

B.Tech. 1st Semester END SEMESTER ASSESSMENT (ESA)
UE22CY151A - Engineering Chemistry

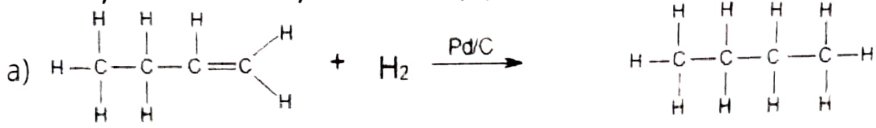
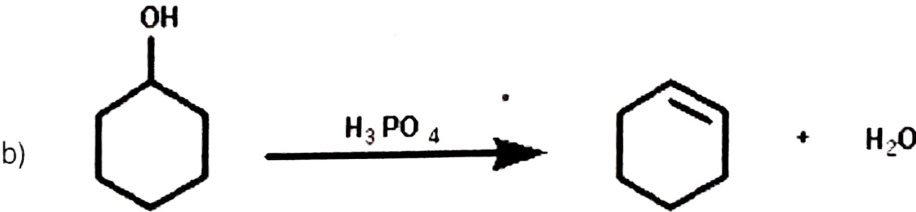
Max Marks: 100

Time: 3 Hours

Answer All Questions

			Marks
1.	a)	The IR spectra (anharmonic oscillator model) of HCl molecule shows a very intense absorption at 2886 cm^{-1} , a weaker one at 5668 cm^{-1} and a very weak one at 8347 cm^{-1} . Calculate the equilibrium frequency of the molecule from the data. Also find the force constant of the bond of HCl. Given atomic masses of H and Cl are 1.008 amu and 35.45 amu respectively. ($1\text{ amu} = 1.66 \times 10^{-27}\text{ kg}$, $c = 3 \times 10^8\text{ ms}^{-1}$)	6
	b)	Calculate the rotational constant for CO molecule if the bond length of CO is 1.31 Å. Gram molar mass of C = 12.000 and O = 15.9994, $1\text{ amu} = 1.66 \times 10^{-27}\text{ kg}$, $c = 3 \times 10^8\text{ ms}^{-1}$ and $h = 6.6 \times 10^{-34}\text{ Js}$.	4
	c)	(i) What is Born Oppenheimer approximation? (ii) If the vibrational- electronic spectra of a molecule shows (0,0) as the most intense line. What inference can one draw from it?	4
	d)	Give reasons for the following- (i) Bulk gold is yellow in colour whereas gold nanoparticles are red in colour. (ii) Melting point of bulk gold is 1050°C whereas that of nano gold is around 350°C .	4
	e)	Give any two advantages of bottom up solution combustion synthesis method of synthesizing nanomaterials	2
2.	a)	(i) Thermal decomposition of ammonium chloride in a closed vessel, $\text{NH}_4\text{Cl (s)} \rightleftharpoons \text{NH}_3\text{(g)} + \text{HCl(g)}$ has how many components? (ii) Thermal decomposition of MgCO_3 in a closed container, $\text{MgCO}_3\text{(s)} \rightleftharpoons \text{MgO(s)} + \text{CO}_2\text{(g)}$ has how many phases? (iii) Curves on either side of the eutectic point in a Pb-Ag system have what variance?	3
	b)	(i) What are the phases in equilibrium at the triple point in one component water system, write the phase rule and calculate the degree of freedom at that point. (ii) What is Pattinson's process for desilverisation of argentiferous lead?	6
	c)	For the cell $\text{Pt/Hg (l)/Hg}_2\text{Cl}_2\text{(s)/Cl}^-(0.1\text{N})//\text{Ce}^{4+}(0.05), \text{Ce}^{2+}(0.5)/\text{Pt}$ (i) Write the anodic and cathodic reaction (ii) Calculate E°_{Cell} (iii) Calculate E_{cell} Given the standard reduction potential of decinormal calomel electrode is 0.334 V and that of $E^\circ \text{Ce}^{4+}/\text{Ce}^{2+}$ is 0.5771 V and the temperature is 298K.	6

	d)	A glass electrode is coupled with saturated calomel electrode to measure unknown pH. The cell potentials measured with solution of unknown pH is 0.385 V. If the E_G^0 of the glass electrode is 0.8727 V and $E_{SCE} = 0.244V$, Calculate the pH of unknown solution.	3
	e)	In the conductometric titration of a mixture of strong acid and weak acid with a strong base NaOH, why does the conductance increase after the neutralisation of the strong acid?	2
3.	a)	Of all the energy storage/energy conversion devices discussed, suggest the most suited one for the below mentioned applications- (i) Start-stop application for hybrid cars (ii) Space exploration (iii) laptops	3
	b)	Calculate the energy density and power density of 20 kg battery which contains 5kg of Zinc as anodic material and discharges constant current for 10 hours. The voltage of the battery is 1.5 V. (Given : Atomic mass of Zinc is 65 g, number of electrons transferred in the redox reaction is 2, $F=96500$ C/mol)	6
	c)	(i) If E^0 Cell for H_2-O_2 alkaline fuel cell is 1.23 V the heat evolved during the reaction $\Delta H = -285.8$ kJ/mole, calculate the efficiency of the fuel cell. 3marks (ii) Why can't carbon containing fuels be used in an alkaline fuel cell? 2marks	5
	d)	Give any two points of difference between a potentiometric and amperometric sensor.	4
	e)	What are the two factors on which the absorbance of light of a particular wavelength by a substance in solution varies with?	2
4.	a)	(i) Assume two scenarios, one in which Iron (Fe) is in contact with copper (Cu) and another in which iron is in contact with silver (Ag). If the standard reduction potential of Fe, Cu and Ag is -0.44 V, 0.34 and 0.8 V respectively, which of the two scenarios would result in faster corrosion of Fe and Why? (ii) What would happen to the corrosion rate if the metal ions liberated at anode accumulate at the anodic region? Why? (iii) Under what conditions can oxides of antimony and arsenic be used for corrosion control and how do they bring about reduction in corrosion rate.	6
	b)	With the help of a neat and labeled diagram explain the impressed current cathodic protection technique of corrosion control. What can cause hydrogen embrittlement on a protected metal surface.	6
	c)	(i) What kind of corrosion takes place at the rivets/joints of a mild steel boiler? (ii) Give the two chemical reactions indicating the dissolution of iron and its subsequent hydrolysis during the corrosion in a boiler. (iii) Give the representation corrosion cell formed in the boiler (iv) How can this type of corrosion be prevented ?	6

	d)	What is intrinsic viscosity ? How is it related to the molecular mass of a polymer?	2
5	a)	(i) How does residual unsaturation affect the chemical resistance of a polymer? Why? (ii) How does the response to heat of a thermoplastic polymer differ from that of a thermosetting polymer? Why?	4
	b)	Taking acetone and hydrogen cyanide as the starting material, give the reactions involved in the synthesis of PMMA. Give two advantages of PMMA.	6
	c)	Calculate the polydispersity index of a polymeric sample which has 100 molecules of mass 1000, 200 molecules having mass 2000 and 500 molecules having mass 5000.	5
	d)	<p>Given below are the reactions corresponding to the catalytic hydrogenation of propene (a) and dehydration of cyclohexanol using an acid catalyst to obtain cyclohexene (b) respectively</p> <p>a) </p> <p>b) </p> <p style="text-align: center;">Cyclohexanol Cyclohexene</p> <p>Which of the two reactions is in greater agreement (conforms more) with the atom economy principle of green chemistry?</p>	2
	e)	25 ml of sewage water sample is mixed with 25 ml of K ₂ Cr ₂ O ₇ solution and the unreacted K ₂ Cr ₂ O ₇ consumed 9 ml of 0.25N FAS to give the colour change with ferroin indicator. Under similar conditions, in blank titration 15ml of FAS is used up. Calculate the COD (Chemical Oxygen Demand) of the sample in mg/L (ppm).	3