Edexcel International Chemistry A Level

CP10 - Finding the Activation Energy of a Reaction

(A Level only)

Flashcards

What equation links the rate constant and temperature?

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Arrhenius equation:

$$k = Ae^{\frac{-Ea}{RT}}$$

k - rate constant

A - pre-exponential factor

Ea - activation energy ($J\ mol^{-1}$)

R - gas constant

T - temperature (K)

e - mathematical quantity (≈ 2.71828…)

What is the inverse of e^x?

What is the inverse of e?

ln(x)

How is temperature converted from celsius to kelvin?

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Temperature in kelvin = temperature in celsius + 273

How can the gradient of an Arrhenius plot be calculated?

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An Arrhenius plot is a straight line graph so:

$$\text{Gradient} = \frac{\text{change in y}}{\text{change in x}}$$

Rearrange the Arrhenius equation into its logarithmic form

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$$k = Ae^{\frac{-Ea}{RT}}$$

$$\ln(k) = \ln\left(Ae^{\frac{-Ea}{RT}}\right)$$

$$\ln(k) = \ln(A) - \frac{Ea}{RT}$$

ln(k) is plotted against 1/T. What are the gradient and y intercept equal to?

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Gradient = -Ea/R

y intercept = ln(A)

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$$-\frac{Ea}{R} = -9.1 \times 10^3$$

$$Ea = -(9.1 \times 10^3) \times -8.3145$$

$$Ea = 75662 \text{ Jmol}^{-1}$$

$$Ea = 75.7 \text{ kJ mol}^{-1}$$

The y intercept of an Arrhenius plot is -0.7. Calculate A.

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$\ln A = -0.7$

$A = e^{-0.7}$

$A = 0.5$

How can the activation energy of a reaction be calculated?

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- Measure the initial rate of a reaction (1/t). Measure the temperature.
- Calculate the rate constant (k).
- Plot a graph of 1/T against ln(k).
- Calculate the gradient of the graph. From the logarithmic Arrhenius equation - multiply the gradient by the negative gas constant (-R) to find the activation energy (Ea).

The rate constant is proportional to 1/t and can be thought of as being a ratio of c, concentration of phenol, to t, time taken for the reaction to finish. If we substitute: k = c/t what does our modified form of the Arrhenius equation look like?

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$$\ln(t) = \ln c - \ln A + E_a /RT.$$

If we plot ln(t) against 1/T from our modified arrhenius equation how do we find E_a?

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Plotting ln(t) against 1/T should produce a straight graph, with gradient E_a/R. This allows the activation energy to be found, as R is a constant (8.31 J K^{-1} mol^{-1}).