

IIT - JEE ADVANCED - 2012

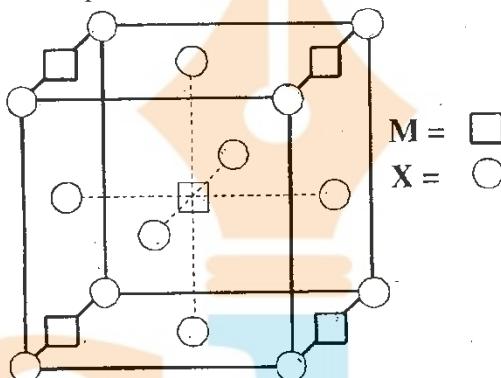
PAPER-1 [Code – 8]

PART - II: CHEMISTRY

SECTION – I: Single Correct Answer Type

This section contains **10 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct.

21. A compound M_pX_q has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



(A) MX
 (C) M_2X
 (B) MX_2
 (D) M_5X_{14}

Sol. (B)

$$X = 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$$

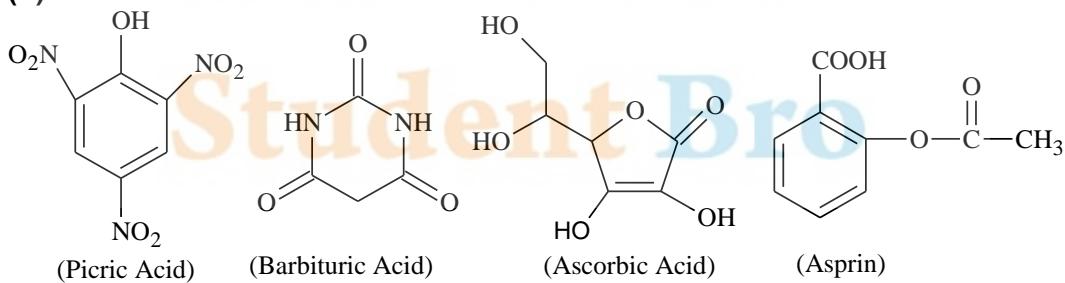
$$M = 4 \times \frac{1}{4} + 1 = 2$$

So, unit cell formula of the compound is M_2X_4 and the empirical formula of the compound is MX_2 .

22. The carboxyl functional group ($-COOH$) is present in

(A) picric acid
 (B) barbituric acid
 (C) ascorbic acid
 (D) aspirin

Sol. (D)



23. As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is

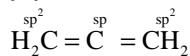
(A) Tetraquadiaminecobalt (III) chloride
 (B) Tetraquadiaminocobalt (III) chloride
 (C) Diaminetetraaquacobalt (III) chloride
 (D) Diamminetetraaquacobalt (III) chloride

Sol. (D)

$[Co(H_2O)_4(NH_3)_2]Cl_3$
 Diamminetetraaquacobalt (III) chloride

24. In allene (C_3H_4), the type(s) of hybridization of the carbon atoms is (are)
 (A) sp and sp^3
 (B) sp and sp^2
 (C) only sp^2
 (D) sp^2 and sp^3

Sol. **(B)**



25. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is [a_0 is Bohr radius]

$$(A) \frac{h^2}{4\pi^2 m a_0^2}$$

$$(C) \frac{h^2}{32\pi^2 m a_0^2}$$

$$(B) \frac{h^2}{16\pi^2 m a_0^2}$$

$$(D) \frac{h^2}{64\pi^2 m a_0^2}$$

Sol. **(C)**

As per Bohr's postulate,

$$mv\tau = \frac{nh}{2\pi}$$

$$\text{So, } v = \frac{nh}{2\pi mr}$$

$$KE = \frac{1}{2} mv^2$$

$$\text{So, } KE = \frac{1}{2} m \left(\frac{nh}{2\pi mr} \right)^2$$

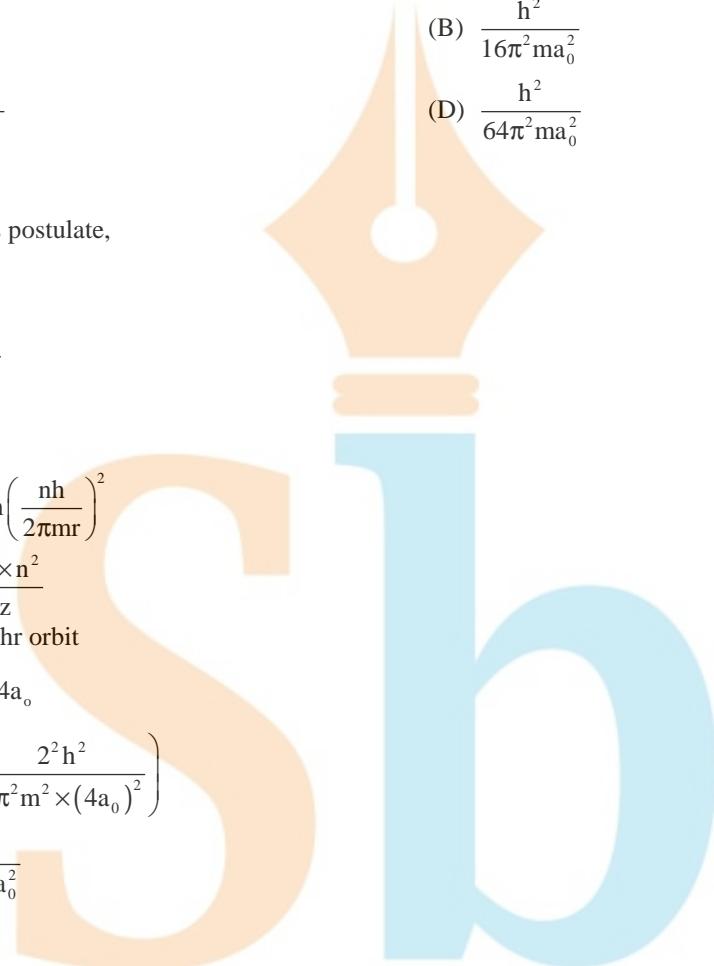
$$\text{Since, } r = \frac{a_0 \times n^2}{z}$$

So, for 2nd Bohr orbit

$$r = \frac{a_0 \times 2^2}{1} = 4a_0$$

$$KE = \frac{1}{2} m \left(\frac{2^2 h^2}{4\pi^2 m^2 \times (4a_0)^2} \right)$$

$$KE = \frac{h^2}{32\pi^2 m a_0^2}$$



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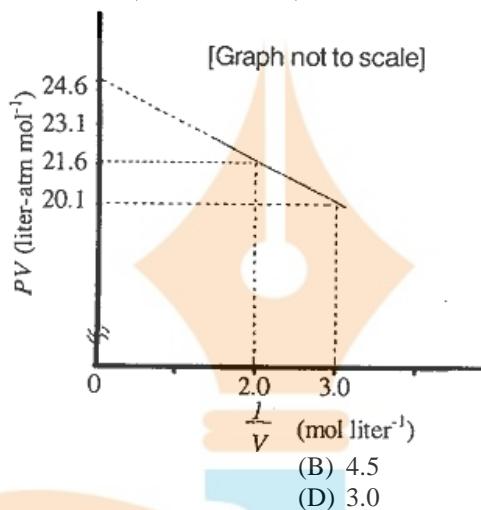
26. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen?

(A) HNO_3 , NO , NH_4Cl , N_2
 (B) HNO_3 , NO , N_2 , NH_4Cl
 (C) HNO_3 , NH_4Cl , NO , N_2
 (D) NO , HNO_3 , NH_4Cl , N_2

Sol. (B)

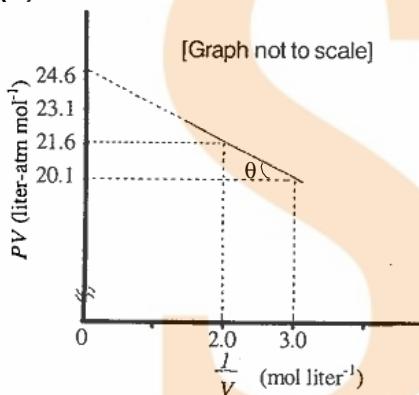


27. For one mole of a van der Waals gas when $b = 0$ and $T = 300 \text{ K}$, the PV vs. $1/V$ plot is shown below. The value of the van der Waals constant a (atm.litre 2 mol $^{-2}$) is



(A) 1.0
 (C) 1.5
 (B) 4.5
 (D) 3.0

Sol. (C)



van der Waals equation for 1 mole of real gas is,

$$\left(P + \frac{a}{V^2} \right) (V - b) = RT$$

but, $b = 0$ (given)

$$\Rightarrow \left(P + \frac{a}{V^2} \right) (V) = RT$$

$$\therefore PV = -a \times \frac{1}{V} + RT \quad \dots \dots \text{(i)}$$

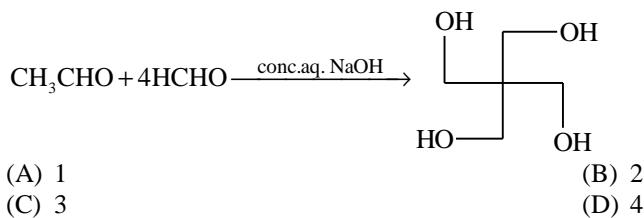
$$y = mx + c$$

$$\text{Slope} = \tan(\pi - \theta) = -a$$

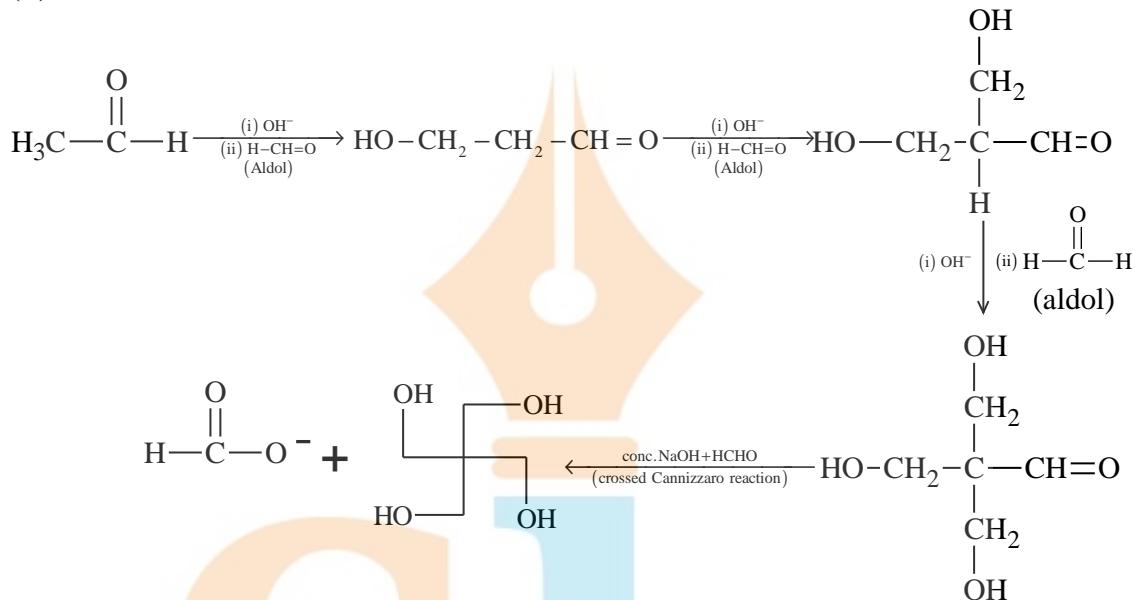
$$\text{So, } \tan \theta = a = \frac{21.6 - 20.1}{3 - 2} = 1.5$$

$$\text{or, } \tan \theta = \frac{24.6 - 20.1}{3 - 0} = 1.5$$

28. The number of aldol reaction(s) that occurs in the given transformation is



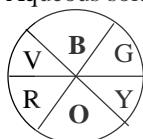
Sol. (C)



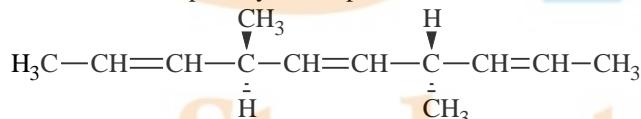
29. The colour of light absorbed by an aqueous solution of CuSO_4 is
(A) orange- red (B) blue-green
(C) yellow (D) violet

Sol.

(A) Aqueous solution of copper sulphate absorbs orange red light and appears blue (complementary colour).

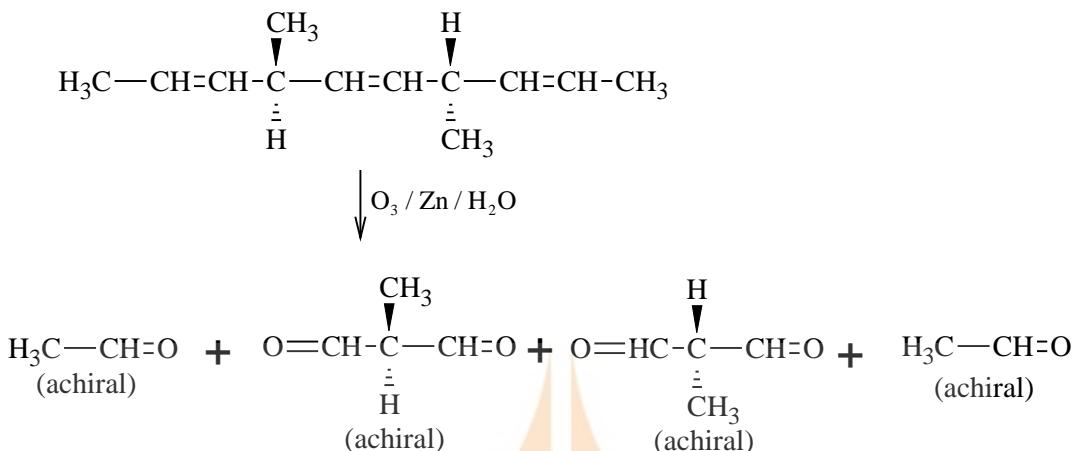


30. The number of optically active products obtained from the **complete** ozonolysis of the given compound is



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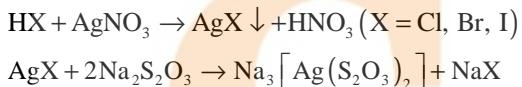
Sol. (A)



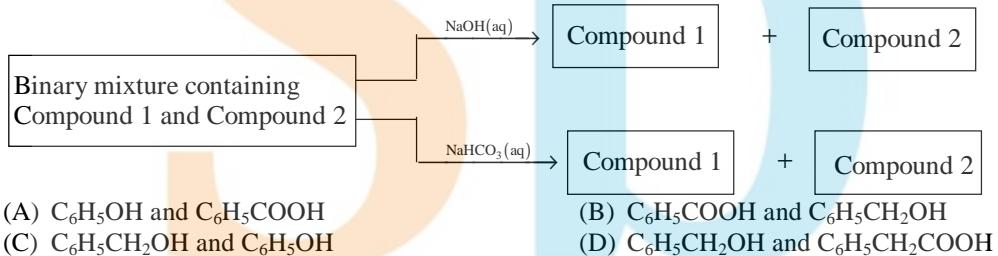
SECTION II : Multiple Correct Answer (s) Type

This section contains **5 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** are correct.

Sol. (A, C, D)



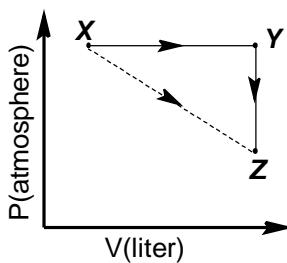
32. Identify the binary mixture(s) that can be separated into individual compounds, by differential extraction, as shown in the given scheme.



Sol. (B, D)

- (A) Both are soluble in NaOH, hence **inseparable**.
- (B) Only benzoic acid (C_6H_5COOH) is soluble in NaOH and $NaHCO_3$, while benzyl alcohol ($C_6H_5CH_2OH$) is not. Hence, **separable**.
- (C) Although NaOH can enable separation between benzyl alcohol ($C_6H_5CH_2OH$) and phenol (C_6H_5OH) as only the later is soluble in NaOH. However, in $NaHCO_3$, both are insoluble. Hence, **inseparable**.
- (D) α -phenyl acetic acid ($C_6H_5CH_2COOH$) is soluble in NaOH and $NaHCO_3$. While benzyl alcohol ($C_6H_5CH_2OH$) is not. Hence, **separable**.

33. For an ideal gas, consider only P - V work in going from an initial state **X** to the final state **Z**. The final state **Z** can be reached by either of the two paths shown in the figure. Which of the following choice(s) is(are) correct? [Take ΔS as change in entropy and w as work done]



(A) $\Delta S_{x \rightarrow z} = \Delta S_{x \rightarrow y} + \Delta S_{y \rightarrow z}$
 (B) $w_{x \rightarrow z} = w_{x \rightarrow y} + w_{y \rightarrow z}$
 (C) $w_{x \rightarrow y \rightarrow z} = w_{x \rightarrow y}$
 (D) $\Delta S_{x \rightarrow y \rightarrow z} = \Delta S_{x \rightarrow y}$

Sol. (A, C)

$\Delta S_{x \rightarrow z} = \Delta S_{x \rightarrow y} + \Delta S_{y \rightarrow z}$ [entropy (S) is a state function, hence additive]
 $w_{x \rightarrow y \rightarrow z} = w_{x \rightarrow y}$ (work done in $Y \rightarrow Z$ is zero as it is an isochoric process)

34. Which of the following molecules, in pure form, is (are) **unstable** at room temperature?



Sol. (B, C)

Compound and being antiaromatic are unstable at room temperature.

35. Choose the correct reason(s) for the stability of the **lyophobic** colloidal particles.

(A) Preferential adsorption of ions on their surface from the solution
 (B) Preferential adsorption of solvent on their surface from the solution
 (C) Attraction between different particles having opposite charges on their surface
 (D) Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles

Sol. (A, D)

Lyophobic colloids are stable due to preferential adsorption of ions on their surface from solution and potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles that makes lyophobic sol stable.

SECTION III: Integer Answer Type

This section contains **5 questions**. The answer to each question is a **single digit integer**, ranging from 0 to 9 (both inclusive).

36. 29.2 % (w/w) HCl stock solution has density of 1.25 g mL^{-1} . The molecular weight of HCl is 36.5 g mol^{-1} . The volume (mL) of stock solution required to prepare a 200 mL solution of 0.4 M HCl is

Sol. (8)

Stock solution of HCl = 29.2% (w/w)

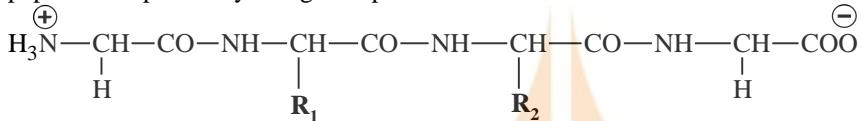
$$\text{Molarity of stock solution of HCl} = \frac{29.2 \times 1000 \times 1.25}{36.5 \times 100}$$

If volume of stock solution required = V ml

$$V \times \frac{29.2}{36.5} \times \frac{1000}{80} = 200 \times 0.4$$

$$\Rightarrow V = 8 \text{ ml}$$

37. The substituents \mathbf{R}_1 and \mathbf{R}_2 for nine peptides are listed in the table given below. How many of these peptides are positively charged at pH = 7.0?



Peptide	\mathbf{R}_1	\mathbf{R}_2
I	H	H
II	H	CH_3
III	CH_2COOH	H
IV	CH_2CONH_2	$(\text{CH}_2)_4\text{NH}_2$
V	$\text{CH}_2\text{CONH}_2^-$	CH_2CONH_2
VI	$(\text{CH}_2)_4\text{NH}_2$	$(\text{CH}_2)_4\text{NH}_2$
VII	CH_2COOH	CH_2CONH_2
VIII	CH_2OH	$(\text{CH}_2)_4\text{NH}_2$
IX	$(\text{CH}_2)_4\text{NH}_2^-$	CH_3

Sol. (4)

Peptides with isoelectric point (pI) > 7, would exist as cation in neutral solution (pH = 7).

IV, VI, VIII and IX

38. An organic compound undergoes first-order decomposition. The time taken for its decomposition to 1/8 and 1/10 of its initial concentration are $t_{1/8}$ and $t_{1/10}$ respectively. What is the value of $\frac{[t_{1/8}]}{[t_{1/10}]} \times 10$? (take $\log_{10}2 = 0.3$)

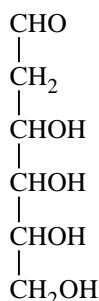
Sol. (9)

$$t_{1/8} = \frac{2.303 \log 8}{k} = \frac{2.303 \times 3 \log 2}{k}$$

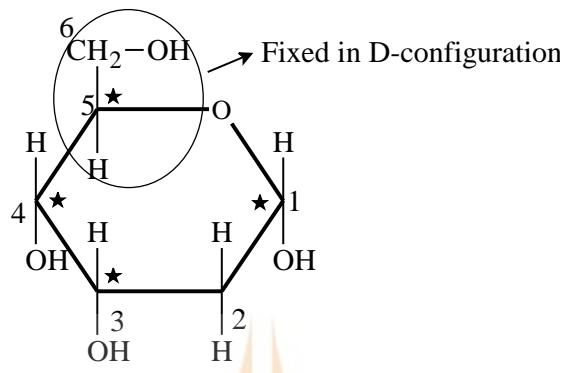
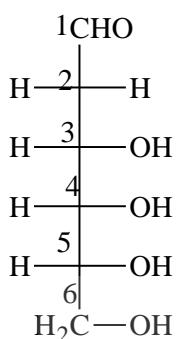
$$t_{1/10} = \frac{2.303}{k} \log 10 = \frac{2.303}{k}$$

$$\left[\frac{t_{1/8}}{t_{1/10}} \right] \times 10 = \frac{\left(\frac{2.303 \times 3 \log 2}{k} \right)}{\left(\frac{2.303}{k} \right)} \times 10 = 9$$

39. When the following aldohexose exists in its D-configuration, the total number of stereoisomers in its pyranose form is

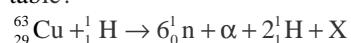


Sol. (8)



Hence total number of stereoisomers in pyranose form of D-configuration = $2^3 = 8$

40. The periodic table consists of 18 groups. An isotope of copper, on bombardment with protons, undergoes a nuclear reaction yielding element X as shown below. To which group, element X belongs in the periodic table?



Mass number: $63 + 1 = 1 \times 6 + 4 + 1 \times 2 + A$

$$A = 64 - 12 = 52$$
$$\text{Atomic number: } 29 + 1 = 6 \times 0 + 2 + 2 \times 1 + Z$$
$$Z = 30 - 4 = 26$$

$${}_Z^AX = {}_{26}^{52}\text{Fe}$$

Hence X is in group '8' in the periodic table.

Sb

Student Bro