

AHL Worksheet – Chapter 6

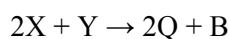
1 Consider the following data for the reaction:



Experiment	[A] / mol dm ⁻³	[B] / mol dm ⁻³	Rate / mol dm ⁻³ s ⁻¹
1	0.400	0.100	2.50×10^{-3}
2	0.400	0.200	5.00×10^{-3}
3	0.200	0.200	2.50×10^{-3}

- a Deduce the order of reaction with respect to A and with respect to B. [4]
- b What is the overall order of reaction? [1]
- c Work out a value for the rate constant of this reaction with units. [3]
- d What will be the rate of reaction when the concentration of A is 0.100 mol dm⁻³ and that of B is 0.0500 mol dm⁻³? [1]

2 Consider the following data for the reaction:



Experiment	[X] / mol dm ⁻³	[Y] / mol dm ⁻³	Rate / mol dm ⁻³ s ⁻¹
1	2.20×10^{-3}	4.40×10^{-3}	1.28×10^{-5}
2	6.60×10^{-3}	4.40×10^{-3}	1.15×10^{-4}
3	8.80×10^{-3}	8.80×10^{-3}	2.05×10^{-4}

- a Work out the order of reaction with respect to X. [2]
- b Work out the order of reaction with respect to Y. [3]
- c What is the rate expression for the reaction. [1]
- d Work out a value with units of k , the rate constant, for this reaction. [3]
- e What is the rate of reaction when the concentration of X and Y are both 2.20×10^{-2} mol dm⁻³? [1]
- 3 a Write down the expression for the Arrhenius equation. [1]
- b State the effect of increasing the temperature on the value of the rate constant. [1]

- c Use the following data to calculate a value for the activation energy for the reaction:



T / K	k / s^{-1}
300	0.0000174
350	0.000229
400	0.00158
450	0.00713
500	0.0237

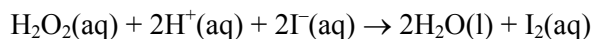
T / K	k / s^{-1}
550	0.0636
600	0.144
650	0.289
700	0.524

The value of the gas constant is $8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

- 4 For each of the following mechanisms give the overall stoichiometric equation for the reaction and the rate equation: [6]



- 5 The rate of the reaction:



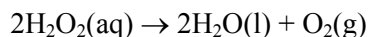
may be measured by determining how long it takes to produce a certain amount of iodine. The results of a series of experiments in which the concentration of the iodide ion was varied are shown below. (All other concentrations remained constant.)

Concentration of $\text{I}^-(\text{aq})$	Time / s
0.100	24
0.080	30
0.060	39

Concentration of $\text{I}^-(\text{aq})$	Time / s
0.040	58
0.020	120

Plot a graph of rate ($\propto 1/\text{time}$) against concentration of $\text{I}^-(\text{aq})$ and use this to determine the order of reaction with respect to $\text{I}^-(\text{aq})$. [5]

- 6 Hydrogen peroxide decomposes according to the equation:



Concentration of hydrogen peroxide solution / mol dm ⁻³	Rate of reaction / mol dm ⁻³ s ⁻¹
0.04	2.9×10^{-5}
0.08	5.9×10^{-5}
0.12	8.9×10^{-5}
0.16	1.21×10^{-4}
0.20	1.51×10^{-4}
0.24	1.77×10^{-4}

- a** Use a graphical method to determine: [7]
- i** the order of reaction with respect to hydrogen peroxide at this temperature and
 - ii** the rate constant at this temperature.
- b** Explain the effect of introducing a catalyst on the value of the rate constant. [2]
- c** A student suggested that this data shows that the decomposition of hydrogen peroxide occurs via a simple single-step mechanism whereby two hydrogen peroxide molecules collide in the rate-determining step. Comment on this hypothesis. [2]