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. Compare the energy of orbitals for multielectronic species.

	n	l	m
(A)	3	0	0
(B)	3	1	–1
(C)	4	2	0
(D)	3	2	1

(1) C > D > B > A (2) C > B > D > A

(3) A > B > C > D (4) A > B > D > C

Answer (1)

Sol. (A) 3s (B) 3p (C) 4d (D) 3d

More the value of (n + l) more will be the energy of orbital.

2. Which of the following will produce C_6H_5NC?

(1) $C_6H_5NO_2 \xrightarrow{CHCl_3/KOH}$

(2) $C_6H_5NH_2 \xrightarrow{CHCl_3/KOH(alc)}$

(3) $C_6H_5CH_2NH_2 \xrightarrow{AgCN}$

(4) $C_6H_5CH_2Cl \xrightarrow{KCN}$

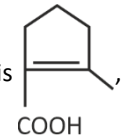
Answer (2)

Sol. $C_6H_5NH_2 \xrightarrow{CHCl_3/KOH} C_6H_5NC$

Carbylamine reaction

3. Consider the sequence :

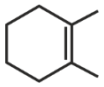
$$P \xrightarrow[\text{ozonolysis}]{\text{reductive}} Q \xrightarrow[\Delta]{\text{alkali}} R \xrightarrow[(ii)H^+]{(i)NaOI} S$$

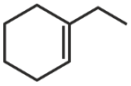
If 'S' is 

, then 'P' is

(1) 

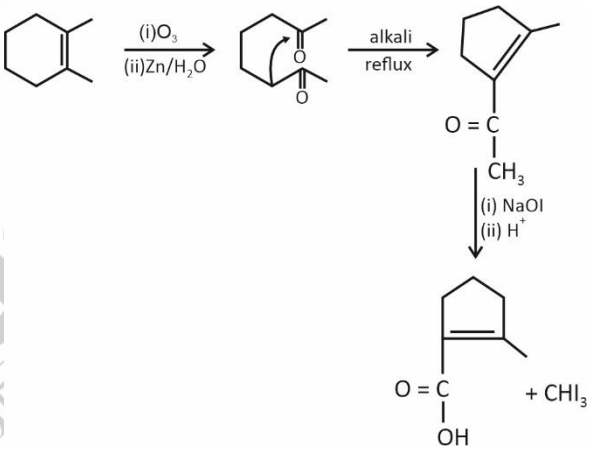
(2) 

(3) 

(4) 

Answer (3)

Sol.



4. Given below are two statements:

Statement I: $K_2Cr_2O_7$ can be used as a primary standard

Statement II: Phenolphthalein is a weak base indicator

In the light of above statements choose the correct option.

(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. $K_2Cr_2O_7$ is available in high purity, is non hygroscopic, is stable at room temperature and has a molar mass, which minimizes weighing errors

Statement-I is correct

Phenolphthalein is actually a week organic acid.

Statement II is incorrect

5. What amount of residue will be produced on heating 2.76 gram of pure Ag_2CO_3?

(1) 1.08 g (2) 2.16 g

(3) 3.2 g (4) 4.32 g

Answer (2)

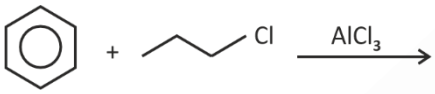
Sol.

$$\underset{0.01}{Ag_2CO_3(s)} \rightarrow \underset{0}{2Ag(s)} + \underset{0}{CO_2(g)} + \underset{0}{\frac{1}{2}O_2(g)}$$

$$\underset{0}{\quad} \qquad \underset{0.02}{\quad} \qquad \underset{0.01}{\quad} \qquad \underset{\frac{0.01}{2}}{\quad}$$

Mass of residue = mass of Ag = 0.02 × 108 = 2.16 g

6. Consider the following reaction



Choose the incorrect statement

(1) Isopropylcation intermediate is formed in the reaction

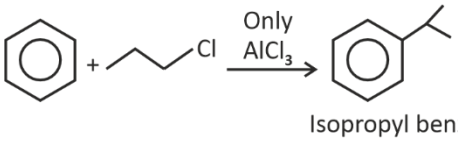
(2) Isopropyl benzene is the major product formed

(3) Rearrangement of carbocation occurs

(4) The product is less reactive than benzene towards electrophilic aromatic substitution.

Answer (4)

Sol.



7. pH of 10^{-7}M aq. KOH solution at 25° is,

(1) 6.50 (2) 6.70

(3) 7.3 (4) 7.00

Answer (3)

Sol. $H_2O \rightleftharpoons H^+ + OH^-$

x x + 10^{-7}

$x(x + 10^{-7}) = 10^{-14}$

Upon solving

Total $OH^- \cong 1.98 \times 10^{-7}$

pOH = 6.7

pH = 7.3

8. Given below are two statements:

Statement I: Stability of carbanion is as follows

$(CH_3)_3\bar{C} < (CH_3)_2C\bar{H} < CH_3 - CH_2^-$

Statement II: Stability of above carbanion can be explained on the basis of inductive effect

(1) Both statement I and II are correct

(2) Both statement I and 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. More is +I effect lesser is the stability of caranion 3° < 2° < 1°

9. Given below two statements :

Statement I : In octahedral complexes each electrons in t_{2g} orbital stabilises by $-0.4\Delta_o$ and that of e_g orbital destabilises by $+0.6\Delta_o$.

Statement II : All d-electrons are of same energy in free state but after complex is formed its degeneracy is disturbed according to crystal field theory.

(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. According to CFT, the d-orbitals splits into t_{2g} set and e_g set of orbitals.

The t_{2g} set decreases in energy by $0.4\Delta_o$ and the e_g set increases in energy by $0.6\Delta_o$

Statement I is correct.

Before complex formation all d-orbitals are degenerate.

Statement II is correct.

10. Consider the following statements

(a) Glucose exists in two anomeric forms

(b) Melting point of α-anomer is greater than β-anomer

(c) Specific rotation of α-anomer is 19° and for β-anomer is 112°

(d) α and β anomers are formed at temperature 303 K and 371 K

Choose the correct statements:

(1) a, b, c only (2) a, d only

(3) a, c, d only (4) a, b, c d

Answer (2)

Sol.
- Glucose is found to exist in 2 different crystalline forms which are named as α and β
- The α-form of glucose (m.p $\rightarrow$ 419K) is obtained by crystallization from conc. solution by glucose at 303 K while the β-form (m.p $\rightarrow$ 423 K) is obtained by crystallization from hot and saturated aqueous solution at 371 K.

$\therefore$ $\alpha \Rightarrow 112°$ (specific rotation)

$\beta \Rightarrow 19°$ (specific rotation)

11. **Statement I :** Order of electronegativity is F > O > N.

Statement II : In OF_2, oxidation state of 'O' is +2 and in N_2O, the value of oxidation state of O is –2.

(1) Both statement I and statement II are wrong

(2) Statement II is wrong, statement I is correct

(3) Both statement I and statement II are correct

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

Answer (3)

Sol.

	en
F	4
O	3.5
N	3.0

12. Consider the following statements

Statement-I: $\Delta U = n(C_{v,m})\,\Delta T = \dfrac{nR}{\gamma-1}[T_2 - T_1]$

where $\gamma = \dfrac{C_P}{C_V}$

Statement-II: If degree of freedom = f, then $\gamma = 1 + \dfrac{2}{f}$

(1) Both statement I and II are correct

(2) Both statement I and 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. $\Delta U = nC_V\Delta T$

$C_P - C_V = R$

$\dfrac{C_P}{C_V} = \gamma$

$\gamma - 1 = \dfrac{R}{C_V}$

$C_V = \dfrac{R}{\gamma-1}$

$\Delta U = \dfrac{nR}{\gamma-1}(T_2 - T_1)$

Statement I is correct

$C_V = \dfrac{f}{2}R$

$C_P = C_V + R$

$C_P = \dfrac{f}{2}R + R$

$$C_P = \left(\frac{f}{2}+1\right)R$$

$$\gamma = \frac{C_P}{C_V} = \frac{\left(\frac{f}{2}+1\right)R}{\frac{f}{2}R} = \left(1+\frac{2}{f}\right)$$

Statement II is true

13. Arrange the following mixtures in increasing order of pH at 25°C (each solution is decimolar).

(a) 10 mL of HCl + 10 mL of $Ca(OH)_2$

(b) 10 mL of HCl + 25 mL of $Ca(OH)_2$

(c) 10 mL of HCl + 10 mL of H_2SO_4

(1) b < a < c

(2) a < b < c

(3) c < a < b

(4) b < c < a

Answer (3)

Sol. (a) $\underset{10\times0.1}{HCl} + \underset{10\times0.1\times2}{Ca(OH)_2}$

$\underset{1}{\quad} \quad \underset{2}{\quad}$

m moles of $OH^- = 1$ $\quad [OH^-] = \frac{1}{20}$ M

pOH = 1.3

pH = 12.7

(b) $HCl \rightarrow \underset{1}{10\times0.1}$ $\quad Ca(OH)_2 \rightarrow \underset{5}{25\times0.1\times2}$

m moles of $OH^- = 4$ $\quad [OH^-] = \frac{4}{35}\ M = 0.1142$

pOH = 0.94

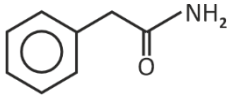
pH = 13.06

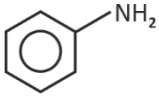
(c) $HCl \rightarrow \underset{1}{10\times0.1}$ $\quad H_2SO_4 \rightarrow \underset{2}{10\times0.1\times2}$

m moles of $H^+ = \frac{3}{20}$ M

pH = 0.82

14. Consider the following statements :

Statement I :  primary aromatic amine.

Statement II :  can be prepared by Gabriel phthalimide synthesis.

Choose the correct option

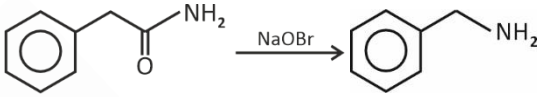
(1) Both statement I and statement II are correct

(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

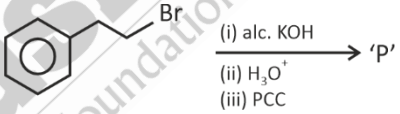
Answer (4)

Sol. 

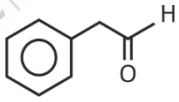
(1° aliphatic amine)

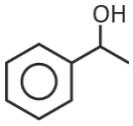
$PhNH_2$ can't be prepared from Gabriel Phthalimide synthesis.

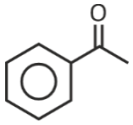
15. Consider the following sequence of reactions.

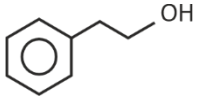


The final major product (P) is

(1) 

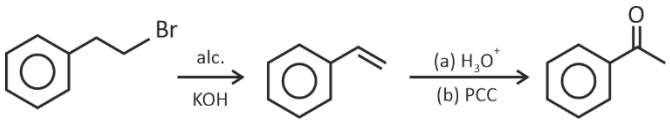
(2) 

(3) 

(4) 

Answer (3)

Sol.



16. The correct relationship between the molar concentration of the anion $[A^{3-}]$ and the solubility product constant (K_{sp}) for an M_3A_2 type salt

(1) $[A^{3-}] = \left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}$

(2) $[A^{3-}] = \left(\frac{8\,K_{sp}}{27}\right)^{\frac{1}{5}}$

(3) $[A^{3-}] = \left(\frac{27\,K_{sp}}{8}\right)^{\frac{1}{5}}$

(4) $[A^{3-}] = \left(\frac{4\,K_{sp}}{9}\right)^{\frac{1}{5}}$

Answer (2)

Sol. $M_3A_2(s) \rightleftharpoons \underset{3s}{3M^{2+}car} + \underset{2s}{2A^{3-}}$

$[A^{3-}] = 2s$

$s = \frac{[A^{3-}]}{2}$

$K_{sp} = (3s)^3\,(2s)^2$

$K_{sp} = 27\,s^3 \times 4\,s^2$

$= 108\,s^5$

$K_{sp} = 108\left(\frac{[A^{3-}]}{2}\right)^5$

$K_{sp} = \frac{108}{32}[A^{3-}]^5$

$K_{sp} = \frac{27}{8}[A^{3-}]^5$

$[A^{3-}]^5 = \frac{8\,K_{sp}}{27}$

$[A^{3-}] = \left(\frac{8\,K_{sp}}{27}\right)^{\frac{1}{5}}$

17. The order of acidic strength for 0.1 M aqueous solution of following is

A. CH_3COOH

B. H_3PO_3

C. H_3PO_4

(1) B > C > A

(2) A > C > B

(3) A > B > C

(4) C > B > A

Answer (1)

Sol. Ka $CH_3COOH = 1.76 \times 10^{-5}$

Ka $H_3PO_3 = 1.6 \times 10^{-2}$

Ka $H_3PO_4 = 7.5 \times 10^{-3}$

$[H^+] = \sqrt{Ka \cdot C}$, $[H^+] \propto \sqrt{Ka}$

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. 0.2 g of organic compound is subjected to estimation of 'S' by Carius method, giving 0.6 g $BaSO_4$. Find % of S. (Nearest integer).

Answer (41)

Sol. Mass of S = $\frac{0.6}{233}\times 32 = 0.082$ g

% of S = $\frac{0.082}{0.2}\times 100 = 41.20\%$

22. Half life for a first order reaction is 6.93 min. What is the time required (in min) to complete 90% of reaction? (Nearest integer)

Answer (23)

Sol. $t_{1/2} = 6.93\,\text{min}$

$k = \frac{0.693}{6.93} = 0.1\,\text{min}^{-1}$

$t_{90\%} = \frac{2.303}{0.1}\log\frac{100}{10}$

= 23.03 min

23. How many compounds among the following having sp^3d hybridisation of central atom BrF_5, XeF_5^-, ICl_2^-, ICl_4^-, SF_4, NH_4^+, ClF_3, XeF_2, XeF_4

Answer (4)

Sol. $BrF_5 \Rightarrow$ Steric no. = 6 sp^3d^2

$XeF_5^- \Rightarrow$ SN = 7 sp^3d^3

$ICl_2^- \Rightarrow$ SN = 5 sp^3d

$ICl_4^- \Rightarrow$ SN = 6 sp^3d^2

$SF_4 \Rightarrow$ SN = 5 sp^3d

$NH_4^+ \Rightarrow$ SN = 4 sp^3

$ClF_3 \Rightarrow$ SN = 5 sp^3d

$XeF_2 \Rightarrow$ SN = 5 sp^3d

$XeF_4 \Rightarrow$ SN = 6 sp^3d^2

24. Consider the following reaction

Phenol $\xrightarrow{HNO_3}$ Product $\xrightarrow[\text{distillation}]{\text{Steam}}$ Filtrate

Change in % of oxygen from phenol and product in filtrate is x %. Value of 2x is _____.

Answer (35)

Sol. Phenol $\xrightarrow{HNO_3}$ O-nitrophenol + p-nitrophenol $\xrightarrow[\text{distillation}]{\text{Steam}}$ Filtrate (p-nitrophenol)

% of O in phenol $= \frac{16}{94}\times 100 = 17\%$

% of O in p-nitrophenol = $= \frac{3\times 16\times 100}{139} = 34.5\%$

difference in % of O = 34.5 – 17 = 17.5%

x = 17.5, 2x = 35

25. Mole fraction of H_2O in 10% $\frac{w}{w}$ solution of urea in water is $x \times 10^{-3}$. Find value of x.

Answer (968)

Sol. Let mass of solution = 100 g

then w_{urea} = 10 g, w_{H_2O} = 90 g

$n_{urea} = \frac{10}{60} = \frac{1}{6}$, $n_{H_2O} = \frac{90}{18} = 5$

$\chi_{H_2O} = \frac{5}{\left(\frac{1}{6}\right)+5} = 0.9677 = 968\times 10^{-3}$

$x \times 10^{-3} = 968 \times 10^{-3}$

x = 968