Enrolment No:	UPES

Course: CHEM-1001 (Chemistry) (End Semester Examination)
Programme: B.Tech. APE-Gas, ASE, ASE+AVE, Chemical, ECE, PSE, EL, CS-CSF, CS-IFM, BFSI, CS-ERA, CS-BAO, CS-DevOps **Semester: I (2017-18)**
Time: 3 hrs. **Max. Marks:100**

Instructions: Read all the below mentioned instructions carefully and follow them strictly

1) Write your **Enrolment No**. at the top of the question paper
2) Do not write anything else on the question paper except your roll number
3) **ATTEMPT ALL THE PARTS OF A QUESTION AT ONE PLACE ONLY**
4) **Internal choice is given for question number 12**
5) CO1, CO2, CO3, CO4 & CO5 mentioned in the last column stand for course outcomes and are for official use only

Section - A (Attempt all **FIVE** Questions)

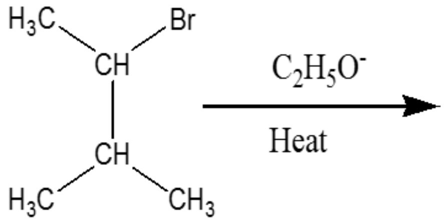
1.	From the given molar conductivities at infinite dilution, determine the value of λ_m^∞ for NH_4OH. λ_m^∞ for $Ba(OH)_2$ = 457.6 ohm^{-1}cm^{2}mol^{-1}; λ_m^∞ for $Ba(Cl)_2$ = 240.6 ohm^{-1}cm^{2}mol^{-1}; λ_m^∞ for NH_4Cl = 129.8 ohm^{-1}cm^{2}mol^{-1}.	**[4]**	**CO3**
2.	Standard reduction electrode potential of four metals A, B, C and D are -1.2V, +0.5V, 0.0V and -3.0V, respectively. Arrange these metals in the order of their **decreasing reducing power**, explaining with suitable reason.	**[4]**	**CO3**
3.	Gives **four examples** of each **polar** and **non-polar** solvents used for nucleophilic substitution (SN) reaction.	**[2+2]**	**CO4**
4.	Classify the following species into electrophiles and nucleophiles: BH_3, NH_3, CN^-, Cl^+, R-Mg-X, CH_3^+, SO_3 and HSO_4^-.	**[4]**	**CO4**
5.	A protein sample is containing **an equimolar mixture** of haemoglobin (M=15.5 kg/mol), ribonuclease (M=13.7 kg/mol) and myoglobin (M =17.2 kg/mol). Find out the number average and mass average molecular weight of the polymer in **gm/mole**.	**[2+2]**	**CO5**

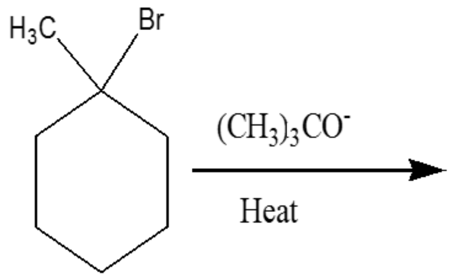
SECTION - B (Attempt all **FIVE** Questions)

6.	Describe the proximate analysis by drawing a **neat sketch only**. **Mention each term and analysis temperature** used on the figure. A sample of maize waste powder was analyzed by proximate analysis by a chemical student of UPES in the chemistry lab. The observed results were as follows: Moisture content 12%; volatile content 18%. If the initial weight of the samples was 0.80 gm, find out the amount of moisture content (**in gm**), volatile content (**in gm**), carbon content (**in gm**) and ash content (**in %**) content, provided that at the end of the experiment the residual ash was found to be 80.0 mg.	**[4+4]**	**CO1**
7.	Write down the expression of the rate constant for **second and third order** reaction (involving a single type of reactant) mentioning **all the terms** used. Draw the **trend of graph** for second and third order reaction in such a way so that a straight line having **positive slope** is obtained. What information can you draw from the slope and intercept of each graph?	**[2+4+2]**	**CO2**

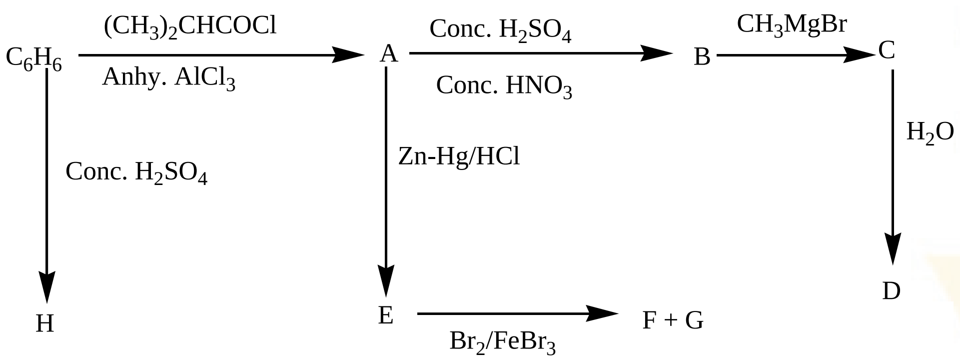
<table>
<tr><td>8.</td><td>(a) Discuss the nature of different oxide layers formed on the surface of metal during corrosion giving examples along with suitable diagram.

(b) $Cu^{2+}_{(aq)} + 2e^{-} \rightarrow Cu_{(s)}$, $E^{o} = +0.340$ V; $Cu^{+}_{(aq)} + e^{-} \rightarrow Cu_{(s)}$, $E^{o} = +0.522$ V. Find out the value of E^{o} for $Cu^{2+}_{(aq)} + e^{-} \rightarrow Cu^{+}_{(aq)}$</td><td>[5+3]</td><td>CO3</td></tr>
<tr><td>9.</td><td>Draw the structure of the possible compounds from the following reactions mentioning the name and type of the reaction involved:

(a) 

(b) 

(C) Arrange the following carbocations in order of increasing stability:
$C_6H_5CH_2^+$, $(C_6H_5)_2CH^+$, $(CH_3)_3C^+$, $(CH_3)_2CH^+$, $CH_3CH_2^+$, CH_3^+</td><td>[3+3+2]</td><td>CO4</td></tr>
<tr><td>10.</td><td>Discuss in detail the method of preparation of nanoparticles using sol gel method by drawing a suitable sketch.</td><td>[4+4]</td><td>CO5</td></tr>
<tr><td colspan="4">SECTION - C
(Question No. 11 is Compulsory; Attempt any one from question numbers 12A & 12B)</td></tr>
<tr><td>11.</td><td>i. In the moving boundary method, a current of 25mA was passed for 10 minutes. If the radius of the vertical cell is 3mm, calculate the distance moved (in mm) by H^+ in a solution of concentration 0.05 gm eq/litre. Given that t_{H+} is 0.8292.</td><td>8</td><td>CO3</td></tr>
<tr><td></td><td>ii. Identify the (A) to (H) in the given reaction sequence, mentioning the name of the reaction involved:


</td><td>8</td><td>CO4</td></tr>
<tr><td></td><td>iii. A diffraction of X-rays for a first order reflection from a certain set of crystal planes occurs at an angle of 21.8° from the planes. Another set of same crystal planes under the same condition shows diffraction at an angle of 10.8^{0}. If the interplanar distance of the crystal in the later condition is 4.1nm, find out the interplanar distance in the first condition.</td><td>4</td><td>CO5</td></tr>
</table>

12A.	**i.**	What are different methods to improve the octane number of a fuel? How does isomerisation help in improving fuel quality?	**4+4**	**CO1**
	ii.	In chemistry, determination of the activation energy is an important parameter of any type of chemical reaction. Write down Arrhenius equation for the determination of activation energy. Mention the terms used in the equation. A biomass conversion reaction occurs at 25^0C with a rate constant k. If the same reaction is carried out at 40^0C, the observed rate constant was 4k. Find out the activation energy of the reaction in Kj/mole.	**1+1+6**	**CO2**
	iii.	Classification of polymers can be done in various ways. Discuss the classification of the polymers based on their thermal response.	**4**	**CO5**
12B.	**i.**	Explain the principle of fractional distillation. Arrange various fractions obtained during fractional distillation of crude oil in an increasing order of their boiling points using a suitable diagram	**2+6**	**CO1**
	ii.	Discuss the kinetics of a first order consecutive reaction of following type. $A \xrightarrow{k_1} B \xrightarrow{k_2} C$	**8**	**CO2**
	iii.	Write down the reaction for the formation of urea formaldehyde polymer. Which type of polymerisation reaction is this?	**3+1**	**CO5**

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Semester: I (2017-18)

Time: 03 hrs.

Max. Marks:100

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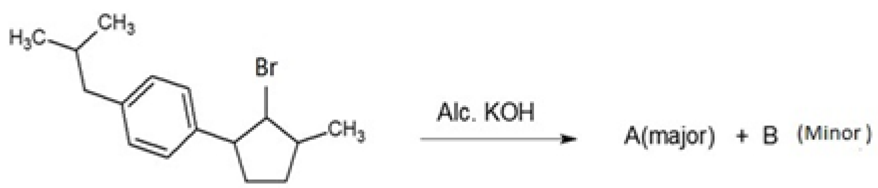
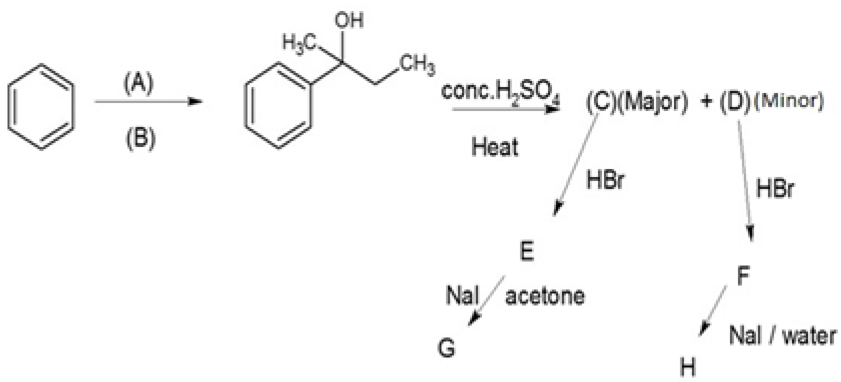
	Section - A (Attempt all **FIVE** Questions**)**		
1.	At 291K, the conductivity of saturated solution of $ZnCl_2$ is $3.86\times10^{-5}Scm^{-1}$ and that of water used for solution is $0.15\times10^{-5}Scm^{-1}$. The ionic conductances of Zn^{+2} and Cl^- at infinite dilution are 51.0 and $47.0 Scm^2 eq.^{-1}$, respectively. Calculate the solubility of $ZnCl_2$ in solution.	**[4]**	**CO3**
2.	Complete the following reaction with mechanism: 	**[4]**	**CO4**
3.	Solutions of two electrolytes ‘C’ and ‘D’ are diluted. The molar conductance of D increases 2.0 times while that of C increases 30 times. Which of the two is a stronger electrolyte? Justify your answer.	**[4]**	**CO3**
4.	Explain the effect of solvent on nucleophilic substitution reactions.	**[4]**	**CO4**
5.	Classify the polymers on the basis of chemical structure (type of monomeric unit used).	**[4]**	**CO5**
	SECTION - B (Attempt all **FIVE** Questions)		
6.	Calculate the bond energy of $C \equiv C$ in C_2H_2 from the following data: (i) $C_2H_2(g) + 5/2\ O_2\ (g) \rightarrow 2CO_2\ (g) + H_2O; \Delta H = -310$ Kcal (ii) $C(s) + O_2(g) \rightarrow CO_2\ (g); \Delta H = -94$ Kcal (iii) $H_2(g) + ½\ O_2\ (g) \rightarrow H_2O\ (g); \Delta H = -68$ Kcal Bond energy of C- H bonds = 99 Kcal Heat of sublimation of C = 171 Kcal and bond energy of H-H = 52 Kcal	**[8]**	**CO1**

7.	(i) The Kp for the reaction $N_2O_4 \leftrightarrow 2NO_2$ is 640 mm at 775K. Calculate the percentage dissociation of N_2O_4 at equilibrium pressure of 160 mm. (ii) For a homogeneous gaseous reaction, $A \rightarrow B + C + D$, the initial pressure was P_o while pressure after time 't' was P. Derive an expression for rate constant K in terms of P_o, P and t, assuming it to be a first order reaction.	**[8]**	**CO2**
8.	A solution of $CuSO_4$ was electrolyzed between copper electrodes. Before electrolysis, 10.09g of the solution contained 0.01790g of $CuSO_4$. After the experiment, 20.12g of the anodic solution contained 0.06230g of $CuSO_4$. At the same time, 0.011894g of copper was deposited in the copper coulometer placed in series. Calculate the transport numbers of Cu^{2+} and SO_4^{2-} ions. (Cu=63.5, O=16 and S=32)	**[8]**	**CO3**
9.	Identify all the missing reagents / products / reactants in the given sequence of reaction. Also give the mechanism for each step.  	**[8]**	**CO4**
10.	Discuss important applications of nanomaterials in daily life.	**[8]**	**CO5**
	SECTION - C **(Question No. 11 is Compulsory; Attempt any one from question numbers 12A & 12B)**		
11.	i. (a) Discuss the formation of various types of films prepared by chlorine with tin and silver. (b) What is the most dangerous form of corrosion? Justify. ii. Discuss the following: (a) Addition of chlorine to cis-2-butene produces racemic mixture as product. (b) Partial racemisation is achieved in SN_1 reaction. iii. How can we get the nanoparticles of ZnO by micro-emulsion method?	**[8+8 +4]**	**CO3 CO4 CO5**
12A.	i. 2.56g coal sample was weighed in a silica crucible. The weight of the silica crucible is 20g. After heating for an hour at 105°C, the residue weighed 2.18g. The crucible was covered with a lid and heated to 7 min at 950°C. The residue weighed 1.628g. The crucible was then heated without lid at 725°C and weight of silica crucible was found to be 20.265g. Calculate the percentage of moisture, volatile content, ash and fixed carbon content in the sample. ii. In Arrhenius's equation for a certain reaction, the value of A and E (activation energy) are 4×10^{13} s^{-1} and 98.6 kj/mol respectively. If the reaction is of first order, at what temperature will its half-life period be 10minutes?	**[8+8 +4]**	**CO1 CO2 CO5**

	iii.	Give two examples each of addition polymerization and condensation polymerization.		
12B.	i. ii. iii.	(a) What are various processes to enhance the quality of petrol? Explain any two. (b) Why are corrections required for bomb calorimeter for estimation of HCV? Discuss types of corrections. In a consecutive reaction $A \rightarrow B \rightarrow C$ with rate constant k_1 and k_2, derive an expression for $[B]_{max.}$ Discuss how does vulcanization help in improving the quality of natural rubber.	**[8+8 +4]**	**CO1 CO2 CO5**