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 last electron of element having atomic number 9 and choose correct option.

   (1) Sum total nodes = 1

   (2) n = 2; l = 0

   (3) Last electron enters in 2s subshell

   (4) There are $5e^-$ with l = 0

Answer (1)

Sol. Electronic configuration of fluorine $\Rightarrow 1s^2 2s^2 2p^5$

Last electron enters in 2p-subshell.

Number of angular nodes = l = 1

Number of radial nodes = n – l – 1 = 0

Total nodes = 1

Number of electrons with l = 0 is 4

2. Which of the following has sp^3d^2 hybridisation?

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

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

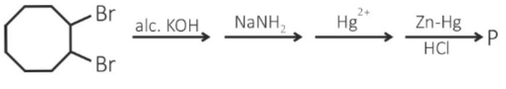
   (3) SF_6

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

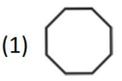
Answer (3)

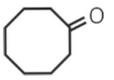
Sol. SF_6 has 6 bond pairs, 6 hybridised sp^3d^2 orbitals.

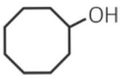
3. Consider the following sequence of reactions given below



The product P is

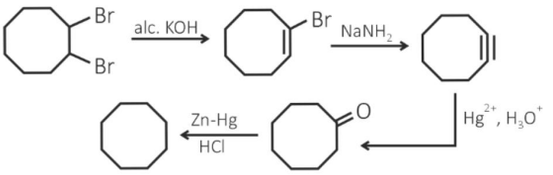
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

4. Atomic number of element with lowest first ionisation enthalpy is

   (1) 32 (2) 19

   (3) 35 (4) 87

Answer (4)

Sol. Atomic Number

32 $\Rightarrow$ Ge

19 $\Rightarrow$ K

35 $\Rightarrow$ Cl

87 $\Rightarrow$ Fr

87 Fr has lowest 1^{st} ionisation enthalpy.

5. Consider the following statement

   Statement-I: H_2Se is more acidic than H_2Te.

   Statement-II: H_2Se has higher bond dissociation enthalpy, then H_2Te

   In light of above statement, choose correct option.

   (1) Statement-I is true and statement-II is false

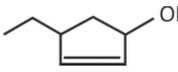
   (2) Statement-I is false and statement-II is true

   (3) Both statement-I and statement-II are true

   (4) Both statement-I and statement-II are false

Answer (4)

Sol. H_2Se is less acidic than H_2Te as bond dissociation enthalpy of H_2Te is lower then H_2Se and hence H^+ is dissociated with more ease.

6. The correct IUPAC name of  is

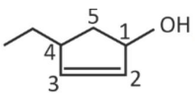
(1) 4-ethylcyclopent-2-en-1-ol

(2) 3-ethylcyclopent-4-en-1-ol

(3) 5-ethylcyclopent-1-en-3-ol

(4) 3-ethylcyclopent-1-en-5-ol

Answer (1)

Sol.  4-ethylcyclopent-2-en-1-ol

7. Correct decreasing order of spin only magnetic moment values is

(1) $Cr^{3+} > Cr^{2+} > Cu^{2+} > Cu^{+}$ (2) $Cr^{3+} > Cr^{2+} > Cu^{+} > Cu^{2+}$

(3) $Cr^{2+} > Cr^{3+} > Cu^{2+} > Cu^{+}$ (4) $Cr^{2+} > Cr^{3+} > Cu^{+} > Cu^{2+}$

Answer (3)

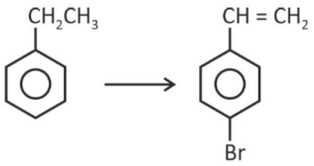
Sol. Cu^{+} [Ar] $3d^{10} \Rightarrow n = 0, \mu = 0$

Cu^{2+} [Ar] $3d^{9} \Rightarrow n = 1, \mu = \sqrt{3}$ BM

Cr^{2+} [Ar] $3d^{4} \Rightarrow n = 4, \mu = \sqrt{24}$ BM

Cr^{3+} [Ar] $3d^{3} \Rightarrow n = 3, \mu = \sqrt{15}$ BM

8. The correct sequence of reagents to the added for the following conversion



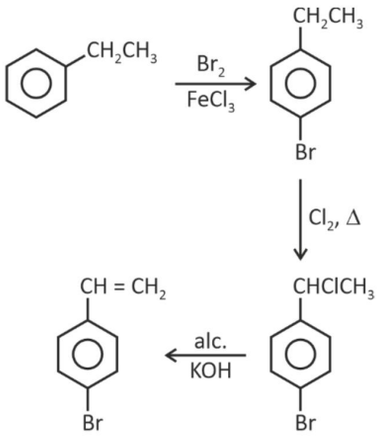
(1) Br_2/Fe; alc. KOH; $Cl_2/FeCl_3$

(2) $Br_2/FeCl_3$; Cl_2/Δ; alc. KOH

(3) $FeCl_3/Br_2$; alc. KOH; H^+/Δ

(4) $Cl_2/FeCl_3$; $Br_2/FeCl_3$; alc. KOH

Answer (2)

Sol. 

9. For a first order reaction, the ratio of time required is $\frac{t_1}{t_2}$, if t, is time consumed when reactant reaches $\frac{1}{4}$th of initial concentration and t_2 is the time when it reaches $\frac{1}{8}$th of initial concentration

(1) $\frac{2}{3}$

(2) $\frac{3}{4}$

(3) $\frac{3}{2}$

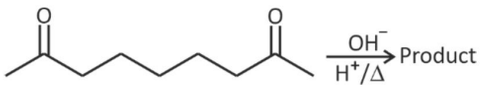
(4) $\frac{4}{3}$

Answer (1)

Sol. $t_1 = \frac{2.303}{K} \log \frac{A_0}{A_{0/4}} = \frac{2.303}{K} \log 4$

$t_2 = \frac{2.303}{K} \log \frac{A_0}{A_{0/8}} = \frac{2.303}{K} \log 8$

$\frac{t_1}{t_2} = \frac{2 \log 2}{3 \log 2} = \frac{2}{3}$

10. 

The correct IUPAC name of the product is

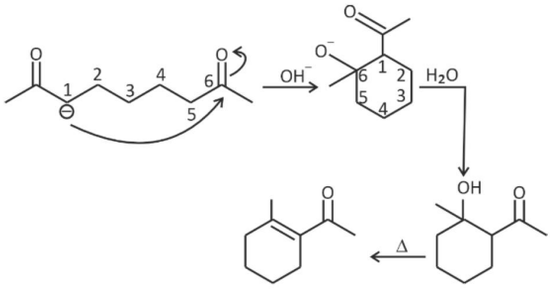
(1) 1-acetyl-2-methy cyclohexene

(2) (2-methylcyclohex-1-enyl)ethanone

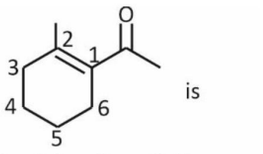
(3) cyclo-oct-2-en-1-one

(4) 2-cycloocten-1-one

Answer (2)

Sol. 

The IUPAC Name of



is

1-(2methylcyclohex-1-enyl)ethanone

11. Match list-I with list-II and choose the correct option.

	List-I		**List-II**
(a)	Nucleophile	(i)	Tetrahedral shape
(b)	Electrophile	(ii)	Planar and sp^2 hybridized
(c)	Carbocation	(iii)	Species that accepts electron
(d)	Carbanion	(iv)	Species that donate electron

(1) a(i), b(ii), c(iv), d(iii)

(2) a(iv), b(iii), c(ii), d(i)

(3) a(iv), b(iii), c(i), d(ii)

(4) a(iii), b(iv), c(ii), d(i)

Answer (2)

Sol. Electrophile $\rightarrow$ Electron loving species

Nucleophile $\rightarrow$ +ve charge/vacant orbital loving species

$\overset{+}{C}H_3 \Rightarrow$ planer (sp^2) ; $\overset{-}{C}H_3 \Rightarrow$ tetrahedral

12. Match List-I with List-II and select the correct option.

	List-I		**List-II**
A	dil $KMnO_4$	I	Unsaturation test
B	$FeCl_3$ test	II	Alcoholic -OH
C	Liberate CO_2 with $NaHCO_3$	III	Phenolic -OH
D	Ceric Ammonium nitrate test	IV	Carboxylic Acid

(1) A-I, B-IV, C-III, D-II

(2) A-IV, B-I, C-III, D-II

(3) A-I, B-III, C-IV, D-II

(4) A-III, B-II, C-IV, D-I

Answer (3)

Sol. A-I, B-III, C-IV, D-II

13. An aqueous solution of 0.1 M HA shows depression in freezing point of 0.2°C. If K_f (H_2O) = 1.86 K kg mol^{-1} and assuming molarity = molality, find the dissociation constant of HA.

(1) 4.50×10^{-5}

(2) 6.25×10^{-3}

(3) 5.625×10^{-4}

(4) 2.65×10^{-4}

Answer (3)

Sol. $\underset{0.1(1-\alpha)}{HA} \rightleftharpoons \underset{0.1\alpha}{H^+} + \underset{0.1\alpha}{A^-}$

$i = 1 + \alpha$

$\Delta T_f = iK_f m$

$0.2 = i \times 1.86 \times 0.1$

$$i = \frac{0.2}{0.186} = 1.075$$

$\alpha = 0.075$

$$K_a = \frac{0.1(\alpha)^2}{1-\alpha} \simeq 0.1(0.075)^2$$

$= 5.625 \times 10^{-4}$

14. Which of the following solution can form minimum boiling azeotrope?

(1) $C_2H_5OH + H_2O$

(2) n-heptane + n-hexane

(3) $CH_3COOH + C_5H_5N$

(4) $C_2H_5Br + C_2H_5I$

Answer (1)

Sol. The solution showing positive deviation forms minimum boiling azeotrope.

15. On combustion of 0.21 g of an organic compound containing C, H and O gave 0.127 g H_2O and 0.307 g CO_2. The percentage of H and O in the given organic compound respectively are

(1) 7.55 and 43.85

(2) 6.72 and 53.41

(3) 6.72 and 39.87

(4) 53.41 and 39.60

Answer (2)

Sol. Mass of organic compound = 0.21 g

Mass of H_2O formed = 0.127 g

Mass of CO_2 formed = 0.307 g

$$\text{Mass of H in organic compound} = \frac{0.127 \times 2}{18} \text{ g}$$

$$\text{\% of H in organic compound} = \frac{0.127 \times 2 \times 100}{18 \times 0.21} = 6.72\ \%$$

$$\text{Mass of C in organic compound} = \frac{0.307 \times 12}{44} \text{ g}$$

$$\text{\% of C in organic compound} = \frac{0.307 \times 12 \times 100}{44 \times 0.21} = 39.87\ \%$$

$\therefore$ % of O in organic compound = 100 – 6.72 – 39.87

= 53.41 %

16. Match List-I with List-II and select the correct option.

	List-I (Complex)		**List-II (Characteristics)**
A.	$[NiCl_4]^{2-}$	I.	sp^3, tetrahedral, 3.87 BM
B.	$[Ni(CN_4)]^{2-}$	II.	dsp^2, square planar, 0 BM

C.	$[CoCl_4]^{2-}$	III.	sp^3d^2, octahedral, 2.82 BM
D.	$[Ni(H_2O)_6]^{2+}$	IV.	sp^3, tetrahedral, 2.82 BM

(1) A-II, B-IV, C-I, D-III

(2) A-IV, B-I, C-II, D-III

(3) A-I, B-II, C-IV, D-III

(4) A-IV, B-II, C-I, D-III

Answer (4)

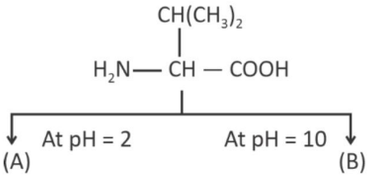
Sol. $[NiCl_4]^{2-} \Rightarrow Ni^{2+}(3d^8) \Rightarrow sp^3$, octahedral, 2.82 BM

$[Ni(CN_4)]^{2-} \Rightarrow Ni^{2+}(3d^8) \Rightarrow dsp^2$, square planar, 0 BM

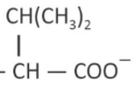
$[Ni(H_2O)_6]^{2+} \Rightarrow Ni^{2+}(3d^8) \Rightarrow sp^3d^2$, octahedral, 2.82 BM

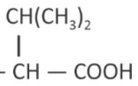
$[CoCl_4]^{2-} \Rightarrow Co^{2+}(3d^7) \Rightarrow sp^3$, tetrahedral, 3.87 BM

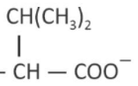
17. Consider the following amino acid.

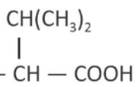


Which of the following option contain correct structure of (A) and (B)

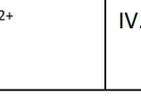
(1) (A) = 

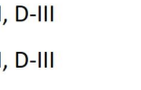
(B) = 

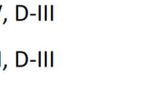
(2) (A) = 

(B) = 

(3) (A) = 

(B) = 

(4) (A) = 

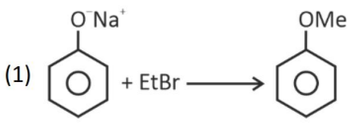
(B) = 

Answer (3)

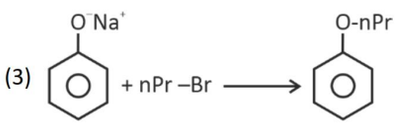
Sol. At pH = 2 $\rightarrow$ NH_2 group exists as NH_3^+

At pH = 10 – COOH group is ionised to COO^-

18. In which of the following reaction, major product is matched correctly?

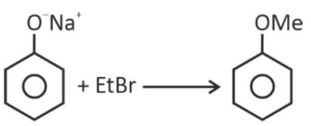
(1) 

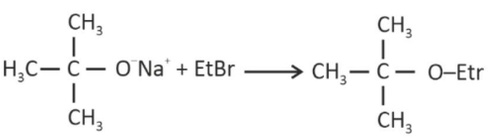
(2) $t-BuO^-Na^+ + EtBr \xrightarrow{\Delta} t-Bu-O-Et$

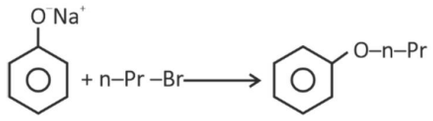
(3) 

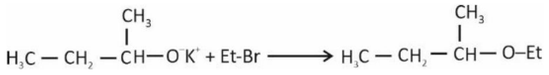
(4) $Sec\ BuO^-K^+ + EtBr \xrightarrow{\Delta} Sec\ But-OEt$

Answer (3)

Sol. 







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. The energy of an electron in first Bohr orbit of H-atom is –13.6 eV. Find the magnitude of energy of an electron in first excited state of Be^{3+} ion in eV.

Answer (54)

Sol. $E_{2,\,Be^{3+}} = -13.6 \times \frac{Z^2}{n^2}$

$= -13.6 \times \frac{4^2}{2^2}$

$= -13.6 \times 4$

$= -54.4$ eV

22. Consider the following cell

$Pt(s)\,H_2(1\text{ atm})\,|\,H^+(1\text{ M})\,||\,Cr_2O_7^{2-}, Cr^{3+}, H^+\,|\,Pt(s)$

$E^\circ_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\text{ V}$, At equilibrium $\frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}]} = 10^{-7}$

At what pH at cathode, E_{cell} of reaction is zero.

Answer (10)

Sol. Cell reaction

Cathode $Cr_7O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+}$

Anode $(H_2 \longrightarrow 2H^+ + 2e^-) \times 3$

$Cr_2O_7^{2-} + 14H^+ + 3H_2 \longrightarrow 6H^+ + 2Cr^{3+}$

$K = \frac{[H^+]^6_{anode}[Cr^{3+}]^2}{[H^+]^{14}_{anode}[Cr_2O_7^{2-}] \times (p_{H_2})^3} = \frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}][H^+]^{14}_{anode}}$

$E_{cell} = E^\circ_{cell} - \frac{0.06}{n}\log K$

At equilibrium. $E_{cell} = 0$

$0 = 1.33 - \frac{0.06}{6}\log\frac{10^{-7}}{[H^+]^{14}}$

$133 = \log\frac{10^{-7}}{[H^+]^{14}}$

$[H^+]^{14} = \frac{10^{-7}}{10^{133}} = 10^{-140}$

$[H^+] = 10^{-10}$

$\boxed{pH = 10}$

23.

24.

25.