Essential Pre-Uni Chemistry M3.1

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

Part A y-intercept

On a plot of $\ln(k)$ against $\frac{1}{T}$, what is the y-intercept?

The following symbols may be useful: `A`, `E_A`, `R`, `T`, `k`

Part B Units of gradient

Give the units of the gradient of an Arrhenius plot.

- $^{\circ}\mathrm{C}$
- $\mathrm{K\,m^{-2}}$
- $\mathrm{N\,dm^{-3}}$
- K

Part C Gradient

On a plot of $\ln(k)$ against $\frac{1}{T}$, what is the gradient?

The following symbols may be useful: `A`, `E_A`, `R`, `T`, `k`

Essential Pre-Uni Chemistry M3.2

A Level

$$k = A\mathrm{e}^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

Part A Activation energy

If the gradient of an Arrhenius plot is $-1203\,\mathrm{K}$, find the activation energy. Use $R = 8.3145\,\mathrm{J\,mol^{-1}\,K^{-1}}$.

Part B Activation energy II

If the gradient of an Arrhenius plot is $-4250\,\mathrm{K}$, find the activation energy. Give your answer to 3 significant figures.

Part C Gradient of Arrhenius plot

If a reaction has activation energy of $16.5\,\mathrm{kJ\,mol^{-1}}$, find the expected gradient of an Arrhenius plot.

Part D y-intercept

The pre-exponential factor, A, is found to have a value of $0.6\,\mathrm{s}^{-1}$ for a first-order reaction. Calculate the expected y-intercept of an Arrhenius plot.

Essential Pre-Uni Chemistry M3.3

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

Part A A for a first-order reaction

The y-intercept of an Arrhenius plot for a first-order reaction is at -2.30. Find the pre-exponential factor, A, according to the Arrhenius model.

Part B A for a second-order reaction

The y-intercept of an Arrhenius plot for a second-order reaction is at 3.20. Find the pre-exponential factor, A, according to the Arrhenius model.

Essential Pre-Uni Chemistry M3.4

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

Part A Activation energy

The rate constant, k, for a first-order reaction is found to be $0.0250\,\mathrm{s}^{-1}$ at $290\,\mathrm{K}$. If the pre-exponential factor is $26.0\,\mathrm{s}^{-1}$, find the activation energy.

Part B Pre-exponential factor A

The rate constant, k, for a second-order reaction is found to be $0.050\,\mathrm{dm}^3\,\mathrm{mol}^{-1}\,\mathrm{s}^{-1}$ at $300\,\mathrm{K}$. If the activation energy is $2.50\,\mathrm{kJ\,mol}^{-1}$, find the value of the pre-exponential factor, A.

Essential Pre-Uni Chemistry M3.5

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

A first-order reaction has pre-exponential factor $8.0\,\mathrm{s}^{-1}$ and activation energy $4.8\,\mathrm{kJ\,mol}^{-1}$. Find the rate constant at:

Part A $290\,\mathrm{K}$

$290\,\mathrm{K}$

Part B $900\,\mathrm{K}$

$900\,\mathrm{K}$

Essential Pre-Uni Chemistry M3.6

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

If a reaction has activation energy $14.0\,\mathrm{kJ\,mol^{-1}}$, and a pre-exponential factor of $120\,\mathrm{s^{-1}}$, find the temperature at which the rate constant is equal to $2.00\,\mathrm{s^{-1}}$.

Essential Pre-Uni Chemistry M3.7

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

A reaction is found to have a rate constant of $1.25 \times 10^{-3}\,\mathrm{dm^6\,mol^{-2}\,s^{-1}}$ at $400\,\mathrm{K}$ and $1.60 \times 10^{-3}\,\mathrm{dm^6\,mol^{-2}\,s^{-1}}$ at $500\,\mathrm{K}$.

Part A E_A

Find the activation energy.

Part B A

Find the pre-exponential factor, A.

Part C Order of the reaction

Give the overall order of reaction.

Essential Pre-Uni Chemistry M3.8

A Level

$$k = Ae^{-E_A/RT}$$

An Arrhenius plot is a graph of $\ln(k)$ against $\frac{1}{T}$ in K^{-1}.

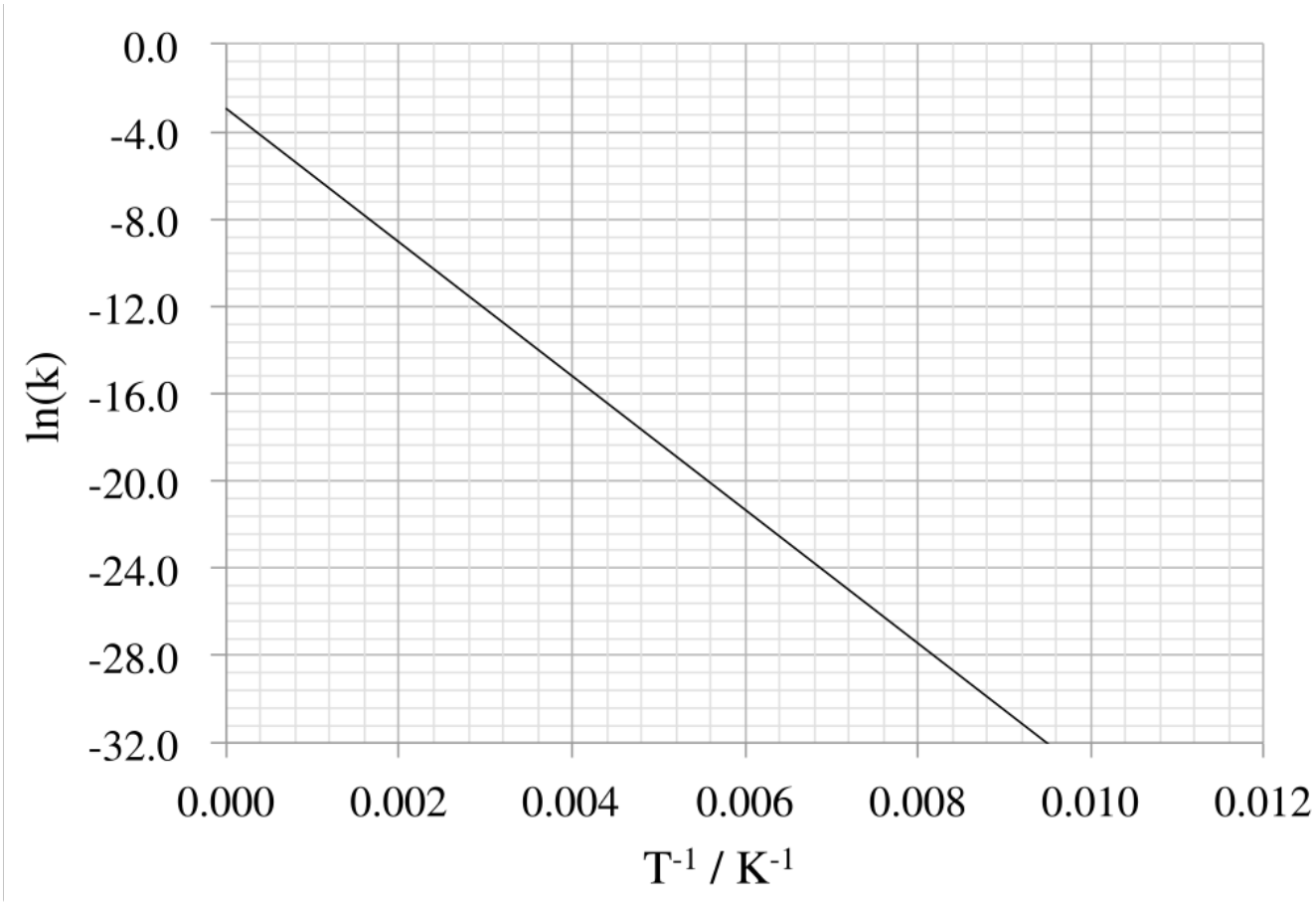

Figure 1: M3.8 Arrhenius Plot

Part A E_A

Using the graph above, find the activation energy. Give your answer to 2 significant figures

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Part B A

Using the graph above, find the pre-exponential factor. Give your answer to 1 significant figure

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Essential Pre-Uni Chemistry M4.1

A Level

The iodination of propanone, $C_3H_6O + I_2 \longrightarrow C_3H_5OI + HI$, when catalysed in aqueous conditions, obeys the rate law:

$$\text{rate} = k[C_3H_6O][HCl]$$

.

Part A Catalyst

Identify the catalyst in this reaction.

Part B Type of catalyst

Is the catalyst homogeneous or heterogeneous?

- homogeneous
- heterogeneous

Part C Concentration of catalyst

If the catalyst has an initial concentration of $0.020\,\mathrm{mol\,dm^{-3}}$, give the concentration of the catalyst when the concentration of propanone has decreased to one quarter of its original value.

Essential Pre-Uni Chemistry M4.6

A Level

Complete the following description of heterogeneous catalysis.

A heterogeneous catalyst works best when it has a large _____ so that many of its _____ are exposed to the reactants. In the first stage, reactants are _____ onto the catalytic surface, weakening internal bonds in the reactant particles. In the second stage, the particles react to form products. The _____ of the slowest step in this reaction is lower than that of the slowest step in the uncatalysed reaction. The third stage is the _____, or release, of product particles from the surface. This _____ the surface ready for further reactions. If the products are not released, or if some contaminant binds to the surface, further catalytic activity is impeded and the catalyst has been _____.

Items:

mass **desorption** **enthalpy change** **rate** **density** **destruction** **poisoned** **absorbed**

regenerates **surface area** **active sites** **volume** **adsorbed** **activation energy** **corroded**