following is the correct order with respect to the property indicated?

(1) Cl > F (Ionisation energy)

(2) $K_2O > Na_2O > Al_2O_3$ (Basic nature)

(3) K > Na > Al > Mg (Metallic character)

(4) None of these

Answer (2)

Sol. F > Cl : First ionisation energy (due to small size of F)

K > Na > Mg > Al : Metallic character (It decreases from Left to Right across the period and increases from Top to Bottom.

4. Given below are two statements.

Statement I : Arginine and Tryptophan are essential amino acids.

Statement II : Glycine does not have any chiral carbon.

In the light of the above statements, which is 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 and statement-II is incorrect

(4) Statement-I is incorrect and statement-II is correct

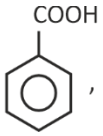
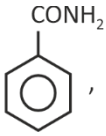
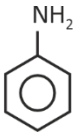
Answer (1)

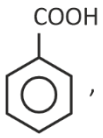
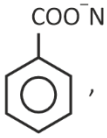
Sol. Arginine are Tryptophan both are essential amino acids. Glycine does not contain any chiral centre.

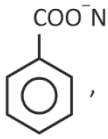
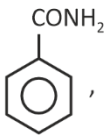
5. Observe the following reaction sequence:

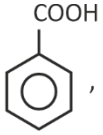
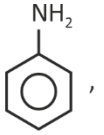
$$(P)\xrightarrow[\Delta]{NH_3}(Q)\xrightarrow{Br_2, KOH}(R)$$

Which of the following is the correct structure for P, Q and R?

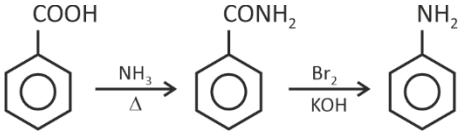
(1) P =  , Q =  , R = 

(2) P =  , Q =  , R = 

(3) P =  , Q =  , R = 

(4) P =  , Q =  , R = 

Answer (1)

Sol. 

6. In the following reaction,

$$MnO_4^{2-} \xrightarrow{H^+}$$

Manganate ion undergoes disproportionation in acidic medium to form

(1) MnO_2, MnO_4^- (2) MnO, MnO_2

(3) MnO_2, Mn_2O_3 (4) MnO_4^-, MnO

Answer (1)

Sol. MnO_4^{2-} disproportionates in acidic solution to gives

MnO_4^- and MnO_2

$$3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

7. 80 mL of an organic compound is mixed with 264 mL O_2 and ignited. It gives 224 mL of gaseous mixture at NTP. After passing through KOH 64 mL of gas remains. The organic compound is

(1) C_2H_4 (2) C_2H_2

(3) C_4H_{10} (4) C_3H_6

Answer (2)

Sol. $$C_xH_y(g) + \left(x+\frac{y}{4}\right)O_2(g) \rightarrow xCO_2(g) + \frac{y}{2}H_2O(l)$$

t = 0 80 mL 264 mL

$\left(V_{CO_2} + V_{O_2}\right)_{\text{after reaction}} = 224$ mL

After passing through KOH, 64 mL gas left

$\left(V_{O_2}\right)_{\text{left}} = 64$ mL

$\left(V_{O_2}\right)_{\text{used}} = 200$ mL

$\left(V_{CO_2}\right)_{\text{formed}} = 224 - 64 = 160$ mL

1 mL $C_xH_y \rightarrow x$ mL CO_2

80 mL $\rightarrow$ 160 mL CO_2

$\boxed{x = 2}$

$$\frac{V_{C_xH_y}}{1} = \frac{\left(V_{O_2}\right)_{\text{used}}}{x+\frac{y}{4}}$$

$$80 = \frac{200}{\left(2+\frac{y}{4}\right)}$$

160 + 20y = 200

20y = 40

$\boxed{y = 2}$ formula C_2H_2

8. Consider the following reaction

$Ca + 2HCl \rightarrow CaCl_2 + H_2$

We have 14 g Ca reacts with excess of HCl. Choose the incorrect option.

(1) Mass of $CaCl_2$ produced is 38.85 g

(2) Mole of H_2 produced is 0.35 mol

(3) Volume of H_2 produced at STP is 7.84 L

(4) Mass of $CaCl_2$ produced is 3.885 g

Answer (4)

Sol. $Ca + 2HCl \rightarrow CaCl_2 + H_2$

$\frac{14}{40} = 0.35\,mol$

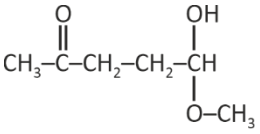
$n_{CaCl_2} = 0.35$

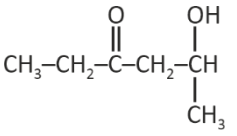
$W_{CaCl_2} = 38.85\,g$

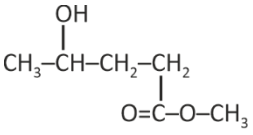
$n_{H_2} = 0.35$

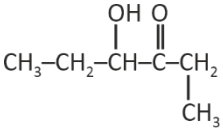
V_{H_2} at STP = 0.35 × 22.4 = 7.84 L

9. $C_6H_{12}O_3$ gives positive iodoform test on hydrolysis with dil. Acid. The hydrolysis product formed gives Tollens' and iodoform test both. Find structure of $C_6H_{12}O_3$.

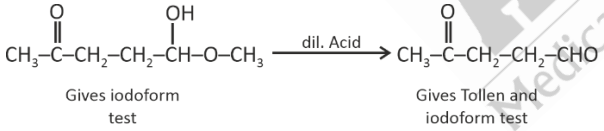
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

10. Given below are two statements :

Statement I : All the pairs of molecules (PbO, PbO_2); (SnO, SnO_2) and (GeO, GeO_2) contain amphoteric oxides.

Statement II : $AlCl_3$, BH_3, BeH_2 and NO_2 all have incomplete octet.

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

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

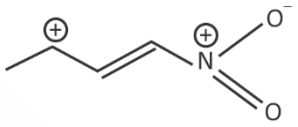
(3) Statement I is correct but Statement II is incorrect

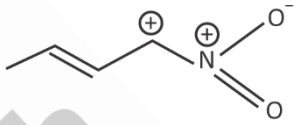
(4) Statement I is incorrect but Statement II is correct

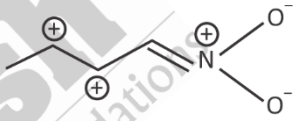
Answer (4)

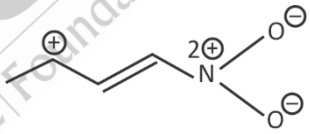
Sol.
- SnO, SnO_2, PbO, PbO_2 are amphoteric oxides.
- GeO_2 is acidic.
- GeO is distinctly acidic.

11. Which of the following resonating structure is the most stable?

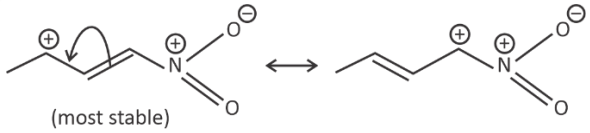
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

12. Consider the following statements.

(A) Propanal and Propanone are functional isomers

(B) Ethoxyethane and methoxypropane are metamers

(C) But-2-ene shows optical isomerism

(D) But-1-ene and But-2-ene are functional isomers

(E) Pentane and 2, 2-dimethylpropane are chain isomers

The correct statements are

(1) A, B, D only

(2) B, C, D only

(3) A, B, E only

(4) A, B, D, E only

Answer (3)

Sol.
- But-2-ene doesn't show optical isomerism as it contain plane of symmetry and has no chiral centre also.
- But-1-ene and But-2-ene are position isomers.

13. Given below are two statements

Statement I: When electric discharge is put on hydrogen, it emits discrete frequency in electromagnetic spectrum.

Statement II: Frequency of He^+ ion of 2nd line of Balmer series is equal to first line of Lyman series.

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

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

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

Answer (1)

Sol. For He^+ ion

$$\nu \propto z^2\left(\frac{1}{2^2}-\frac{1}{4^2}\right) \propto 2^2\left(\frac{1}{2^2}-\frac{1}{4^2}\right)$$

$$\propto \frac{3}{4}$$

For H atom

$$\nu \propto 1^2\left(\frac{1}{1^2}-\frac{1}{2^2}\right) \propto \frac{3}{4}$$

$\therefore$ frequency is same.

14. Which of the following compound is paramagnetic in nature?

(1) $[Ni(CO)_4]$

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

(3) $[NiCl_4]^{2-}$

(4) $[Co(H_2O)]^{3+}$

Answer (3)

Sol.

$Ni(CO)_4$	$3d^8 4s^2$	↑↓ ↑↓ ↑↓ ↑↓ ↑↓ n = 0	sp^3
$Ni(CN)_4^{2-}$	$3d^8$	↑↓ ↑↓ ↑↓ ↑↓ ☐ $\because$ CN^- is SFL n = 0	dsp^2
$NiCl_4^{2-}$	$3d^8$	↑↓ ↑↓ ↑↓ ↑ ↑ n = 2 Paramagnetic	sp^3
$[Co(H_2O)_6]^{3+}$	$3d^6$	↑↓ ↑↓ ↑↓ ☐ ☐ n = 0 H_2O with Co^{3+} is SFL	d^2sp^3

15. Observe the following reaction sequence :

$$C_4H_8 \xrightarrow{HCl} C_4H_9Cl \xrightarrow{NH_3} C_4H_9NH_2$$

(A) (B) (C)

(Optically active)

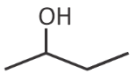
$$\xrightarrow{NaNO_2 + HCl} C_4H_9OH$$

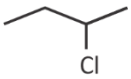
Which of the following is correct structure of A, B and C?

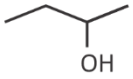
(1) (A) =  , (B) = 

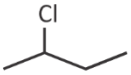
(C) = 

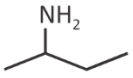
(2) (A) =  , (B) = 

(C) = 

(3) (A) =  , (B) = 

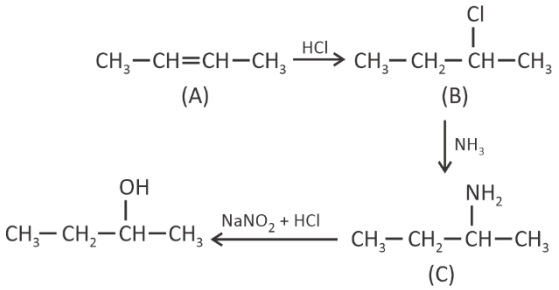
(C) = 

(4) (A) =  , (B) = 

(C) = 

Answer (4)

Sol.



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. For two chemical reactions A and B, if the difference between their activation energy is 20 kJ at 300 K (R = 8.3 J K^{-1} mol^{-1}). Determine $\ln\frac{K_2}{K_1}$.

Answer (8)

Sol. For reaction A,

$$k_1 = Ae^{-\frac{E_{a_1}}{RT}}$$

For reaction B,

$$k_2 = Ae^{-\frac{E_{a_2}}{RT}}$$

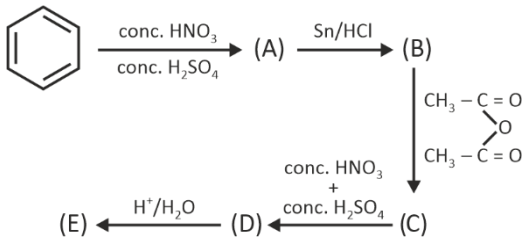
$$\frac{k_2}{k_1} = \frac{e^{-\frac{E_{a_2}}{RT}}}{e^{-\frac{E_{a_1}}{RT}}}$$

$$\frac{k_2}{k_1} = e^{\frac{-E_{a_2}+E_{a_1}}{RT}}$$

$$\ln\frac{k_2}{k_1} = \frac{-E_{a_2}+E_{a_1}}{RT}$$

$$\ln\frac{k_2}{k_1} = \frac{20000}{8.3\times 300}$$

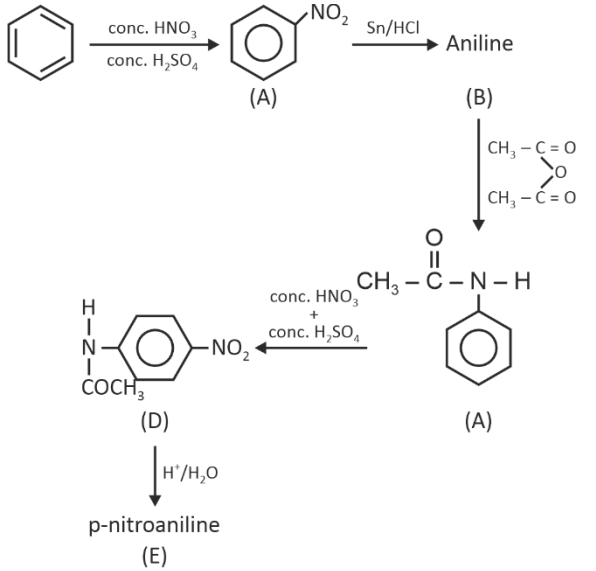
$$\ln\frac{k_2}{k_1} \approx 8$$

22. 

% of N in compound E is ____

Answer (20)

Sol.



$$\% \text{ of N} = \frac{14 \times 2 \times 100}{138} = 20.28 \approx 20$$

23. 1 g of AB_2 is dissolved in 50 g solvent such that ΔT_f = 0.689. When 1 g AB is dissolved in 50 g of same solvent, ΔT_f is 1.176. Find molar mass of AB_2. K_f = 5 K kg/mol.

AB_2 and AB are non electrolyte. (Report to nearest integer)

Answer (145 g)

Sol. Let 'a' and 'b' are atomic weight of 'A' and 'B' respectively

$$0.689 = 5\left[\frac{1}{a+2b} \times \frac{1000}{50}\right] \quad ...(1)$$

$$1.176 = 5\left[\frac{1}{a+b} \times \frac{1000}{50}\right] \quad ...(2)$$

$$\frac{0.689}{1.176} = \frac{a+b}{a+2b} = \frac{1}{1.7}$$

$\Rightarrow$ 1.7a + 1.7b = a + 2b

0.7a = 0.3b

$$b = \frac{7}{3}a$$

$$\text{Now, } 1.176 = \left[\frac{1}{a+\frac{7}{3}a} \times 20\right] \times 5 = \frac{300}{10a}$$

$$\Rightarrow a = \frac{30}{1.176} = 25.51$$

$$b = \frac{7}{3}a = 59.52 \text{ g}$$

M_{AB_2} = 25.51 + 2 × 59.52 = 144.55 g

24. Out of the following, how many compounds have tetrahedral geometry?

$\overset{+}{N}H_4$, XeF_4, $[NiCl_4]^{2-}$, $[PtCl_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, BF_3 and $[Ni(CO)_4]$

Answer (3)

Sol.

Species		Geometry
$\overset{+}{N}H_4$	$\Rightarrow$	Tetrahedral
XeF_4	$\Rightarrow$	Octahedral
$[NiCl_4]^{2-}$	$\Rightarrow$	Tetrahedral
$[PtCl_4]^{2-}$	$\Rightarrow$	Square planar
$[Cu(NH_3)_4]^{2+}$	$\Rightarrow$	Square planar
BF_3	$\Rightarrow$	Triangular Planar
$[Ni(CO)_4]$	$\Rightarrow$	Tetrahedral

25.