



### Topic 11 Exercise 1 - orders of reaction

1. Explain what is meant by the term "rate of reaction".
2. The initial rates of the reaction  $2A + B \rightarrow 2C + D$  at various concentrations of A and B are given below:

[A] moldm <sup>-3</sup>	[B] moldm <sup>-3</sup>	Initial rate /moldm <sup>-3</sup> s <sup>-1</sup>
0.01	0.20	0.10
0.02	0.20	0.20
0.01	0.40	0.40

- a) What is the order of reaction with respect to A and B?
- b) What is the overall order of reaction?
- c) What is the rate constant?
- d) What will be the rate of the reaction if the concentrations of A and B are both 0.01 moldm<sup>-3</sup>?

3. For the reaction  $2NO(g) + H_2(g) \rightarrow N_2O(g) + H_2O(g)$ , the following rate data were collected:

Initial [NO]/M	Initial [H <sub>2</sub> ]/M	Initial rate/Ms <sup>-1</sup>
0.60	0.37	$3.0 \times 10^{-3}$
1.20	0.37	$1.2 \times 10^{-2}$
1.20	0.74	$1.2 \times 10^{-2}$

What is the rate constant for the reaction?

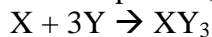


4. For the reaction  $\text{PCl}_3 + \text{Cl}_2 \rightarrow \text{PCl}_5$ , the following data were obtained:

Experiment No.	$[\text{PCl}_3]/\text{mol dm}^{-3}$	$[\text{Cl}_2]/\text{mol dm}^{-3}$	Rate / $\text{mol dm}^{-3} \text{s}^{-1}$
1	0.36	1.26	$6.0 \times 10^{-4}$
2	0.36	0.63	$1.5 \times 10^{-4}$
3	0.72	2.52	$4.8 \times 10^{-3}$

Deduce the rate equation and the rate constant.

5. Two compounds, X and Y, are known to undergo the reaction



Using the experimental results in the table below:

EXPERIMENT	Initial concentration of X/ $\text{mol dm}^{-3}$	Initial concentration of Y/ $\text{mol dm}^{-3}$	Initial rate of formation of $\text{XY}_3/\text{mol dm}^{-3} \text{s}^{-1}$
1	0.100	0.100	0.00200
2	0.100	0.200	0.00798
3	0.100	0.300	0.01805
4	0.200	0.100	0.00399
5	0.300	0.100	0.00601

Find the rate constant.

6. The data in the table below relates to the reaction between hydrogen and nitrogen monoxide at 673K.  $2\text{NO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

Experiment number	Initial concentration of $\text{H}_2/\text{mol dm}^{-3}$	Initial concentration of $\text{NO}/\text{mol dm}^{-3}$	Initial rate of production of $\text{N}_2/\text{mol dm}^{-3} \text{s}^{-1}$
1	$2.0 \times 10^{-3}$	$6.0 \times 10^{-3}$	$6.0 \times 10^{-3}$
2	$3.0 \times 10^{-3}$	$6.0 \times 10^{-3}$	$9.0 \times 10^{-3}$
3	$6.0 \times 10^{-3}$	$1.0 \times 10^{-3}$	$0.5 \times 10^{-3}$

Deduce the rate equation and calculate the rate constant.