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**COURSE: CHM210 (PHYSICAL CHEMISTRY)**

**DEPARTMENT: BIOCHEMISTRY**

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 **QUESTIONS/ANSWERS**

1. Activation energy, isthe minimum amount of energy that is required to activate atoms or molecules to a condition in which they can undergo chemical transformation or physical transport

2. k = Ae-Ea/RT

k is the rate constant (frequency of collisions resulting in a reaction),

T is the absolute temperature (in kelvins),

A is the pre-exponential factor, a constant for each chemical reaction,

*E*a is the activation energy for the reaction (in the same units as *RT*),

R is the universal gas constant.

2b. ln k = -Ea/RT + ln A …………….(i)

 In a graph of activation energy vs rate of reaction, slope = -Ea/R and intercept = ln A.

At temperature T1, equation(i) will be

ln k1 = -Ea/RT1 + ln A …………………(II)

At temperature T2, equation II will be

ln k2 = -Ea/RT2 + ln A …………………(Iii) (k1 and k2 are the rate constants at temperature T1 and T2)

Subtracting equation III from equation Iii, we get

ln k2 – ln k1 = Ea/RT1– Ea/RT2

∴ ln k2/ k1= (Ea/R)[1/T1 – 1/T2]

∴ log k2/ k1= (Ea/2.303R)[(T2– T1)/T1T2]

2b. (ii) Temperature Dependence of the Rate Constant: Increasing the temperature of a reaction generally speeds up the process (increases the rate) because the rate constant increases according to the Arrhenius Equation. Rate (M s-1) = k [A]x[B]y k = Ae -Ea/RT As T increases, the value of the exponential part of the equation becomes less negative thus increasing the value of k.

3.

|  |  |  |  |
| --- | --- | --- | --- |
| T(K) | K(S-1) × 10-5 | In K | $\frac{1}{T}$ ($\frac{1}{K})$ |
| 298 | 1.74 | -10.96 | 0.0033 |
| 308 | 6.61 | -9.62 | 0.0032 |
| 318 | 2.51 | -10.59 | 0.0031 |
| 328 | 7.59 | -9.49 | 0.0030 |
| 339 | 2.40 | -10.64 | 0.0029 |

The activation energy can be calculated from the slope = -Ea/R. The value of the slope is -770x – 7.873 so:

-770x-7.873 = -Ea/8.314

Ea = 640.18x – 6.55 J/mol