


Name:			
Enrolment No:			
<b>UPES</b> <b>End Semester Examination, May 2024</b> <b>Course: Engineering Thermodynamics</b> <b>Semester : 2<sup>nd</sup></b> <b>Program: B.Tech Biomedical Engineering/Biotechnology/Food Technology</b> <b>Duration : 3 Hours</b> <b>Course Code: MECH1013</b> <span style="float: right;"><b>Max. Marks: 100</b></span>			
<b>Instructions: Attempt all the questions</b>			
S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q1	The purpose of catalysts is to reduce the activation energy of for product formation. Is this statement true or false?	1.5	CO4
Q2	Define homogeneous catalysis.	1.5	CO4
Q3	The fugacity is equal to the pressure in case of ideal gases. Is this statement true or false?	1.5	CO2
Q4	Which of the following is true for molecularity and order of a reaction?  a. molecularity and order of a reaction can be fractional values b. molecularity and order of a reaction are both related to collisions among molecules c. molecularity and order of a reaction can both be zero d. molecularity and order of a reaction can both have a value of one	1.5	CO3
Q5	Molecularity of a complex reaction is always governed by the slow reaction. Is this statement true or false?	1.5	CO3
Q6	Define a thermodynamic system and surrounding.	1.5	CO1

<b>Q7</b>	All spontaneous thermodynamic processes are characterized by negative Gibb's free energy. Is this statement true or false?	<b>1.5</b>	<b>CO1</b>
<b>Q8</b>	Increasing the reactant surface area results in an increase in the rate of reaction. Is this statement true or false?	<b>1.5</b>	<b>CO3</b>
<b>Q9</b>	Collision theory of chemical reaction is based on classical hard sphere model. Is this statement true or false?	<b>1.5</b>	<b>CO3</b>
<b>Q10</b>	Catalysts increase the rate of reaction without taking part in the reaction. Is this statement true or false?	<b>1.5</b>	<b>CO4</b>
<b>Q11</b>	Refrigeration process works on the principle of heat engine. Is this statement true or false?	<b>1.5</b>	<b>CO1</b>
<b>Q12</b>	Proteins are not responsible for providing structural integrity to cell membrane. Is this statement true or false?	<b>1.5</b>	<b>CO2</b>
<b>Q13</b>	Give the mathematical relationship highlighting Fick's second law of diffusion.	<b>1.5</b>	<b>CO2</b>
<b>Q14</b>	The sodium-glucose transporter is an antiport. Is this statement true or false?	<b>1.5</b>	<b>CO2</b>
<b>Q15</b>	Secondary active transport require energy from electrochemical gradient. Is this statement true or false?	<b>1.5</b>	<b>CO2</b>
<b>Q16</b>	A successful chemical reaction is determined by the orientation of reactants. Is this statement true or false?	<b>1.5</b>	<b>CO3</b>
<b>Q17</b>	Biochemical reactions can be accurately described by the classical theory. Is this statement true or false?	<b>1.5</b>	<b>CO3</b>
<b>Q18</b>	On which principle is the 1 <sup>st</sup> law of thermodynamics based?	<b>1.5</b>	<b>CO1</b>
<b>Q19</b>	Passive transport occurs against the concentration gradient. Is this statement true or false?	<b>1.5</b>	<b>CO2</b>
<b>Q20</b>	Isochoric processes are characterized by a constant pressure. Is this statement true or false?	<b>1.5</b>	<b>CO1</b>
<b>Section B</b> <b>(4Qx5M=20 Marks)</b>			
<b>Q 1</b>	Explain the various gas laws and derive an expression of the ideal gas behavior.	<b>5</b>	<b>CO1</b>
<b>Q2</b>	Discuss why transition state theory is more efficient than collision theory for explaining reaction kinetics.	<b>5</b>	<b>CO3</b>

<b>Q3</b>	Describe homogeneous and heterogeneous catalysis with suitable examples.	<b>5</b>	<b>CO4</b>
<b>Q4</b>	(a) What is the change in internal energy of 5 moles of monoatomic Ar <sub>(g)</sub> if its temperature is increased by 40°C?  (b) If the gas is heated to 200 J, how much work is being done on the system? If temperature now increases to 70°C, what is the entropy of the system?	<b>5</b>	<b>CO1</b>
<b>Section C</b> <b>(2Qx15M=30 Marks)</b>			
<b>Q 1</b>	Explain the refrigeration process in detail with the help of a suitable diagram.	<b>15</b>	<b>CO1</b>
<b>Q2</b>	(a) Define fugacity. Estimate the fugacity coefficient if N <sub>2</sub> gas exhibits fugacity of 97.03 atm at temperature and pressure of 0°C and 100 atm respectively.  (b) Estimate the Gibb's free energy change involved during the active transport of Na <sup>+</sup> ions across the cell membrane, provided the outside and inside concentrations are 150 mM and 10 mM respectively. Assume the membrane potential to be 60 mV.	<b>15</b>	<b>CO2</b>
<b>Section D</b> <b>(2Qx10M=20 Marks)</b>			
<b>Q 1</b>	Discuss the various types of passive transport involved in biological membranes. Describe the governing mechanism of passive transport.	<b>10</b>	<b>CO2</b>
<b>Q2</b>	For the reaction $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$ , calculate the following:  1. Express the rate of reaction in terms of the reactants and product using both mass action law and differential forms.  2. At a particular instant if [NO] is decreasing at 0.5 mol/L/s, what is the rate of formation of NO <sub>2</sub> at that instant?	<b>10</b>	<b>CO3</b>