The Effect of Temperature on Rates of Reaction.

There is a significant relationship between the rate of chemical reaction and the temperature at which the reaction takes place. For homogeneous reaction, it is usually found that the velocity Constant of the reaction is approximately doubled for every ten degree rise in temperature. and the relationship can be represented by the equation

$$k = A \exp\left(-\frac{E}{RT}\right)$$

which is the 'Arrhenius Equation' where:.

k is the velocity Constant; R = the gas Constant, E = the activation energy of the reaction. A = the frequency factor.

* The Arrhenius equation can be applied successfully to many homogeneous gas reaction, to reactions in Solution and to heterogeneous reaction and can be used in several forms such as:.

$$\ln k = \ln A - \frac{E}{RT} \quad *$$

A graph plotted of ln k against $\frac{1}{T}$ gives a straight line from whose slope E can be determined.

Differentiating * with respect to temperature gives.

$$\frac{d \ln k}{dT} = \frac{E}{RT^2} \quad \circledast$$ as A is a constant. and the greater the activation energy of a reaction, the greater will be increase of reaction rate with temperature

* The relationship between the equilibrium Constant and temperature in the Van't Hoff isochore has a form similar to ⊛. and it was Vant Hoff who first argued that the logarithm of the velocity Constant should bear a linear relationship to the reciprocal of the absolute temperature. Arrhenius extended this argument and interpreted by suggesting that reactant molecules must be "activated" by acquiring an extra energy E, the activation energy of the reaction before the Could react.

Ex: The Thermal decomposition of hydrogen iodide

$$2HI = H_2 + I_2$$

calculate the raise in reaction rate when the temperature raised by $100\,C°$.

Given: $E = 180\,kJ$; $T = 27\,C°$

Ans: $T_1 = 27 + 273 = 300\,k$

$T_2 = 127 + 273 = 400\,k$; $Rate \propto \exp\left(\frac{-E}{RT}\right)$

$$Rate \propto \exp\left(\frac{-180{,}000}{2494}\right)$$

if the temperature was raised by $100\,c°$ the rate would then be

$$rate_{400} \propto \exp\left(\frac{-180{,}000}{3326}\right)$$

This means that raising the Temperature by $100\,c°$ will raise the reaction rate by a factor of

$$\frac{rate_{400}}{rate_{300}} = \exp\left(-\frac{180{,}000}{3326} + \frac{180{,}000}{2494}\right) = 6.9 \times 10^{7}$$

Ex: The following table described the values of Constant velocity for leaching process of galena in hydrated media Contains Ammonium acetate at different temperatures:- *

$\log k$ $(cal^2/cm^4.min)$	-10	-11.1	-11.2	-11.5	-12.1	-12.6
$\left(\frac{1}{T}\right) * 10^3$ (k)	2.3	2.35	2.38	2.45	2.61	2.75

Calculate the activation energy of leaching process.

* عملية الترشيح لكالينا بوسط مائي يحتوي على اسيتات الأمونيوم.