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**.

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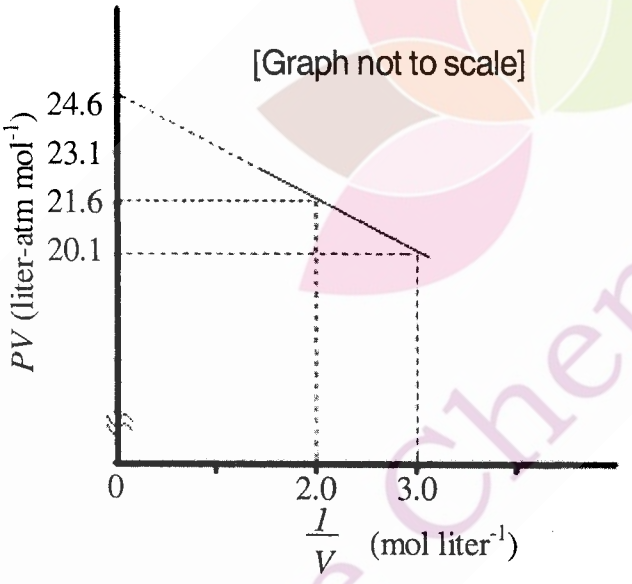
21. In allene (C_3H_4), the type(s) of hybridisation of the carbon atoms is (are)

(A) *sp* and sp^3 (B) *sp* and sp^2 (C) only sp^2 (D) sp^2 and sp^3

ANSWER : B

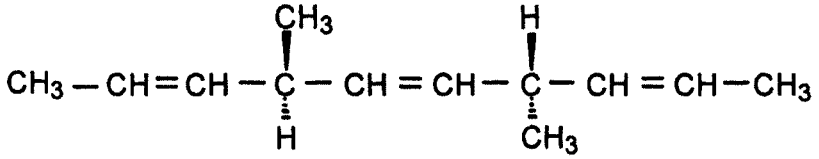
22. For one mole of a van der Waals gas when $b = 0$ and $T = 300$ K, the PV vs. $1/V$ plot is shown below. The value of the van der Waals constant a (atm.liter^2 mol^{-2}) is



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

ANSWER : C

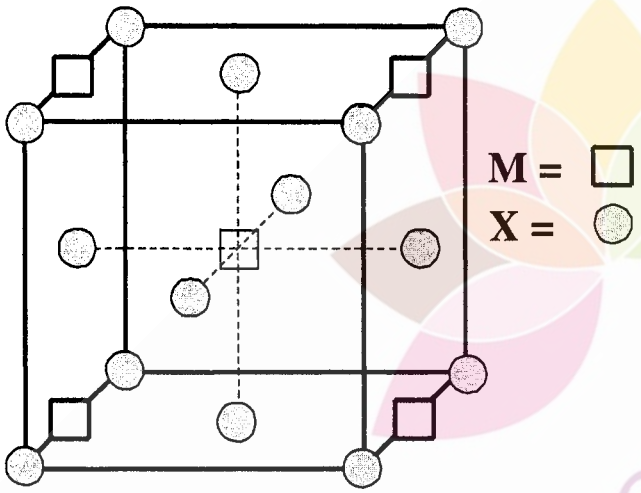
23. The number of optically active products obtained from the **complete** ozonolysis of the given compound is



(A) 0 (B) 1 (C) 2 (D) 4

ANSWER : A

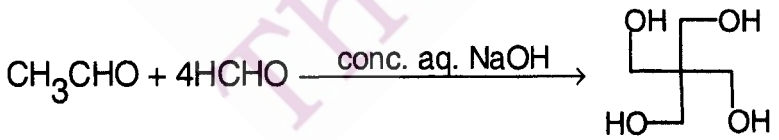
24. A compound M_pX_q has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



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

ANSWER : B

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



(A) 1 (B) 2 (C) 3 (D) 4

ANSWER : C

26. The colour of light absorbed by an aqueous solution of $CuSO_4$ is

(A) orange-red (B) blue-green (C) yellow (D) violet

ANSWER : A

27. The carboxyl functional group (–COOH) is present in

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

ANSWER : D

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

(A) $\frac{h^2}{4\pi^2 m a_0^2}$ (B) $\frac{h^2}{16\pi^2 m a_0^2}$ (C) $\frac{h^2}{32\pi^2 m a_0^2}$ (D) $\frac{h^2}{64\pi^2 m a_0^2}$

ANSWER : C

29. 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

ANSWER : B

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

(A) Tetraaquadiaminecobalt (III) chloride

(B) Tetraaquadiamminecobalt (III) chloride

(C) Diaminetetraaquacobalt (III) chloride

(D) Diamminetetraaquacobalt (III) chloride

ANSWER : D

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**.

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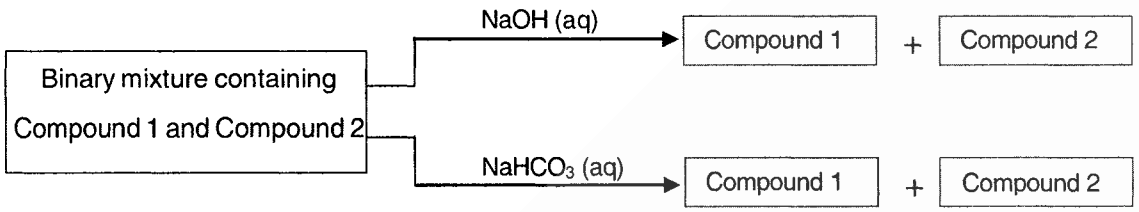
31. Identify the binary mixture(s) that can be separated into individual compounds, by differential extraction, as shown in the given scheme.



(A) C_6H_5OH and C_6H_5COOH (B) C_6H_5COOH and $C_6H_5CH_2OH$

(C) $C_6H_5CH_2OH$ and C_6H_5OH (D) $C_6H_5CH_2OH$ and $C_6H_5CH_2COOH$

ANSWER : BD

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

(A) Preferential adsorption of ions on their surface from the solution

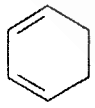
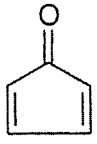
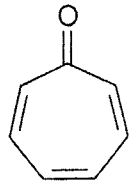
(B) Preferential adsorption of solvent on their surface from the solution

(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

ANSWER : AD

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

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

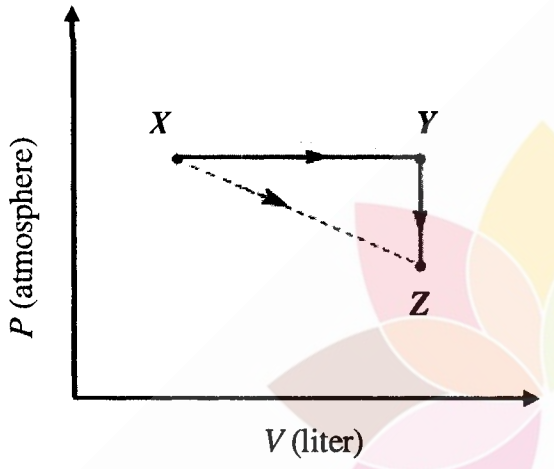
ANSWER : BC

34. Which of the following hydrogen halides react(s) with $AgNO_3(aq)$ to give a precipitate that dissolves in $Na_2S_2O_3(aq)$?

(A) HCl (B) HF (C) HBr (D) HI

ANSWER : ACD

35. 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) $\Delta S_{x\to z} = \Delta S_{x\to y} + \Delta S_{y\to z}$ (B) $w_{x\to z} = w_{x\to y} + w_{y\to z}$

(C) $w_{x\to y\to z} = w_{x\to y}$ (D) $\Delta S_{x\to y\to z} = \Delta S_{x\to y}$

ANSWER : AC

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*).

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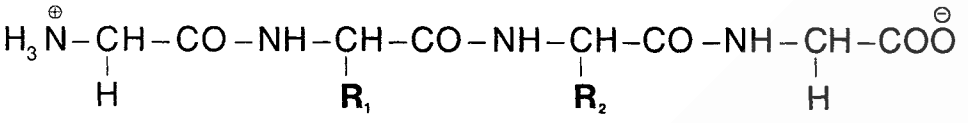
36. The substituents $\mathbf{R_1}$ and $\mathbf{R_2}$ for nine peptides are listed in the table given below. How many of these peptides are positively charged at pH = 7.0 ?



Peptide	$\mathbf{R_1}$	$\mathbf{R_2}$
I	H	H
II	H	CH_3
III	CH_2COOH	H
IV	CH_2CONH_2	$(CH_2)_4NH_2$
V	CH_2CONH_2	CH_2CONH_2
VI	$(CH_2)_4NH_2$	$(CH_2)_4NH_2$
VII	CH_2COOH	CH_2CONH_2
VIII	CH_2OH	$(CH_2)_4NH_2$
IX	$(CH_2)_4NH_2$	CH_3

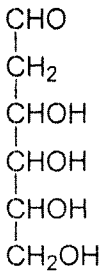
ANSWER : 4

37. 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 ?

$$^{63}_{29}Cu + {}^{1}_{1}H \rightarrow 6\,{}^{1}_{0}n + \alpha + 2\,{}^{1}_{1}H + \mathbf{X}$$

ANSWER : 8

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



ANSWER : 8

39. 29.2% (w/w) HCl stock solution has a 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

ANSWER : 8

40. 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 $\log_{10} 2 = 0.3$)

ANSWER : 9