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. Number of radial nodes present in 3*p*.

(1) 0

(2) 1

(3) 2

(4) 4

Answer (2)

Sol. Number of radial nodes = n – l – 1

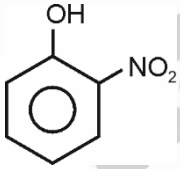
n = 3, l = 1

= 3 – 1 – 1

= 1

2. Which of the following compound has intramolecular hydrogen bonding in it.

(1) NH_3

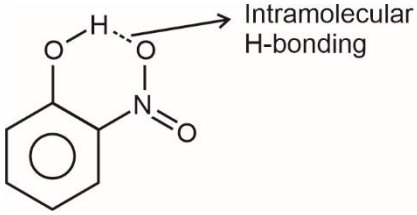
(2) 

(3) H_2O

(4) C_2H_5OH

Answer (2)

Sol. In NH_3, H_2O and C_2H_5OH intermolecular H-bonding is present



3. Which of the following has highest 3rd ionization energy?

(1) Mn

(2) V

(3) Cr

(4) Fe

Answer (1)

Sol. Mn has highest 3rd I.E. among the given elements due to d^5 configuration.

According to NCERT,

Element	IE_3 (kJ/mol)
V	2833
Cr	2990
Mn	3260
Fe	2962

4. Which of the following compound has colour due to *d-d* transition?

(1) $KMnO_4$

(2) $K_2Cr_2O_7$

(3) K_2CrO_4

(4) $CuSO_4 \cdot 5H_2O$

Answer (4)

Sol. $CuSO_4 \cdot 5H_2O$ is blue in colour. The water molecules causes splitting of *d* orbitals. This facilitates *d-d* transition and colour.

5. Solubility of $Ca_3(PO_4)_2$ in 100 ml of pure water is w gm. Find out k_{sp} of $Ca_3(PO_4)_2$

(M = molecular mass of $Ca_3(PO_4)_2$)

(1) $108 \times \left(\frac{w}{m}\right)^5$

(2) $108 \times 10^4 \left(\frac{w}{m}\right)^5$

(3) $108 \times 10^5 \left(\frac{w}{m}\right)^5$

(4) $108 \times 10^6 \left(\frac{w}{m}\right)^5$

Answer (3)

Sol. Solubility (s) = $\frac{10w}{M}\frac{mol}{lit}$

$k_{sp} = (x)^y (y)^y (s)^{(x+y)}$

$= (2)^2 (3)^3 \left(\frac{10w}{M}\right)^5$

$= 108\left(\frac{10w}{M}\right)^5$

$= \frac{108w}{M} \times 10^5$

6. Which of the following set of elements can be detected by Lassaigne's test

(1) N, S only

(2) N, P, S only

(3) Halogens P only

(4) N, P, S, halogens

Answer (4)

Sol. Nitrogen, sulphur, halogens and phosphorus present in an organic compound are detected by Lassaigne's test. (Reference NCERT Pg. 354)

7. Which of the following compound in 3d series does not show +3 oxidation state?

(1) V

(2) Cr

(3) Mn

(4) Cu

Answer (4)

Sol. Cu shows only +1 and +2 oxidation state.

8. What is the order of reducing character for AsH_3, NH_3, PH_3 (Group 15 hydrides)

(1) $NH_3 > PH_3 > AsH_3$

(2) $PH_3 > NH_3 > AsH_3$

(3) $AsH_3 > PH_3 > NH_3$

(4) $NH_3 > AsH_3 > PH_3$

Answer (3)

Sol. As we move down the group, bond length increases, bond strength decreases, hence reducing character increases.

9. Highest B.P. is of :

(1) Butanol

(2) Diethylether

(3) Butane

(4) Butanal

Answer (1)

Sol. Butanol has highest B.P. due to H-bonding.

Butanol > Butanal > Diethylether > Butane

(Ref: NCERT Pg : 365)

10. Consider the following two statements.

Statement I : π_{2p} bonding molecular orbital has low electron density above and below internuclear axis.

Statement II : π^*_{2p} antibonding molecular orbital has only one nodal plane.

(1) Statement I : True
Statement II : True

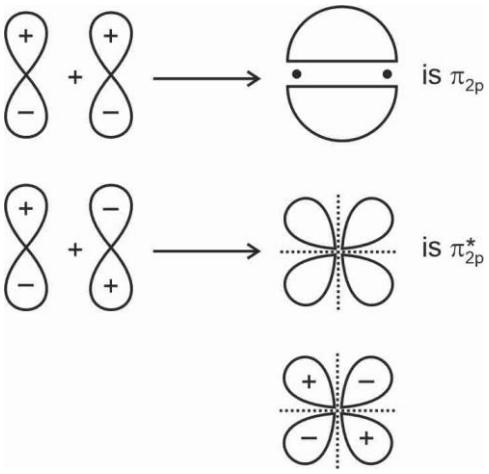
(2) Statement I : False
Statement II : False

(3) Statement I : False
Statement II : True

(4) Statement I : True
Statement II : False

Answer (2)

Sol.



11. Match the following.

	Column I		Column II (Uses)
(i)	CCl_4	(p)	Refrigerator and A.C.
(ii)	CH_2Cl_2	(q)	Non-biodegradable insecticide
(iii)	Freons	(r)	Fire extinguisher
(iv)	DDT	(s)	Paint remover

(1) i-(r), ii-(s), iii-(p), iv-(q)

(2) i-(s), ii-(p), iii-(r), iv-(q)

(3) i-(p), ii-(r), iii-(q), iv-(s)

(4) i-(q), ii-(p), iii-(r), iv-(s)

Answer (1)

Sol. (i) CCl_4 used as fire extinguisher

(ii) CH_2Cl_2 used as paint remover

(iii) Freons are used in refrigerator and A.C.

(iv) DDT is used as non-biodegradable insecticide

12. For complexes (I) and (II).

Choose the correct statement.

I: $[CoF_6]^{3-}$

II: $[Co(NH_3)_6]^{3+}$

(1) I: Outer orbital complex

II: Inner orbital complex

(2) I: Outer orbital complex

II: Outer orbital complex

(3) I: Inner orbital complex

II: Inner orbital complex

(4) I: Inner orbital complex

II: Outer orbital complex

Answer (1)

Sol. I: $[CoF_6]^{3-}$

$Co^{3+} = 4s^0 3d^6$

with F^-, no pairing will take place

$\Rightarrow$ Outer orbital complex (sp^3d^2)

II: $[Co(NH_3)_6]^{3+}$

$Co^{3+} = 4s^0 3d^6$

with NH_3, pairing will take place

$\Rightarrow$ Inner orbit complex (d^2sp^3)

13. While of the following represents meta directing groups?

(1) $-NO_2$, $-SO_3H$, $-COOH$, $-CHO$, $-OH$

(2) $-CH_3$, $-OH$, $-OCH_3$, $-Ph$

(3) $-NO_2$, $-COOH$, $-CHO$, $-\overset{\overset{O}{\|}}{C}-R$

(4) $-NH_2$, $-\overset{\overset{O}{\|}}{C}-R$, $-\overset{\overset{O}{\|}}{C}-NH_2$, $-SO_3H$

Answer (3)

Sol. The correct option which represents meta directing groups$\rightarrow$ (3) $-NO_2$, $-COOH$, $-\overset{\overset{O}{\|}}{C}-R$, $-CHO$

$-OH$, $-NH_2$, $-CH_3$ are o/p directing

Therefore, options (1), (2) and (4) are incorrect.

14. **Statement I :** Ni^{2+} with dmg shows red colouration.

Statement II : Fe^{2+} and Fe^{3+} both are blue coloured.

(1) Both statements I and II are correct

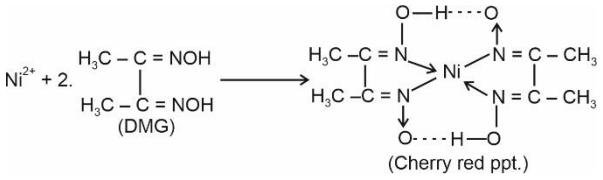
(2) Both statements I and II are incorrect

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

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

Answer (3)

Sol.



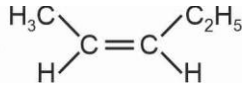
(Cherry red ppt.)

Fe^{2+} forms green ppt. of $Fe(OH)_2$

Fe^{3+} forms reddish Brown ppt of $Fe(OH)_3$

$\therefore$ Statement-I $\Rightarrow$ Correct, Statement-II $\Rightarrow$ Incorrect.

15. Consider the following reactions:

(i) 'A' + H_2 $\xrightarrow{Pd/BaSO_4}$ 

(ii) But-2-yne $\xrightarrow[Na/Liq\,NH_3]{H_2}$ B

Identify A and B

(1) A = Pentyne and B = cis But-2-ene

(2) A = Pent-3-yne B = trans But-2-ene

(3) A = Pent-2-yne and B = trans But-2-ene

(4) A = Pent-2-yne and B = cis But-2-ene

Answer (3)

Sol. (i) Pent-2-yne (A) $\xrightarrow[\text{(Lindlar's catalyst)}]{H_2}$ cis pent-2-ene

(ii) But-2-yne $\xrightarrow[Na/Liq\,NH_3]{H_2}$ trans But-2-ene

[This is Birch reduction]

16. **Statement-I :** SiO_2 and GeO_2 are acidic, SnO and PbO are amphoteric

Statement-II : Allotropes of carbon are formed due to catenation and dπ-pπ bond

(1) Statement-I and Statement-II both correct

(2) Statement-I and Statement-II both incorrect

(3) Statement-I correct and Statement-II both incorrect

(4) Statement-I and Statement-II both incorrect

Answer (3)

Sol. SiO_2 and GeO_2 are acidic and SnO, PbO are amphoteric

Carbon does not have *d* orbital cannot for dπ-dπ bond

17. **Statement-I :** In p and d block both metals and non-metals are present.

Statement-II : Electronegativity and ionisation enthalpy of metals is greater than non-metals.

(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.

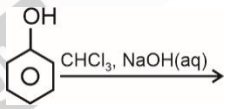
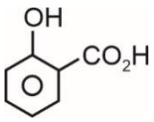
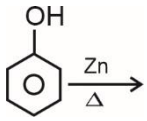
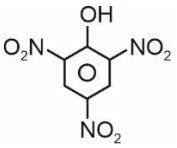
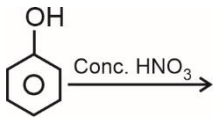
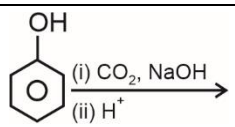
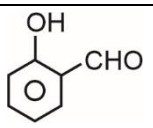
(4) Statement-I is incorrect and statement-II is correct.

Answer (2)

Sol. In p-block both metals and non-metals are present but in d-block only metals are present.

Electronegativity and I.E. of non-metals is greater than that of metals

18. Match the List-I and List-II

	List-I		List-II
(A)		(i)	
(B)		(ii)	
(C)		(iii)	
(D)		(iv)	

(1) A → (i); B → (ii); C → (iii); D → (iv)

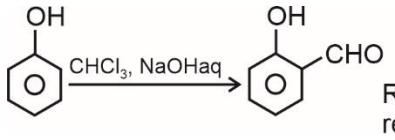
(2) A → (i); B → (iv); C → (iii); D → (ii)

(3) A → (iv); B → (iii); C → (ii); D → (i)

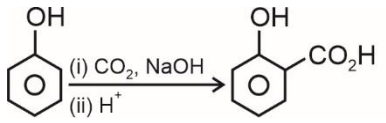
(4) A → (iii); B → (ii); C → (i); D → (vi)

Answer (3)

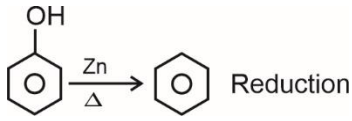
Sol.



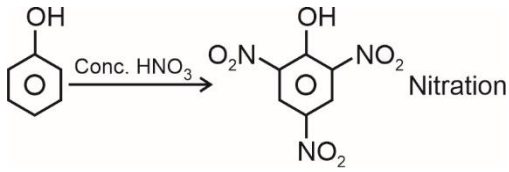
Reimer-Tiemann reaction



Kolbe reaction



Reduction



Nitration

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. A 10 mL hydrocarbon (C_xH_y) on combustion give 40 mL CO_2 and 50 mL H_2O. Calculate the value of x + y.

Answer (14)

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

10 mL 40 mL 50 mL

10 mL of C_xH_y produces 40 mL of CO_2 means 1 mL of CO_2 will produce 4 mL of CO_2

Value of x = 4

10 mL of C_xH_y produces 50 mL of H_2O

$\frac{y}{2} = 5 \Rightarrow y = 10$

So hydrocarbon C_xH_y is C_4H_{10}

x = 4

y = 10

x + y = 14

22. When electron transition from 2nd to 1st orbit takes place, the frequency of photon emitted is 3×10^{15} Hz. The frequency of photon emitted when electron transitions from 3rd to 1st orbit is ____ $\times 10^{15}$ Hz. [Nearest Integer]

Answer (4)

Sol. $\nu \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$$\frac{\nu_{3\rightarrow1}}{\nu_{2\rightarrow1}} = \frac{\left(1-\frac{1}{9}\right)}{\left(1-\frac{1}{4}\right)}$$

$$\nu_{3\rightarrow1} = 3\times10^{15}\times\frac{8}{9}\times\frac{4}{3}$$

$$= 3.56\times10^{15} \text{ Hz}$$

23. Ethylene glycol of x kg is mixed with 18.6 kg of solvent, 24°C depression in freezing point takes place. Calculate value of x.

(Given K_f = 1.6°C/molal

MW of ethylene glycol = 62 g/mol)

Answer (17)

Sol. $\Delta T_f = i \times k_f \times m$

$$24 = 1\times1.6\times\frac{\text{mass of ethylene glycol in gram}}{62\times18.6}$$

mass of ethylene glycol (in g) = $\frac{24\times62\times18.6}{1.6}$

= 17298 g

x = 17.298 $\approx$ 17 kg

24. For a first order reaction

$A \rightarrow 2B + C$

following data is given

S. No.	Time(s)	Total pressure (atm)
1	0	0.1
2	115	0.28

If the value of rate constant is x sec^{-1}, the value of 100x is

Answer (2)

Sol.

	$A \longrightarrow$	$2B$	$+ C$
$t = 0$	0.1		
$t = 115\ s$	$0.1 - x$	$2x$	x

$0.1 - x + 2x + x = 0.28$

$\Rightarrow 0.1 + 2x = 0.28$

$x = 0.09$

$$\ln\frac{0.1}{(0.1-x)} = kt$$

$$\Rightarrow \ln\left(\frac{0.1}{0.01}\right) = k \times 115$$

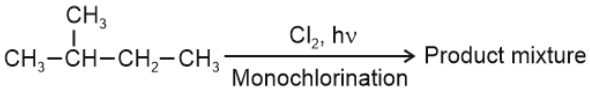
$$\Rightarrow \frac{\ln 10}{115} = k$$

$$\Rightarrow k = \frac{2.303}{115}$$

$\Rightarrow k = 0.02$

$\Rightarrow 100k = 2$

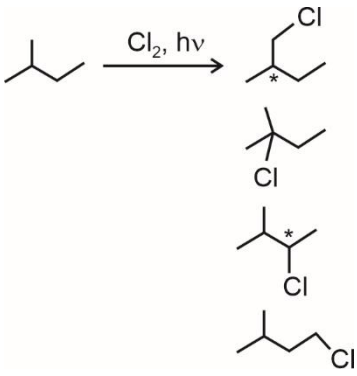
25. Consider the following reaction :



Product mixture consist of how many isomeric products?

Answer (6)

Sol.



Hence product mixture consist of four structural isomers with two enantiomeric pairs. So the total isomeric products are 6.

26. Find out charge (in C) required to electrolysis of 1 mole of H_2O to produce O_2 on one of the electrodes

(F = 96500 C)

Answer (193000)

Sol. $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Charge required = 2 × 96500 = 193000

27. Number of non-cyclic tripeptides formed by using 3 amino acids without repeating them is

Answer (6)

Sol. There are 3 possible first amino acids. Then there are 2 possible second amino acids.

After 2 amino acids are fixed there is only 1 option left for 3rd amino acid.

Total tripeptide = 3 × 2 × 1 = 6

28. In an equilibrium reaction

$A \rightleftharpoons B$ at 300 K, the

Equilibrium constant K value is 10. Then $\Delta G°$ is $-x \times 10^{-1}$ kJ. Find x.

Answer (57)

Sol. $\Delta G° = -RT \ln K_{eq}$

$\Delta G° = -2.303\ RT \log K_{eq}$

$K_{eq} = 10$

$R = 8.314\ J/K^{-}\ mol$

$T = 300\ K$

$\Delta G° = -2.303 \times 8.314 \times 300 \log 10$

$= -5744.14\ J = -5.744\ kJ$

$= -57.44 \times 10^{-1}\ kJ$

$x \approx 57$

29.

30.