I am able to:

1 Define *rate of reaction* and give the usual units for it.

2 Describe a method that could be used to measure the rate of each of the following reactions

(a) $Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$

(b) $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

(c) $H_2O_2(aq) + 2KI(aq) + H_2SO_4(aq) \rightarrow 2H_2O(l) + I_2(aq) + K_2SO_4(aq)$

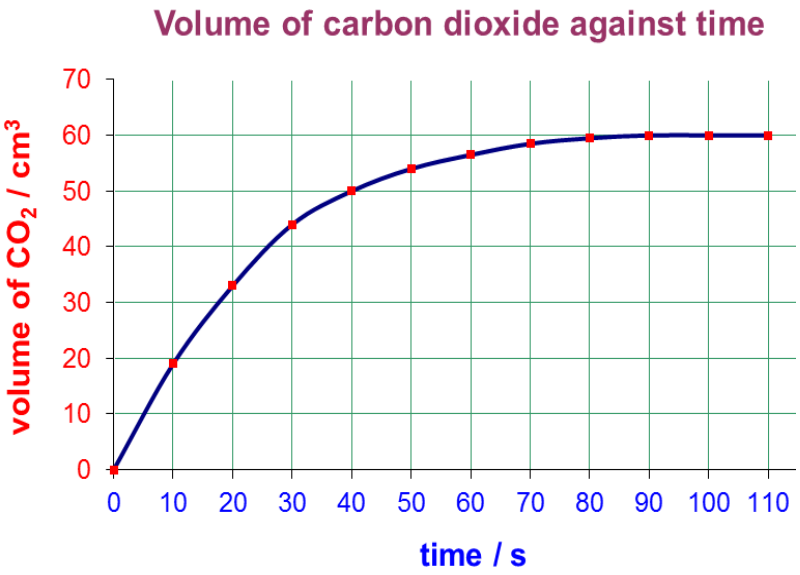
3 Explain two different methods which could be used to determine the rate of the reaction between $CaCO_3$ and dilute hydrochloric acid.

4 Use the graph shown (for the reaction between $CaCO_3$ and HCl)

(a) to explain how the rate of reaction varies with time

(b) to calculate the initial rate of reaction

(c) to work out the average rate of reaction for the first 90 s.



5 Explain the *collision theory*.

6 Explain the effects of changing: (a) particle size (b) concentration on the rate of a reaction.

7 Explain how increasing the pressure would affect the rate of the reaction between hydrogen and iodine:

$H_2(g) + I_2(g) \rightarrow 2HI(g)$

8 Sketch graphs showing the effect of different reaction conditions.

The graph shown is for 25.0 cm^3 of 1 mol dm^{-3} HCl reacting with excess calcium carbonate (medium lumps) at 25 ^oC.

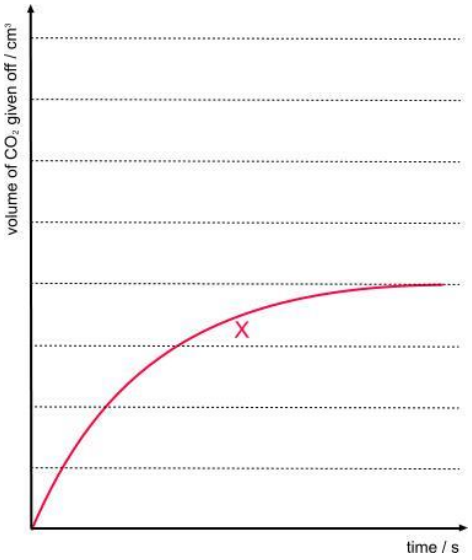
Sketch graphs for:

(a) 25.0 cm^3 of 2 mol dm^{-3} HCl reacting with excess calcium carbonate (medium lumps) at 25 ^oC.

(b) 50.0 cm^3 of 0.5 mol dm^{-3} HCl reacting with excess calcium carbonate (medium lumps) at 25 ^oC.

(c) 25.0 cm^3 of 1 mol dm^{-3} HCl reacting with excess calcium carbonate (medium lumps) at 35 ^oC.

(d) 25.0 cm^3 of 1 mol dm^{-3} HCl reacting with excess calcium carbonate (powder) at 25 ^oC.



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9 State that the average energy of particles in a gas is proportional to the temperature in K.

10 Explain how the average kinetic energy and speed of nitrogen molecules changes as the temperature is increased from 25°C to 50°C

11 Explain what is meant by *activation energy*

12 Sketch the Maxwell-Boltzmann energy distribution.

13 Explain why the rate of a chemical reaction increases as the temperature increases.

14 Explain what a catalyst is.

15 Explain how a catalyst speeds up a chemical reaction.

16 Sketch energy profiles for exo- and endothermic reactions with and without catalysts.

17 Explain the terms: *rate constant*, *order of reaction*, *overall order of reaction*.

18 Write the rate equation and calculate the rate constant (including units) for the reaction $A + B \rightarrow P + Q$

[A] /mol dm^{-3}	[B] /mol dm^{-3}	Initial Rate /mol dm^{-3} s^{-1}
1.0	1.0	2.0×10^{-3}
2.0	1.0	4.0×10^{-3}
2.0	3.0	36×10^{-3}

19 Write the rate equation and calculate the rate constant (including units) for the reaction:
$2Z + 3Y \rightarrow W + X$

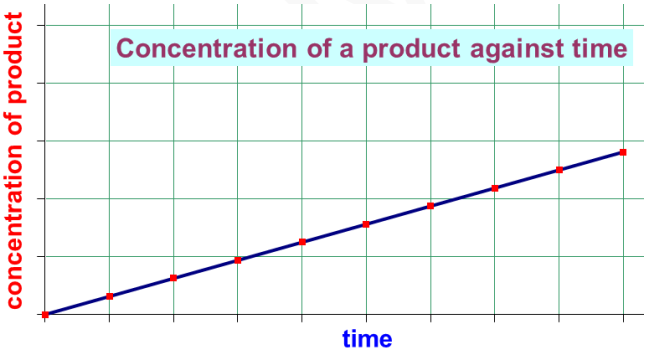
Expt.	[Z] /mol dm^{-3}	[Y] /mol dm^{-3}	Rate /mol dm^{-3} s^{-1}
1	2.0×10^{-3}	2.0×10^{-3}	0.050
2	8.0×10^{-3}	2.0×10^{-3}	0.800
3	1.0×10^{-2}	6.0×10^{-3}	3.750

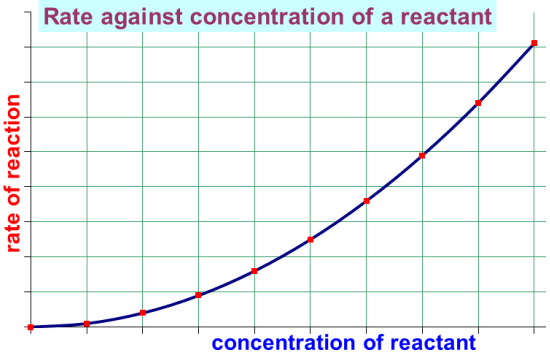
20 Write down possible units for the rate constants for zero, first and second order reactions.

21 Draw graphs of concentration against time for zero, first and second order reactions.

22 Draw graphs of rate against concentration for zero, first and second order reactions.

23 Work out whether the graphs represent zero, first or second order reactions.





24 Explain what is meant by the *rate determining step* for a reaction

25 Work out the rate expression for the reaction $P + 2Q \rightarrow R + S$ given the mechanism:

$Q + P \rightarrow Y + S$ SLOW $Q + Y \rightarrow R$ FAST

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26 Deduce whether mechanisms are correct or incorrect

Consider the reaction $2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$
The rate equation is Rate = $k[NO]^2[H_2]$

Explain why each of the following mechanisms is incorrect:

(a)
$2NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$ SLOW (RDS)
$N_2O(g) + H_2(g) \rightarrow N_2(g) + H_2O(g)$ FAST

(b)
$H_2(g) + NO(g) \rightleftharpoons H_2O(g) + N(g)$ FAST
$H_2(g) + N(g) \rightarrow NH_2(g)$ SLOW (RDS)
$NH_2(g) + NO(g) \rightarrow H_2O(g) + N_2(g)$ FAST

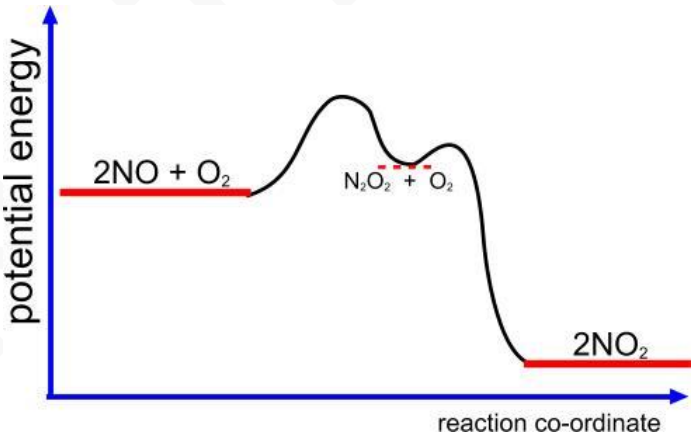
27 Deduce two possible mechanisms for the reaction in 26

28 Explain what is meant by the term *molecularity* and the difference between molecularity and order.

29 Explain the difference between a species that acts as a *catalyst* and one that is an *intermediate* in a reaction. Classify X and Y as catalyst or intermediate in the mechanism:

Step 1: A + X → Y FAST Step 2: Y + B → C + X SLOW

30 Deduce which is the rate determining step and the mechanism from a potential energy profile.



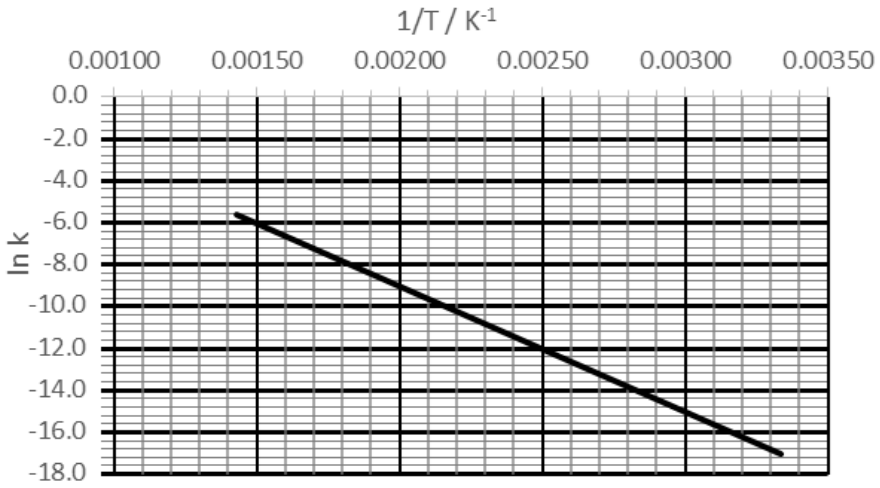
31 Explain why the rate equation cannot be deduced from the stoichiometric equation.

32 Explain how the value of the rate constant changes as the temperature increases.

33 Explain how the Arrhenius equation can be used to determine the activation energy

34 Determine the activation energy from graphical data

35 Determine the value of the frequency factor using data from the graph and suggest a possible unit for A if the reaction is first order.



36 Explain the relationship between the frequency factor and the complexity of the molecules colliding.

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