

Orders of Reaction Questions

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 ⁻³	[B] moldm ⁻³	Initial rate /moldm ⁻³ s ⁻¹
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⁻³?

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 ₂]/M	Initial rate/Ms ⁻¹
0.60	0.37	3.0×10^{-3}
1.20	0.37	1.2×10^{-2}
1.20	0.74	1.2×10^{-2}

What is the rate constant for the reaction?

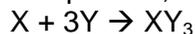
What can you deduce about the rate-determining step of the reaction?

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

Experiment No.	$[\text{PCl}_3]/\text{M}$	$[\text{Cl}_2]/\text{M}$	Rate / Ms^{-1}
1	0.36	1.26	6.0×10^{-4}
2	0.36	0.63	1.5×10^{-4}
3	0.72	2.52	4.8×10^{-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/ mol dm^{-3}	Initial concentration of Y/ mol dm^{-3}	Initial rate of formation of 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 H_2 / mol dm^{-3}	Initial concentration of NO / mol dm^{-3}	Initial rate of production of N_2 / $\text{mol dm}^{-3}\text{s}^{-1}$
1	2.0×10^{-3}	6.0×10^{-3}	6.0×10^{-3}
2	3.0×10^{-3}	6.0×10^{-3}	9.0×10^{-3}
3	6.0×10^{-3}	1.0×10^{-3}	0.5×10^{-3}

Deduce the rate equation and calculate the rate constant.

7. State and explain the effect of the following on the rate of a reaction:

- increasing the temperature
- increasing the pressure
- increasing the concentration of one of the reactants
- adding a catalyst

In each case state what will happen to the rate constant, k.