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**Assignment Title:** Activation Energy

**Course Title:** Physical Chemistry I

**Course Code:** CHM 210

What is activation energy?

2. (a) Write the Arrhenius equation and define all terms

   (b) Use the Arrhenius equation to show why the rate constant of a reaction (i) decreases with increasing activation energy and (ii) increases with increasing temperature

3. Variation of the rate constant with temperature for the first order reaction

N2O5(g) → N2O4(g) + O2(g)

is given in the following table. Determine graphically the activation energy for the reaction.

|  |  |
| --- | --- |
| T (K) | K (s-1) x 10-5 |
| 298 | 1.74 |
| 308 | 6.61 |
| 318 | 2.51 |
| 328 | 7.59 |
| 338 | 2.40 |

1)Activation energy is the minimum quantity of energy which the reacting species must possess in order to undergo a specified reaction.

2) K=Ae -Ea/Rt

K= the rate constant

A= pre exponential

Ea = activation energy

R= the constant

T= the temperature

Bi) The exponential term in the Arrhenius equation implies that the rate constant of a reaction decreases exponentially when the activation energy increases because the rate of reaction is directly proportional to the rate of reaction , the rate decreases exponentially as well. Because a reaction with high activation energy requires a lot of energy to reach the transition stage . it proceeds slower than a reaction with a larger activation energy.

|  |  |
| --- | --- |
| ln K | 1/T |
| -0.9 | 3.356x10-3 |
| -9.6 | 3.247x10-3 |
| -10.5 | 3.145x10-3 |
| -9.4 | 3.049x10-3 |
| -10.6 | 3.959x10-3 |

ii) The Arrhenius equation can be used to determine the effect of change of temperature on the rate constant and on the rate reaction. For a temperature change of 200-300 the frequency factor is approximately constant but the quantity exp -Ea/Rt, the fraction of molecules with energies to or in excess of the activation energy. With an activation energy of 50kg/mol at 200 will give 1.21x10-9 therefore the rate reaction will be nearly doubled due to the increase in temperature by 100

