OCR (A) Chemistry A-level

Topic 5.1.1 - How fast?

Flashcards

Define rate of reaction

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Change in concentration of a reactant or a product per unit time

At a given instant, how could you calculate the rate of reaction?

At a given instant, how could you calculate the rate of reaction?

Rate of reaction = change in concentration of reactants or products / time

If the order is zero with respect to a reactant, what does that mean?

If the order is zero with respect to a reactant, what does that mean?

Changing the concentration of the reactant has no effect on the rate

What is the effect on rate in a first order reaction?

What is the effect on rate in a first order reaction?

Rate is directly proportional to the concentration

What is the effect on rate in a second order reaction?

What is the effect on rate in a second order reaction?

Change in rate = change in concentration squared

Write a generic rate equation and state what each term means

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Rate = $k [X]^x [Y]^y$;

k = rate constant for the reaction

[X] and [Y] are concentrations of species X and Y respectively

x and y are the orders of reaction with respect to X and Y

Do zero order reactants appear on rate equation? Why?

Do zero order reactants appear on rate equation? Why?

No, because they don't have an effect on the rate

How is overall order of a reaction calculated?

How is overall order of a reaction calculated?

Sum of individual orders

How would you calculate the units of the rate constant?

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Units of rate are mol $dm^{-3}s^{-1}$ and units of concentration are mol dm^{-3}

Rearrange rate equation to get k=

Sub in units and cancel them out

When the overall order is 3, what would be the units for rate constant?

When the overall order is 3, what would be the units for rate constant?

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

How could you measure the rate of reaction experimentally (different methods)?

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Use a colorimeter at suitable intervals if there is a colour change.

If gas is evolved, use a gas syringe to collect volume of gas evolved, or measure the change in mass of the reaction mixture.

What does half life mean?

What does half life mean?

The time taken for concentration of a reactant to decrease by half

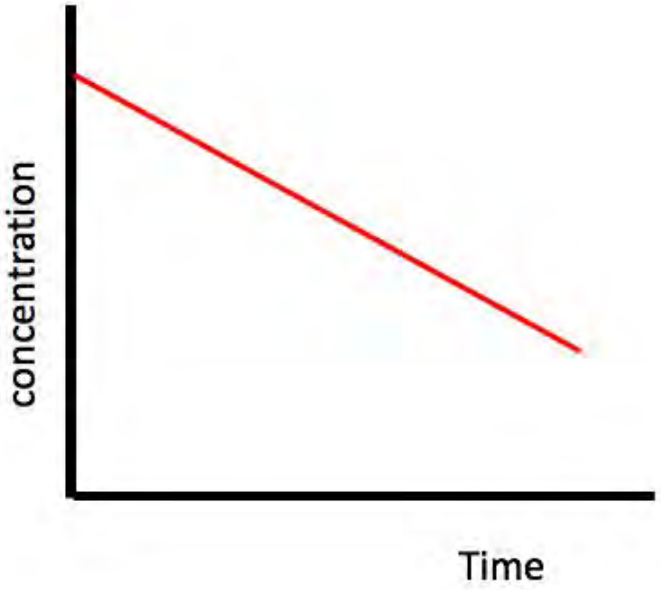
What is the symbol for half life?

What is the symbol for half life?

$t_{1/2}$

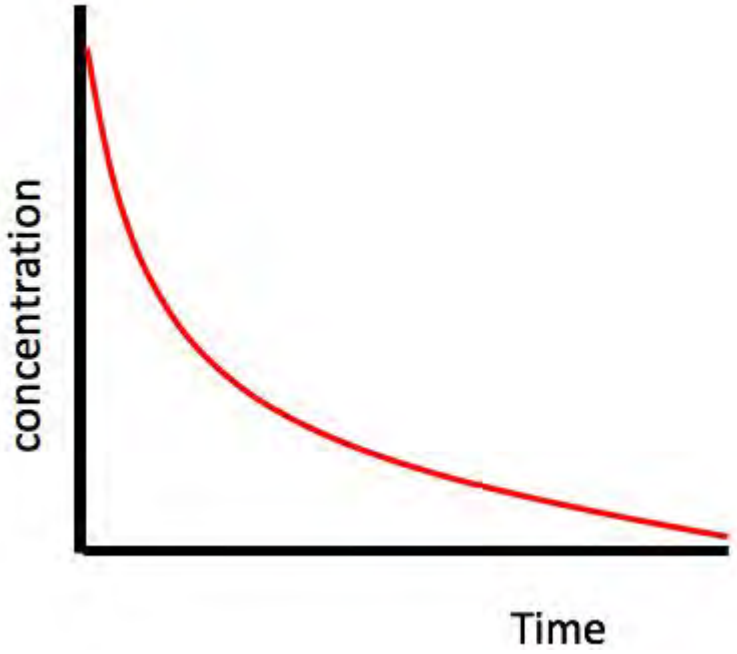
Draw a concentration time graph for a zero order reactant

Draw a concentration time graph for a zero order reactant



Draw a concentration time graph for a first order reactant

Draw a concentration time graph for a first order reactant



What is the relationship between first order reactions and half life?

What is the relationship between first order reactions and half life?

First order reactants have constant half lifes

What is the equation that is used to determine rate constant using half life in a first order reaction?

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$$k = \ln 2 / t_{1/2}$$

How would you draw a rate concentration graph?

How would you draw a rate concentration graph?

Plot [A] against time, draw tangents at different values → draw a secondary graph of rate against [A]

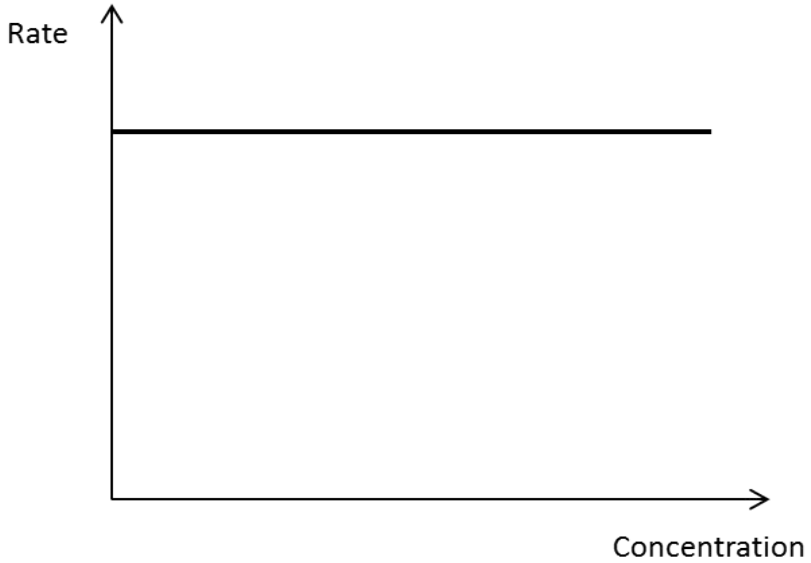
What is the relationship between rate and time?

What is the relationship between rate and time?

$$\text{Rate} \propto 1/t$$

Draw a rate concentration graph for a zero order reactant.

Draw a rate concentration graph for a zero order reactant.



Draw a rate concentration graph for a first order reactant

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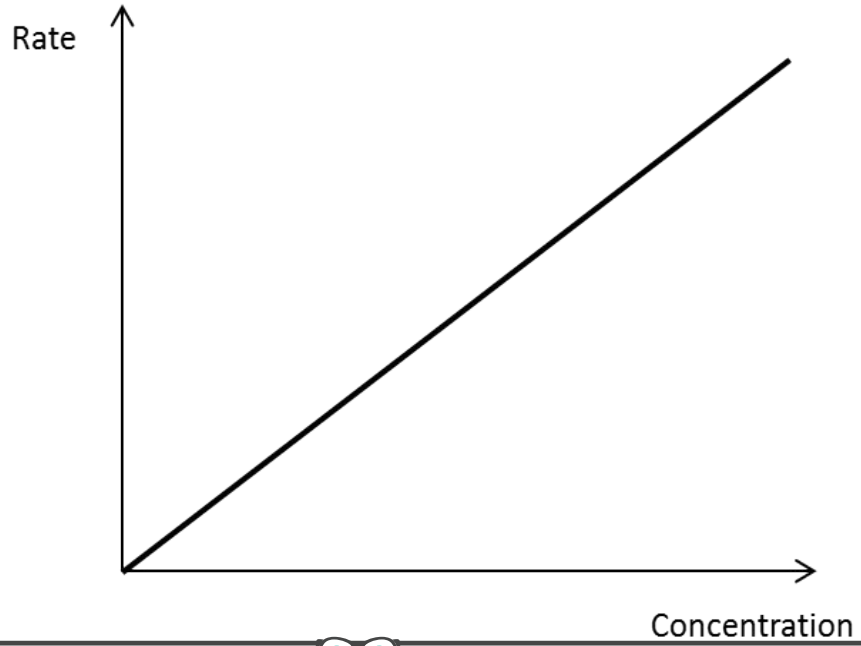
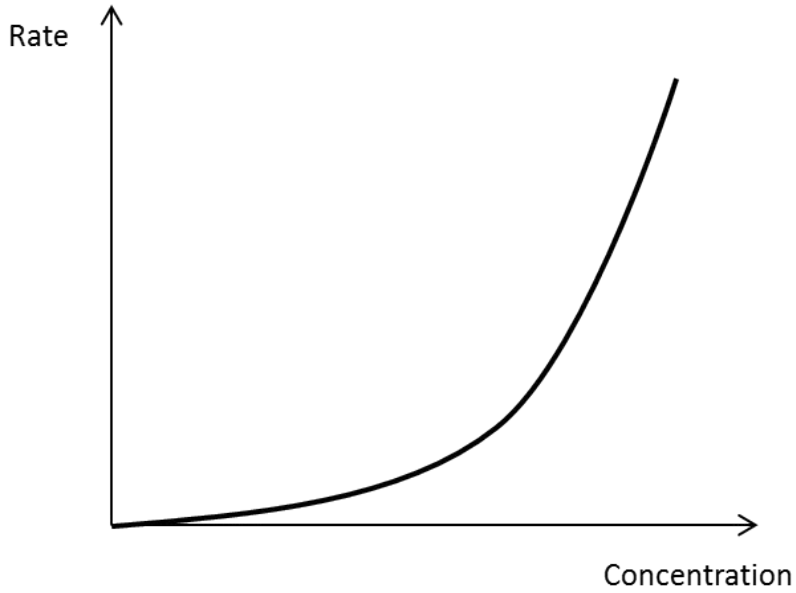


Draw a rate concentration graph from a second order reactant

Draw a rate concentration graph from a second order reactant



How to determine the rate constant from a rate concentration graph of first order?

How to determine the rate constant from a rate concentration graph of first order?

k = rate / concentration

What is rate determining step?

What is rate determining step?

The slowest step in a reaction with multiple steps

How does the rate determining step link to the species involved in the rate equation?

How does the rate determining step link to the species involved in the rate equation?

Any species involved in the rate determining step appear in the rate equation. Species only involved after the rate determining step do not appear in the rate equation

For a reactant in the rate equation, what indicates how many molecules of that reactant are involved in the rate determining step?

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The order of the reactant

The rate equation of a reaction is rate = $k[NO]^2$. How many molecules of NO will be present in the rate determining equation?

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What affects the value of the rate constant for a given reaction?

What affects the value of the rate constant for a given reaction?

Temperature, nothing else

What is the effect of a 10℃ temperature increase on the rate of reaction, roughly?

What is the effect of a 10°C temperature increase on the rate of reaction, roughly?

Doubles rate of reaction

What is the Arrhenius equation? What does each term mean?

What is the Arrhenius equation? What does each term mean?

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

k = rate constant for reaction
A = pre-exponential factor (number of collisions between reactant molecules)
e = mathematical quantity
R = gas constant
T = temperature in Kelvin
E_A = activation energy for reaction in Joules

How can you convert the Arrhenius equation into a useful form for plotting a graph?

How can you convert the Arrhenius equation into a useful form for plotting a graph?

$\ln k = -Ea/RT + \ln A$

Graph of lnk against 1/T is a straight line:

gradient = $-E_A/R$ and y intercept is lnA