

Name:	 UPES UNIVERSITY WITH A PURPOSE
Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2019

Course: Physical Chemistry III
Program: B.Sc. (H) Chemistry
Course Code: CHEM 2003

Semester: III
Time 03 hrs.
Max. Marks: 100

Instructions: Read the instructions given below carefully:

1. All questions are compulsory.
2. Internal choice is given in question number 10 and 12.

SECTION A

S. No.		Marks	CO
Q 1	How many phases and components are present in each of the following systems: (i) An aqueous solution of a salt (NaCl) (ii) CaCO_3 (s) is in equilibrium with CaO (s) and CO_2 (g)	4	CO1
Q 2	Determine the phase rule for Solid \leftrightarrow Liquid equilibrium assuming that vapour is absent.	4	CO1
Q 3	What do you understand by a eutectic mixture?	4	CO1
Q 4	Predict whether silver react with 1 N sulphuric acid to give out hydrogen gas or not. Given $E^0_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$. Justify your answer.	4	CO3
Q 5	Calculate the standard emf of a cell which involve the following reaction $\text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag}$ Given $E^0_{\text{Cu}/\text{Cu}^{2+}} = -0.34\text{V}$ and $E^0_{\text{Ag}/\text{Ag}^+} = -0.80\text{V}$.	4	CO3

SECTION B

Q 6	Draw and Explain neat labelled phase diagram (TC diagram) for two component system.	8	CO2
Q 7	Define degrees of freedom of a system and explain giving examples. Is it possible to have a quadruple point (point having $P=4$) in the phase diagram of a one component system? Justify your answer.	8	CO2
Q 8	Calculate emf of the cell: Ca/Ca^{2+} ($a = 0.800$) // Ag^+ ($a = 0.200$) / Ag at 25°C . Given $E^0_{\text{Ca}^{2+}/\text{Ca}} = -2.87\text{V}$ and $E^0_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$.	8	CO3

Q 9	Discuss the construction of Standard Calomel electrode with its redox reactions.	8	CO3
Q 10	The normal boiling temperature of toluene is 450 K at vapour pressure of 1 atm. The vapour pressure of liquid benzene is 1×10^5 Pa at 30°C. Calculate $\Delta H_m^{vaporization}$ and $\Delta S_m^{vaporization}$ of toluene. (Given: 1 atm = 101325 Pa; R= 8.314J/ mol/K) OR Construct an electrolytic cell. Write the reactions taking place at each electrode.	8	CO2
SECTION-C			
Q 11	<p>a) Discuss the graph of potentiometric titration for a precipitation reaction.</p> <p>b) What is the difference between electromotive force and electrode potential? How they are measured?</p> <p>c) Draw and discuss the phase diagram of CO₂ system.</p>	5 5 10	CO3 CO3 CO2
Q 12	<p>a) A cell is prepared by dipping an iron rod in 1M FeSO₄ solution and a zinc rod in 1M ZnSO₄ solution. Write down half-cell reactions, overall reaction, standard emf of cell and cell representation. Given $E_{Fe^{2+}/Fe}^0 = -0.44V$ and $E_{Zn^{2+}/Zn}^0 = -0.76V$.</p> <p>b) Draw a well labelled triangular phase diagram of a three component system and explain the various regions in it.</p> <p style="text-align: center;">OR</p> <p>a) Consider a cell Pt / H₂ (1atm) / solution of unknown pH // Hg₂Cl₂(s) KCl(s) / Hg. If the emf of this cell is 0.366 volt, what would be the pH of the given solution? (Given $E_{SCE} = 0.242$ volt).</p> <p>b) Derive the phase rule for a non-reactive system.</p>	10 10	CO3 CO2