WJEC (Wales) Chemistry A-level

Topic 3.5 - Chemical Kinetics

Flashcards

What is meant by ‘rate of reaction’?

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The change in concentration of reactants or products over time.

What is a rate equation?

What is a rate equation?

For a reaction between A and B:

$$\text{Rate} = k[A]^m[B]^n$$

where m and n are integers representing the orders with respect to each reactant, and k is the rate constant.

What is a rate constant?

What is a rate constant?

The constant of proportionality linking the rate of reaction and the concentrations of the reactants raised to the power of their orders in the rate equation.

How do you calculate the units of a rate constant?

How do you calculate the units of a rate constant?

- Rearrange the rate equation to make k the subject.
- Substitute units into the equation.
- Cancel the common units to find the units for k.

Use the example below to find the units of the rate constant, k

$$k = \frac{Rate}{[A][B]^2}$$

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$$k = \frac{Rate}{[A][B]^2}$$

$$k = \frac{\cancel{mol\ dm^{-3}}\ s^{-1}}{\cancel{mol\ dm^{-3}} \times (mol\ dm^{-3})^2} = k = \frac{s^{-1}}{mol^2\ dm^{-6}}$$

$$k = dm^6\ mol^{-2}\ s^{-1}$$

What is meant by the term ‘order of reaction’?

What is meant by the term ‘order of reaction’?

- The order with respect to a reactant is the power to which the concentration of the reactant is raised in the rate equation.
- Overall order of a reaction = the sum of all the individual orders of the reactants.

What do the different orders of reaction mean?

What do the different orders of reaction mean?

- Zero order: if rate $\propto [A]^0$ then the rate of reaction is unaffected by changing [A].
- First order: if rate $\propto [A]^1$ then rate of reaction increases at the same rate as [A] increases.
- Second order: if rate $\propto [A]^2$ then rate will increase by the square of the factor [A] increases by.

What is activation energy?

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The minimum energy required for a particular reaction to occur.

What are some different experimental techniques that allow you to obtain rate data?

What are some different experimental techniques that allow you to obtain rate data?

- Titration.
- Measuring the volume of gas released from a reaction over time.
- Measuring the change in mass of a reactant over time.
- Colorimetry.
- Measuring the time taken for a colour change.

What are the two different method types that can be used to investigate reaction rates?

What are the two different method types that can be used to investigate reaction rates?

Initial-rate method: Experiments are carried out where different initial concentrations of one reagent are used.

Continuous monitoring method: The concentration/volume is continuously monitored so that a concentration or volume time graph can be produced from the data.

What does a rate-concentration graph look like for a zero order reactant?

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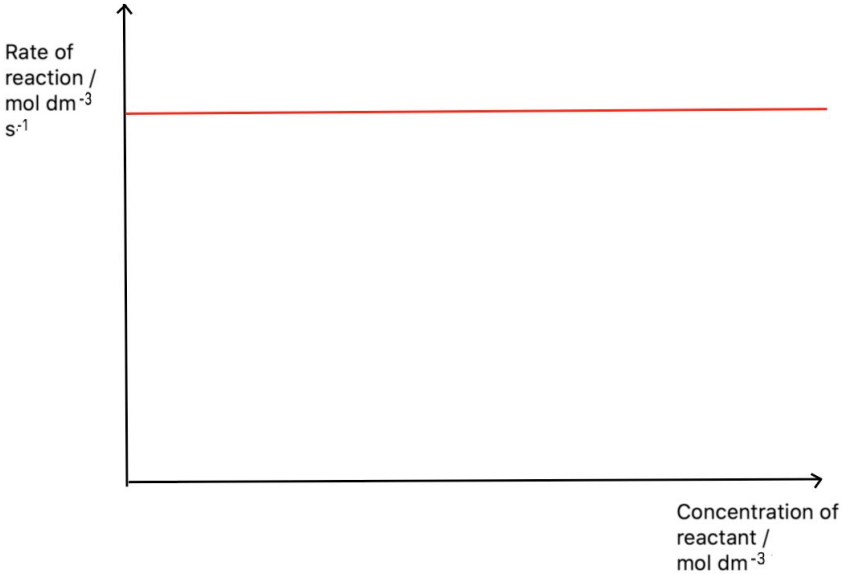

What does a rate-concentration graph look like for a first order reactant?

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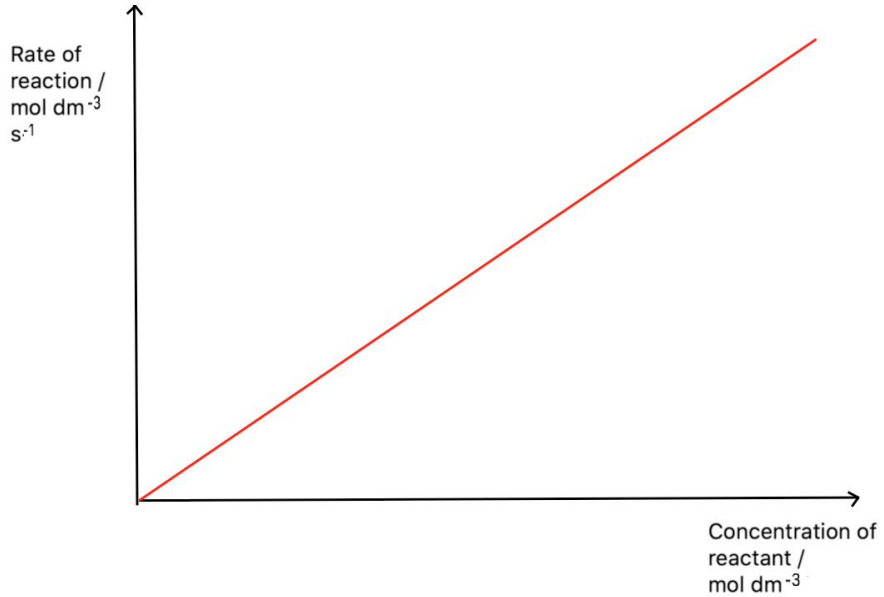

What does a rate-concentration graph look like for a second order reactant?

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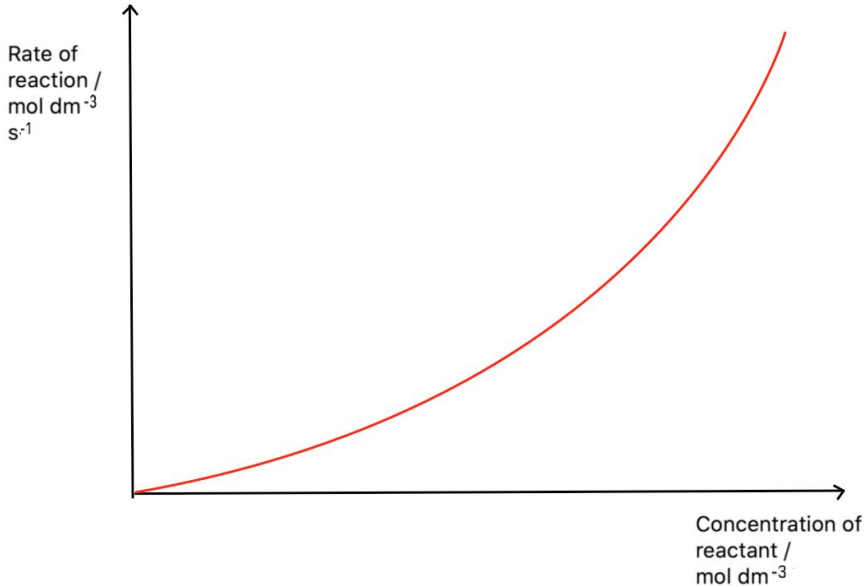

What does a concentration-time graph look like for a zero order reactant?

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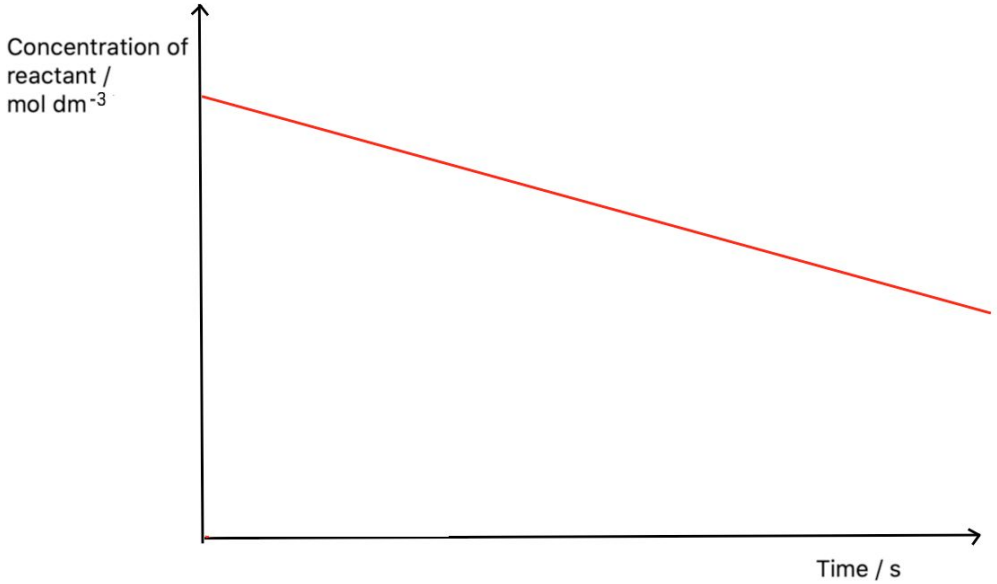

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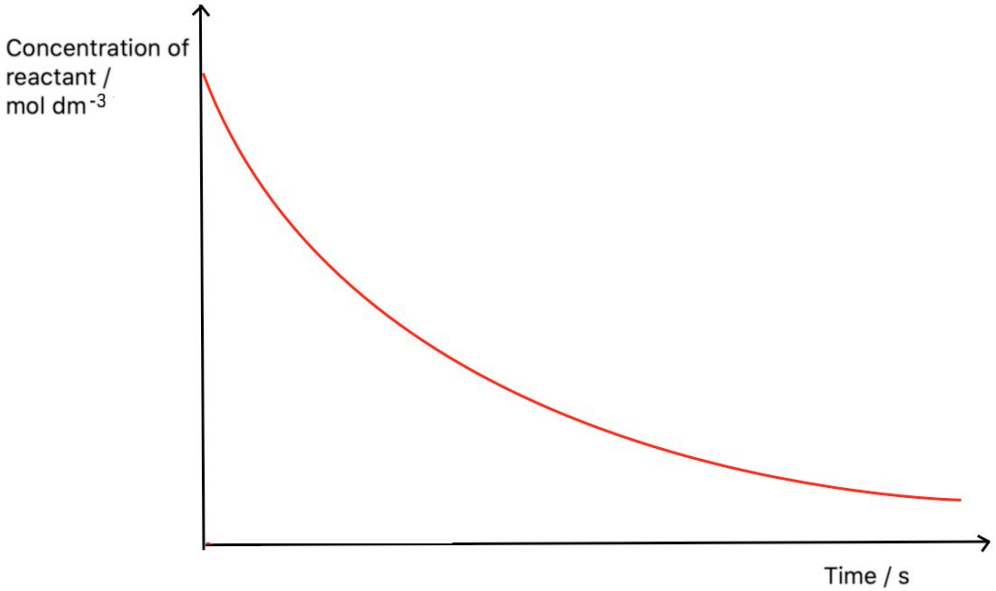

How do you calculate the rate from a first order concentration-time graph?

How do you calculate the rate from a first order concentration-time graph?

- Draw a tangent at the time you want to calculate the rate of reaction for.
- The gradient of this tangent will equal the rate of reaction.

How do you calculate k from a zero order rate-concentration graph?

How do you calculate k from a first order rate-concentration graph?

- Calculate the gradient of the line of best fit.
- The gradient will equal the rate constant, k.

How do you calculate the gradient of a line/tangent?

How do you calculate the gradient of a line/tangent?

Gradient =

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

What is a rate-determining step?

What is a rate-determining step?

- The slowest step of the reaction.
- Only the species that take part in the rate determining step (or steps that take place before it) affect the rate.

What is the relationship between the rate-determining step and the orders with respect to the reactants?

What is the relationship between the rate-determining step and the orders with respect to the reactants?

- The species present in the rate equation are those that take part in the rate determining step.
- For any reactant in the rate equation, the order related to it tells you how many molecules of it are involved in the rate determining step.

How does iodine react with propanone in acid?

How does iodine react with propanone in acid?

$$CH_3COCH_{3(aq)} + I_{2(aq)} \rightarrow CH_3COCH_2I_{(aq)} + HI_{(aq)}$$

- Solution turns from yellow to colourless
- The order with respect to iodine is zero and the order with respect to propanone and acid is first.
- Rate = $k[CH_3COCH_3][H^+]$

What equation can be used to calculate activation energy?

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The Arrhenius equation