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.

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

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

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

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}.

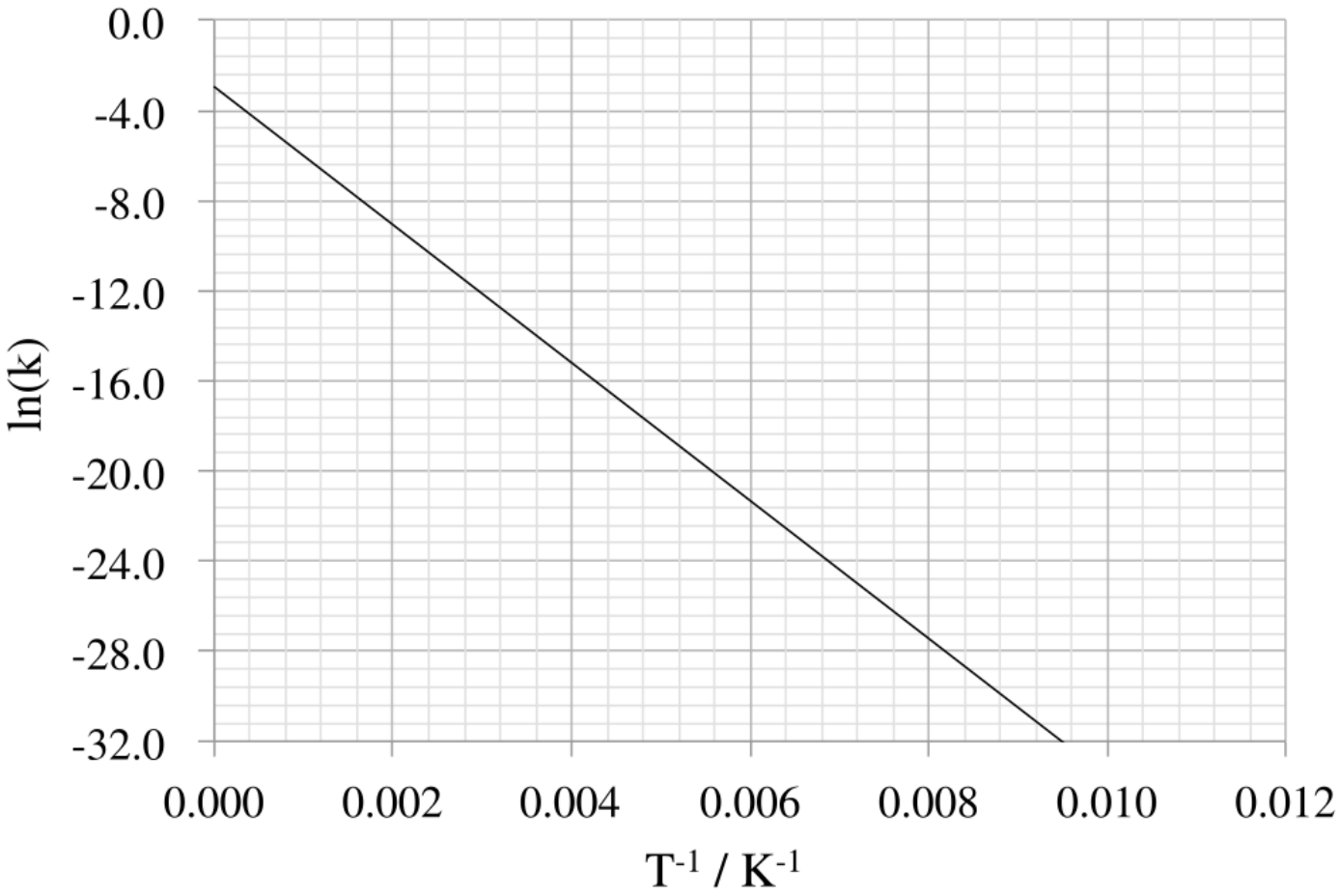

Figure 1

M3.8 Arrhenius Plot

Part A E_A

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

Part B A

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

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

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