Solved Paper 2022

ONLINE

25th July 2nd Shift

CHEMISTRY

SECTION-A (MULTIPLE CHOICE QUESTIONS)

1. Match List I with List II.

List I (Molecule)		List II (Hybridization ; Shape)	
(A)	XeO_3	I.	sp^3d ; linear
(B)	XeF_2	II.	sp^3 ; pyramidal
(C)	$XeOF_4$	III.	sp^3d^3; distorted octahedral
(D)	XeF_6	IV.	sp^3d^2 ; square pyramidal

Choose the correct answer from the options given below:
(a) A-II, B-I, C-IV, D-III (b) A-II, B-IV, C-III, D-I
(c) A-IV, B-II, C-III, D-I (d) A-IV, B-II, C-I, D-III

2. Two solution *A* and *B* are prepared by dissolving 1 g of non-volatile solutes *X* and *Y*, respectively in 1 kg of water. The ratio of depression in freezing points for *A* and *B* is found to be 1 : 4. The ratio of molar masses of *X* and *Y* is
(a) 1 : 4 (b) 1 : 0.25 (c) 1 : 0.20 (d) 1 : 5

3. K_{a_1}, K_{a_2} and K_{a_3} are the respective ionization constants for the following reactions (A), (B) and (C).
(A) $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^-$
(B) $HC_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-}$
(C) $H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$
The relationship between K_{a_1}, K_{a_2} and K_{a_3} is given as
(a) $K_{a_3} = K_{a_1} + K_{a_2}$ (b) $K_{a_3} = K_{a_1} - K_{a_2}$
(c) $K_{a_3} = K_{a_1}/K_{a_2}$ (d) $K_{a_3} = K_{a_1} \times K_{a_2}$

4. The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{m_1} and that of 20 moles another identical cell having 80 mL NaCl solution is Λ_{m_2}. The conductivities exhibited by these two cells are same. The relationship between Λ_{m_2} and Λ_{m_1} is
(a) $\Lambda_{m_2} = 2\Lambda_{m_1}$ (b) $\Lambda_{m_2} = \Lambda_{m_1} / 2$
(c) $\Lambda_{m_2} = \Lambda_{m_1}$ (d) $\Lambda_{m_2} = 4\Lambda_{m_1}$

5. For micelle formation, which of the following statements are correct?
A. Micelle formation is an exothermic process.
B. Micelle formation is an endothermic process.
C. The entropy change is positive.
D. The entropy change is negative.
(a) (A) and (D) only (b) (A) and (C) only
(c) (B) and (C) only (d) (B) and (D) only

6. The first ionization enthalpies of Be, B, N and O follow the order
(a) O < N < B < Be (b) Be < B < N < O
(c) B < Be < N < O (d) B < Be < O < N

7. Given below are two statements.
Statement I : Pig iron is obtained by heating cast iron with scrap iron.
Statement II : Pig ion has a relatively lower carbon content than that of cast iron.
In the light of the above statements, choose the correct answer from the options given below:
(a) Both statement I and statement II are correct.
(b) Both statement I and statement II are not correct.
(c) Statement I is correct but statement II is not correct.
(d) Statement I is not correct but statement II is correct.

8. High purity (>99.95%) dihydrogen is obtained by
(a) reaction of zinc with aqueous alkali.
(b) electrolysis of acidified water using platinum electrodes.
(c) electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.
(d) reaction of zinc with dilute acid.

9. The correct order of density is
(a) Be > Mg > Ca > Sr (b) Sr > Ca > Mg > Be
(c) Sr > Be > Mg > Ca (d) Be > Sr > Mg > Ca

10. The total number of acidic oxides from the following list is
NO, N_2O, B_2O_3, N_2O_5, CO, SO_3, P_4O_{10}
(a) 3 (b) 4 (c) 5 (d) 6

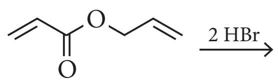
11. The correct order of energy of absorption for the following metal complexes is
A. $[Ni(en)_3]^{2+}$ B. $[Ni(NH_3)_6]^{2+}$
C. $[Ni(H_2O)_6]^{2+}$
(a) C < B < A (b) B < C < A
(c) C < A < B (d) A < C < B

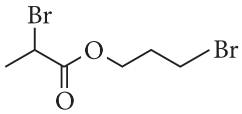
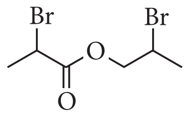
12. Match List I with List II.

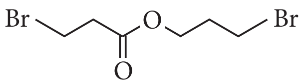
List I		List II	
(A)	Sulphate	I.	Pesticide
(B)	Fluoride	II.	Bending of bones
(C)	Nicotine	III.	Laxative effect
(D)	Sodium arsinite	IV.	Herbicide

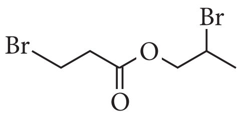
Choose the correct answer from the options given below:
(a) A-II, B-III, C-IV, D-I (b) A-IV, B-III, C-II, D-I
(c) A-III, B-II, C-I, D-IV (d) A-III, B-II, C-IV, D-I

13. Major product of the following reactions is

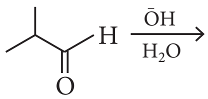


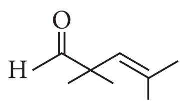
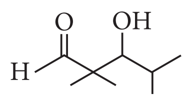
(a)  (b) 

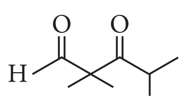
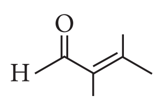
(c) 

(d) 

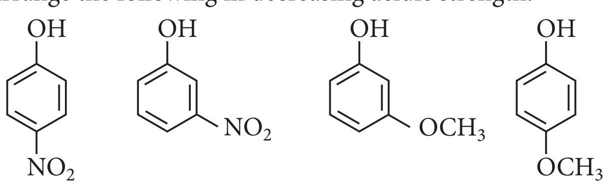
14. What is the major product of the following reaction?



(a)  (b) 

(c)  (d) 

15. Arrange the following in decreasing acidic strength.



(A) (B) (C) (D)

(a) A > B > C > D (b) B > A > C > D
(c) D > C > A > B (d) D > C > B > A

16. $CH_3-CH_2-CN \xrightarrow[\text{Ether}]{CH_3MgBr} A \xrightarrow{H_3O^+} B \xrightarrow[\text{HCl}]{\text{Zn – Hg}} C$

The correct structure of 'C' is

(a) $CH_3-CH_2-CH_2-CH_3$

(b) $CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-CH_3$

(c) $CH_3-CH_2-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_3$

(d) $CH_3-CH_2-CH=CH_2$

17. Match List I with List II.

List I (Polymer)		List II (Used for items)	
(A)	Nylon 6, 6	I.	Buckets
(B)	Low density polythene	II.	Non-stick utensils
(C)	High density polythene	III.	Bristles of brushes
(D)	Teflon	IV.	Toys

Choose the correct answer from the options given below:
(a) A-III, B-I, C-IV, D-II (b) A-III, B-IV, C-I, D-II
(c) A-II, B-I, C-IV, D-III (d) A-II, B-IV, C-I, D-III

18. Glycosidic linkage between C1 of α-glucose and C2 of β-fructose is found in
(a) maltose (b) sucrose
(c) lactose (d) amylose.

19. Some drugs bind to a site other than the active site of an enzyme. This site is known as
(a) non-active site (b) allosteric site
(c) competitive site (d) therapeutic site.

20. In base *vs* acid titration, at the end point methyl orange is present as
(a) quinonoid form (b) heterocyclic form
(c) phenolic form (d) benzenoid form.

SECTION - B (NUMERICAL VALUE TYPE)

Attempt any 5 questions out of 10.

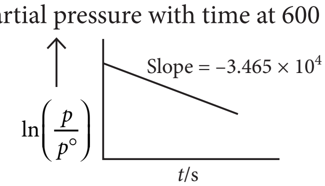
21. 56.0 L of nitrogen gas is mixed with excess of hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be ________ L .

22. A sealed flask with a capacity of 2 dm^3 contains 11 g of propane gas. The flask is so weak that it will burst if the pressure become 2 MPa. The minimum temperature at which the flask will burst is ________°C. [Nearest integer]
(Given : R = 8.3 J K^{-1} mol^{-1}, Atomic masses of C and H are 12u and 1u, respectively.) (Assume that propane behaves as an ideal gas.)

23. When the excited electron of a H atom from n = 5 drops to the ground state, the maximum number of emission lines observed are ________.

24. While performing a thermodynamics experiment, a student made the following observations.
$HCl + NaOH \rightarrow NaCl + H_2O, \Delta H = 57.3 \text{ kJ mol}^{-1}$
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O,$
$\Delta H = -55.3 \text{ kJ mol}^{-1}$
The enthalpy of ionization of CH_3COOH as calculated by the student is ________ kJ mol^{-1}. [Nearest Integer]

25. For the decomposition of azomethane,
$CH_3N_2CH_{3(g)} \rightarrow CH_3CH_{3(g)} + N_{2(g)}$, a first order reaction, the variation in partial pressure with time at 600 K is given as



The half life of the reaction is ________ × 10^{-5} s. [Nearest integer]

26. The sum of number of lone pairs of electrons present on the central atoms of XeO_3, $XeOF_4$ and XeF_6, is ________.

27. The spin-only magnetic moment value of M^{3+} ion (in gaseous state) from the pairs Cr^{3+}/Cr^{2+}, Mn^{3+}/Mn^{2+}, Fe^{3+}/Fe^{2+} and

Co^{3+}/Co^{2+} that has negative standard electrode potential, is ______ B.M. [Nearest integer]

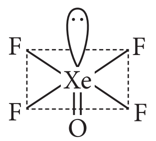
28. A sample of 4.5 mg of an unknown monohydric alcohol, *R*–OH was added to methylmagnesium iodide. A gas is evolved and is collected and its volume measured to be 3.1 mL. The molecular weight of the unknown alcohol is ______ g/mol. [Nearest integer]

29. The separation of two coloured substances was done by paper chromatography. The distance travelled by solvent front, substance *A* and substance *B* from the base line are 3.25 cm, 2.08 cm and 1.05 cm, respectively. The ratio of R_f values of *A* to *B* is ______ .

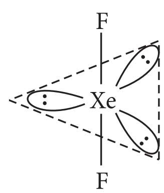
30. The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereo isomers) ______ .

HINTS & EXPLANATIONS

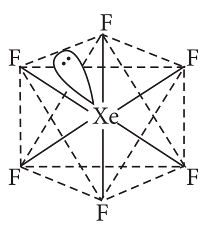
1. (a) :



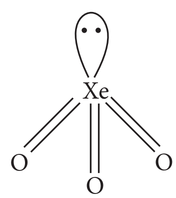
Square pyramidal
sp^3d^2



XeF_2
Linear
sp^3d



XeF_6
Distorted octahedral
sp^3d^3



XeO_3
Pyramidal
sp^3

2. (b) : Depression in freezing point, $\Delta T_f = \dfrac{k_f \times w \times 1000}{m \times W}$

Molar mass of solute *X* and *Y* is m_x and m_y respectively

Weight of solute *X* and *Y* = 1 g (given)

W (wt. of solvent) = 1 kg (given)

$$\therefore \quad \frac{\Delta T_f(A)}{\Delta T_f(B)} = \frac{m_y\,(\text{Molar mass of } y)}{m_x\,(\text{Molar mass of } x)}\ ;\ \frac{1}{4} = \frac{m_y}{m_x}$$

$\Rightarrow\ m_x : m_y = 4 : 1 = 1 : 0.25$

3. (d) :

$$H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^- \quad \Rightarrow \quad K_{a_1}$$
$$HC_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-} \quad \Rightarrow \quad K_{a_2}$$
$$H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-} \quad \Rightarrow \quad K_{a_3}$$

$\therefore\ K_{a_3} = K_{a_1} \times K_{a_2}$ (Read $HC_2O_4^{2-}$ as $C_2O_4^{2-}$)

4. (a) : $\Lambda_m = \dfrac{k \times 1000}{M} \ \Rightarrow\ \dfrac{\Lambda_{m_1}}{\Lambda_{m_2}} = \dfrac{M_2}{M_1}$

$$\frac{\Lambda_{m_1}}{\Lambda_{m_2}} = \left(\frac{20 \times 1000}{80} \times \frac{20}{10 \times 1000}\right) = \frac{1}{2}$$

$\therefore\ \Lambda_{m2} = 2\Lambda_{m1}$

5. (a)

6. (d) : Ionization enthalpy generally increases on moving from left to right along a period. But the trend is some what different here.

The first *I.E.* of N is greater than O due to presence of stable half filled 2*p* orbitals.

The first *I.E* of Be is greater than B due to presence of stable fully-filled 2*s* orbitals.

7. (b) : The iron obtained from blast furnace contains about 4% carbon and many impurities (e.g., S, P, Si, Mn). This is known as pig iron. Cast iron is made by melting pig iron with scrap iron and coke. It contains lower C content (about 3%)

8. (c)

9. (c) : The density of elements of alkaline earth metals first decreases from Be to Ca and then steadily increases from Ca to Ba. Thus, Ca has the least density.

Property	Be	Mg	Ca	Sr	Ba
Density/g cm^{-3}	1.84	1.74	1.55	2.63	3.59

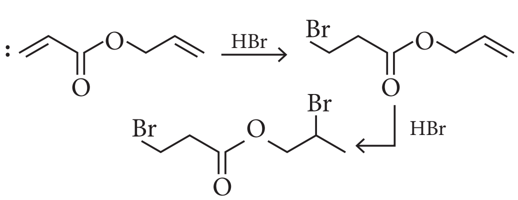
10. (b) : B_2O_3, N_2O_5, SO_3 and P_4O_{10} are acidic in nature while NO, N_2O, CO are neutral oxides.

11. (a) : Complexes having more strong field ligands absorb more energy due to increase in Δ_0 and hence, greater splitting of *d*-orbital.

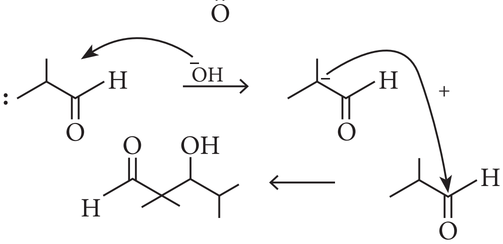
The order of increasing field strength is *en* > NH_3 > H_2O.

12. (c)

13. (d) :

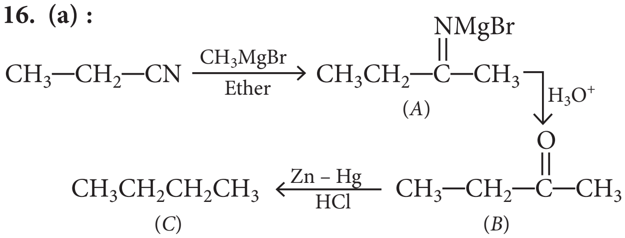


14. (b) :



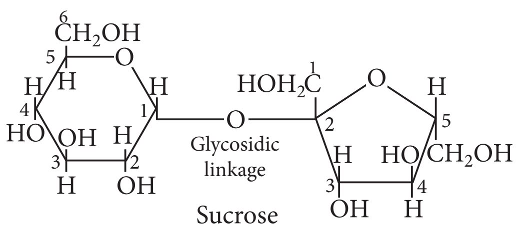
15. (a) : $-NO_2$ group stabilises the phenoxide ion to the greatest extent due to $-I$ and $-R$ effect.
The further order of acidity is due to the $-I$ and $+I$ effects of $-NO_2$ and $-OCH_3$ groups respectively.

16. (a) :



17. (b)

18. (b) : Glycosidic linkage between C_1 of α-glucose and C_2 of β-fructose is found in sucrose.



Sucrose

19. (b) : Some drugs do not bind to the enzyme's active site. These bind to a different site of enzyme which is called allosteric site.

20 (a) : Methyl orange has quinonoid form in acidic solution and benzenoid form in alkaline solution.

21. (46) : $\underset{\substack{(56\text{L})\\2.5\text{ mol}}}{N_2} + 3H_2 \rightarrow \underset{\substack{(20\text{ L})\\0.89\text{ mol}}}{2NH_3}$

22.4 L of N_2 = 1 mol

1 L of $N_2 = \frac{1}{22.4}$ mol

56 L of $N_2 = \frac{1}{22.4} \times 56 = 2.5$ mol

22.4 L of NH_3 = 1 mole of NH_3

1 L of $NH_3 = \frac{1}{22.4}$ mol

20 L of $NH_3 = \frac{1}{22.4} \times 20 = 0.89$ mol of NH_3

Now, 2 moles of NH_3 require = 1 mol of N_2

0.89 mol of $NH_3 = \frac{1}{2} \times 0.89$ mol N_2 = 0.45 mol N_2

Since, 1 mol of N_2 = 22.4 L
0.45 mol = 22.4 × 0.45 = 10.08 L
⇒ Volume of unused N_2 = (56 – 10.08) L = 46 L

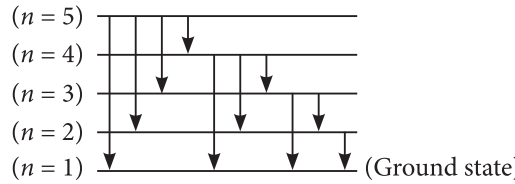
22. (1655) : $PV = nRT$

$(2 \times 10^6 \text{ Pa}) \times (2 \text{ dm}^3) = \frac{11}{44} \times (0.083 \times 10^5 \text{ Pa}) \times T$

(∵ R = 0.083 bar and 1 bar = 10^5Pa)

T = 1927.7 K = 1654.7°C ≈ 1655°C

23. (10) :



Maximum number of emission lines = $\frac{n(n-1)}{2}$

⇒ $\frac{5(4)}{2} = 10$

24. (2) : $HCl + NaOH \longrightarrow NaCl + H_2O$; $\Delta H_1 = -57.3 \text{ kJ mol}^{-1}$
$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$;
$\Delta H_2 = -55.3 \text{ kJ mol}^{-1}$
$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$, ΔH_3 = ?
$\Delta H_3 = \Delta H_2 - \Delta H_1 = -55.3 - (-57.3) \text{ kJ mol}^{-1} = 2 \text{kJ mol}^{-1}$

25. (2) : $k = \frac{1}{t}\ln\left(\frac{p_o}{p}\right) \Rightarrow \ln\left(\frac{p}{p_o}\right) = -kt$

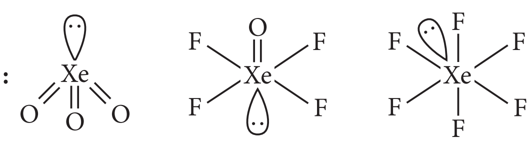
In a plot between $\ln\left(\frac{p}{p_o}\right)$ v/s t, slope = $-k$

$-k = -3.465 \times 10^4 \text{ s}^{-1}$

For a first order reaction, $t_{1/2} = \frac{0.693}{k} = \frac{0.693}{3.465 \times 10^4}$

∴ $t_{1/2} = 2 \times 10^{-5}$ s

26. (3) :



The sum of number of lone pair of electrons is 3.

27. (4) : The standard reduction potential of Cr^{3+}/Cr^{2+} is – 0.407 V.

Spin only magnetic moment, $\mu = \sqrt{n(n+2)}$

($n \rightarrow$ no. of unpaired electrons)

$= \sqrt{3(3+2)}$ = 3.87 B.M ≈ 4 B.M

28. (33) : $R - OH + CH_3MgI \longrightarrow \underset{3.1 \text{ mL}}{CH_4(\uparrow)}$

22400 mL of CH_4 = 1 mol
⇒ 3.1 mL of $CH_4 = 1.38 \times 10^{-4}$ mole
Moles of CH_4 = Moles of R—OH = 1.38×10^{-4} mole
Weight of sample (w) = 4.5 mg = 4.5×10^{-3} g
Molar mass (M) = ?

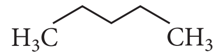
Now, $n = \frac{w}{M} \Rightarrow M = \frac{w}{n} \Rightarrow \frac{(4.5\times10^{-3})\text{ g}}{1.38\times10^{-4}\text{ mole}}$

$\Rightarrow$ 32.6 g/mole ≃ 33 g/mol

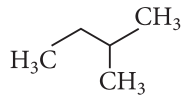
29. **(2) :** $R_f = \frac{\text{Distance moved by the substance from base line}}{\text{Distance moved by the solvent from base line}}$

$R_f(A) = \frac{2.08}{3.25}$ and $R_f(B) = \frac{1.05}{3.25}$ $\therefore$ $\frac{R_f(A)}{R_f(B)} = \frac{2.08}{1.05}$

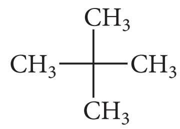
$= 1.98 \approx 2.$

30. **(8) :** 

= 3 mono substituted products



= 4 mono substituted products



= 1 mono substituted product