



School of Advanced Sciences

Department of Chemistry

Fall Semester 2022-23

Continuous Assessment Test - II

Course Code : BCHY101L

Duration: 90 Minutes

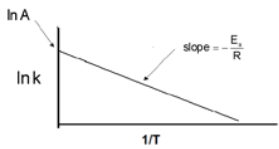
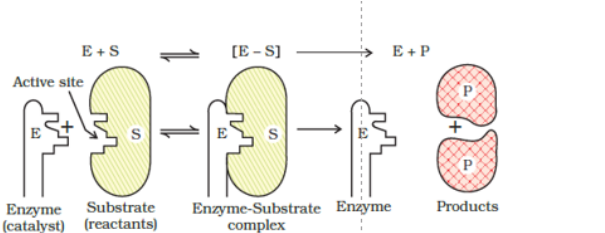
Max. Marks : 50

Course Name : Engineering Chemistry

Slot : D2

Note: Students are allowed to carry their self-hand written note book/ any other printed material/ textbook to the examination.

Q. No.	Answer <u>ALL</u> the questions (5 X 10 = 50 Marks)	Marks	CO	BL
1	<p>Derive the net work done by a gas in a theoretical engine cycle proposed by Sadi Carnot. Besides, if the efficiency of such engine with a hot reservoir of 320 °Celsius is 30%, what is the temperature of the cold reservoir?</p> $W_I = R T_2 \ln \frac{V_b}{V_a} \quad W_{II} = -C_v (T_1 - T_2) \quad W_{III} = R T_1 \ln \frac{V_d}{V_c} \quad W_{IV} = C_v (T_1 - T_2)$ $\text{Total work done} = R T_2 \ln \frac{V_b}{V_a} - C_v (T_1 - T_2) + R T_1 \ln \frac{V_d}{V_c} + C_v (T_1 - T_2)$ $\text{Total } W = R T_2 \ln \frac{V_b}{V_a} + R T_1 \ln \frac{V_d}{V_c}$ <p>Ans: $\eta = 1 - (T_c / T_h)$ $0.3 = 1 - (T_c / 593)$ $T_c = 415\text{K} (143^\circ\text{C})$</p>	10	CO1	BT3
2	<p>a) When 5 moles of an ideal gas expands reversibly and isothermally from 10 L to 100 L at 303K, calculate its entropy change.</p> <p>Ans: $\Delta S = 2.303nR \log(V_2/V_1)$ $\Delta S = 2.303 \times 5 \times 8.314 \log(100/10) = 95.7 \text{ JK}^{-1}$</p> <p>b) List out the necessary experimental data required to evaluate the activation energy. Which equation is applicable to calculate it showing the appropriate plot?</p>	5 + 5	CO2	BT2

	<div style="border: 1px solid black; padding: 10px;"> $\ln K = \ln A - \frac{E_a}{RT}$ <p>where, A is the pre-exponential factor and E_a is the activation energy.</p> <ul style="list-style-type: none"> ◆ A plot of $\ln k$ against $1/T$ is a straight line when the reaction follows the behaviour described by the Arrhenius equation. ◆ The higher the activation energy, the stronger the temperature dependence of the rate constant (i.e., the steeper the slope). ◆ If a reaction has zero activation energy, its rate is independent of temperature. $\ln(k) = -\frac{E_a}{RT} + \ln A$ $y = mx + b$  <p>If we plot the graph $\ln k$ vs $1/T$, we will get the value of A from the intercept at infinite T (i.e., $1/T=0$) and the value of E_a from the slope.</p> </div>			
3	<p>a) Substrate specificity is the distinctive feature of the biocatalysis. Write the significance and mechanism of this catalysis with a rate equation.</p> <div style="border: 1px solid black; padding: 10px;">  <p style="text-align: center;"> $E + S \xrightleftharpoons{K_1} ES \xrightleftharpoons{K_2} P + E$ </p> <p> P = Product S = Substrate/Reactant E = Enzyme ES = Enzyme Substrate complex </p> $V = \frac{V_m [S]}{K_m + [S]}$ <p> V = velocity of a reaction V_m = Maximum velocity </p> $K_m = \frac{K_2 + K_1}{K_1}$ <p>K_m = Michaelis Menten constant</p> </div> <p>b) Could Grätzel cells be an alternative to conventional photovoltaic technology? Explain. Ans: Draw the setup and compare with the conventional one</p>	5 + 5	CO3	BT1
4	<p>a) This component can be connected to batteries to regulate the power they supply and also considered as electrical equivalents of flywheels in machines. Find out this component mentioning its function and differentiate with batteries. Ans: Supercapacitors – Function and comparison with batteries</p> <p>b) Show that the ‘pulling from the melt’ method provides high-pure semiconducting materials with a neat diagram. Ans: Single crystal growth of silicon Czochralski Technique - with a neat diagram</p>	5 + 5	CO3	BT6
5	This storage device made its way from cell phones and laptops to	10	CO5	BT2



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	<p>automobiles, and this budding power system intakes gaseous small molecules to give away electricity. Identify both energy devices and brief about them with appropriate cell reaction.</p> <p>Ans: Li-ion secondary battery and Hydrogen-oxygen Fuel cells</p>			
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