

**2020**  
**CHEMISTRY**  
**[HONOURS]**  
**Paper : VII**

Full Marks : 50

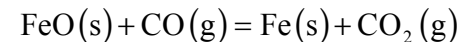
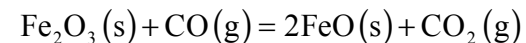
Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer any **five** questions: 2×5=10
- a) What is the [111] interplanar distance ratio of a bcc lattice?
- b) For the reaction  $\text{H}_2(\text{g}) + \text{S} \rightleftharpoons \text{H}_2\text{S}$ ,  
 $K_p = 6.02 \times 10^5$  at  $25^\circ\text{C}$ . Calculate standard free energy of  $\text{H}_2\text{S}$ .
- c) Show that surface tension is numerically the same as the surface energy/Area of a liquid.
- d) What is 'viscosity average molar mass'?
- e) Explain why sulphate ions are good precipitating agent for Barium ions.

[Turn over]

- f) Consider the following reactions:



show that the system is bivariant.

- g) State one application of addition of a foreign substance in a partially miscible liquid system.
- h) What do you mean by micelle and reverse micelle?
2. Answer any **four** questions: 5×4=20
- a) i) For an equilibrium phase transition at temperature  $T$ ,  $\left(\frac{\partial S}{\partial V}\right)_T = \frac{\Delta H}{T\Delta V^x}$ . Find  $x$ .  
 Terms have their usual meanings.
- ii) Explain how a wetting liquid rises in a capillary tube. 2+3
- b) Draw a fcc lattice structure. Show that 74% of the spaces of such a crystal is occupied by the constituent species. 2+3

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- c) i) Show that for a real gas

$$\text{fugacity} = P e^{\frac{BP}{RT}},$$

where  $V_{\text{Real}} = V_{\text{Ideal}} + B$ . Terms have their usual meanings.

- ii) If pH of a 0.02(M) MCl solution is 5.48, where MOH is a weak base, calculate its degree of hydrolysis.

3+2

- d) Draw free energy vs. extent of reaction graph showing different stages of reaction and correlate it to Van't Hoff reaction isotherm.

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- e) Find the expression of  $C_v$  for a monoatomic solid according to Einstein model. What is Dulong-Petit's law?

$3\frac{1}{2} + 1\frac{1}{2}$

- f) i) At 35°C, in a phenol-water two layer system, 40% by weight of phenol is present. Water is present in the two layers by weight of 30% and 92%. Calculate the relative weights of two layers.

- ii) Write down the combined form of Van't Hoff's laws of osmotic pressure. 4+1

- g) i) Justify: Eutectic mixture has a definite composition and melting point, yet it is not a compound.

- ii) Calculate pH of a 0.03(M)  $\text{H}_2\text{SO}_4$  solution. First dissociation is complete, second dissociation constant is  $1.01 \times 10^{-2}$ .

2+3

3. Answer any **two** questions:  $10 \times 2 = 20$

- a) i) Give one example of utilization of Micellar solubilization.

- ii) For this equilibrium  $X_{(g)} \rightleftharpoons Y_{(g)} + Z_{(g)}$ , arrive at the expression for  $\Delta K_p$  if an excess amount of Y is present at constant volume before reaction.

- iii) Show that in a liquid-liquid solution, if one component shows negative deviation from Raoult's law, the other component will exhibit the same.

- iv) Write down the expression for glancing angle in the powder method of crystal analysis.

2+3+3+2

- b) i) Derive Bragg's equation in connection with diffraction of X-ray by crystals.

- ii) A crystallographic plane makes intercepts  $\frac{1}{2}, \infty, 2$  units to the crystallographic axes. Find the maximum value of wave length that can be used here in Bragg's method if it is a simple cubic system with edge length  $a = 1.5 \text{ \AA}$ .
- iii) Define Miller indices. Arrive at the general formula for the inter-planar spacing in a cubic system. 3+4+3
- c) i) If elevation of boiling point of a dilute solution  $\Delta T_b = X\pi$ , find X.  $\pi$  = Osmotic pressure of the solution.
- ii) Draw the cooling curve of a molten mass for a two-component system.
- iii) Explain why at CMC, the solutions of long chain fatty acids have minimum surface tension.
- iv) A liquid rises 2 cm in a capillary tube of radius 0.002 cm. Calculate its surface tension if its density is 0.92 gm/cc. 3+2+3+2
- d) i) Show that the excess pressure inside a spherical soap bubble of radius 'r' formed within liquid has the expression  $2\gamma/r$  (where  $\gamma$  = surface tension). Hence prove that there is no excess pressure inside the flat surface.
- ii) Calculate the decrease in surface area when droplets of average radius  $1.0 \times 10^{-6} \text{ m}$  coalesce to form  $1.0 \times 10^{-3} \text{ m}^3$  of water at 278 K.
- iii) Calculate the viscosity coefficient of  $\text{CO}_2$  at  $27^\circ\text{C}$ . Given that van der Waal's constant  $b = 32 \text{ cc mol}^{-1}$ , average velocity of  $\text{CO}_2$  molecule at that temperature is  $3.8 \times 10^4 \text{ cm s}^{-1}$ . 4+3+3
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