

IIT-JEE-Chemistry-Mains-2003

Mains

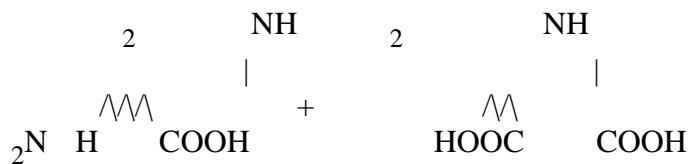
Note : Question number 1 to 10 carries 2 marks each and 11 to 20 carries 4 marks each.

- Calculate the molarity of water if its density is 1000 kg/m^3
- The average velocity of gas molecules is 400 m/sec . Calculate its rms velocity at the same temperature.
- Write down the heterogeneous catalyst involved in the polymerization of ethylene.
- Which one is more soluble in diethyl ether anhydrous AlCl_3 or hydrated AlCl_3 ? Explain in terms of bonding.
- Using VSEPR theory, draw the shape of PCl_5 and BrF_5 .
- A racemic mixture of (phenyl) propanoic acid on esterification with (+) 2-butanol gives two esters. Mention the stereochemistry of the two esters produced.
- Wavelengths of high energy transition of H^α is 91.2 nm . Calculate the corresponding wavelength of He atoms.
- Match the values

	K_a
(a) Benzoic acid	3.3×10^{-5}
(b) $\text{O}_2\text{N}-\text{C}_6\text{H}_4-\text{COOH}$	6.3×10^{-5}
(c) $\text{Cl}-\text{C}_6\text{H}_4-\text{COOH}$	30.6×10^{-5}
(d) $\text{H}_3\text{CO}-\text{C}_6\text{H}_4-\text{COOH}$	6.4×10^{-5}
(e) $\text{H}_3\text{C}-\text{C}_6\text{H}_4-\text{COOH}$	4.2×10^{-5}

9. Write down reactions involved in the extraction of Pb. What is the oxidation number of lead litharge?

10. Following two amino acids lysine and glutamine form dipeptide linkage. What are two possible dipeptides?



11. (a) You are given marbles of diameter 10 mm. They are to be placed such that their centres are lying in a square bound by four lines each of length 40 mm. What will be the arrangements of marbles in a plane so that maximum number of marbles can be placed inside the area? Sketch the diagram and derive expression for the number of molecules per unit area.

(b) 1 gm of charcoal adsorbs 100 ml 0.5 M CH_3COOH to form a monolayer, and thereby the molarity of CH_3COOH reduces to 0.49. Calculate the surface area of the charcoal adsorbed by each molecule of acetic acid. Surface area of charcoal = $3.01 \times 10^2 \text{ m}^2/\text{gm}$.

12. (a) Will the pH of water be same at 4°C and 25°C? Explain.

(b) Two students use same stock solution of ZnSO_4 and a solution of CuSO_4 . The emf of one cell is 0.03 V higher than the other. The conc. of CuSO_4 in the cell with higher emf value is 0.5 M. Find out the conc. of CuSO_4 in the other cell ($2.203 \text{ RT/F} = 0.06$).

13. Convert



(in not more than 3 steps)



14. There is a solution of hydroxy benzoic acid and p-amino benzoic acid. Discuss one method by which we can separate them and also write down the confirmatory tests of the functional groups present.

15. $\text{A}(\text{C}_{12}\text{H}_{12}) \xrightarrow{-\text{HCl}} \text{B} + \text{C}$
 $\text{B}(\text{C}_{12}\text{H}_{11}\text{Cl}) \quad \text{C}$

-- $\text{alkOH} \rightarrow \text{D}$ (isomer of A)

-- $\text{ozonolysis} \rightarrow \text{E}$ (it gives negative test with Fehling solution but

responds to iodoform test)

-- ozonolysis --> F + G (both gives positive Tollen's test but do not give iodoform test)

F + G. NaOH --> HCOONa + a primary alcohol

Identify to A to G.

16. Identify the following :

NO_3^- -- SO_2 --> A -- Na_2CO_3 --> B -- Elemental S / H_2S --> C -- I_2 --> D

Also mention the oxidation state of S in all the compounds.

17. Write the IUPAC nomenclature of the given complex along with its hybridization and structure $\text{K}_2[\text{Cr}(\text{NO})(\text{NH}_3)(\text{CN})_4]$, $m = 1.73 \text{ BM}$.

18. A mixture consists A (yellow solid) and B (colourless solid) which gives lilac colour in flame
(a) Mixture gives black precipitate C on adding H₂S.

(b) C is soluble in aqua-regia and on evaporation of aqua-regia and adding SnCl_2 gives grayish black precipitate D.

The salt solution with NH_4OH gives a brown precipitate.

(i) The sodium extract of the salt with FeCl_3 gives a violet layer.

(ii) The sodium extract gives yellow precipitate with AgNO_3 solution which is insoluble in NH_3 .

Identify A and B, and the precipitates C and D.

19. (a) Match the following if the molecular weights of X, Y and Z are same

	Boiling Point	K _b
X	100	0.68
Y	27	0.53
Z	253	0.98

(b) $C_{u,v}$ value of He is always $3R/2$ but $C_{u,v}$ value for H_2 is $3R/2$ at low temperature and $5R/2$ at moderate temperature and more than $5R/2$ at higher temperature explain in two to three lines.

20. (a) C_2H_2 CH_2
 V/V
 |

OH

Write resonance structure of the given compound.

(b) Compound A of molecular formula $C_9H_7O_2Cl$ exists in ketoform and predominantly in enolic form 'B'. On oxidation with $KMnO_4$, 'A' gives m-chlorobenzoic acid. Identify 'A' and 'B'.