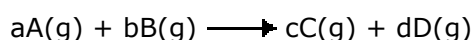


Exercise 5.21 – The rate expression

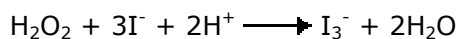
Q521-01 The following initial rate data were collected for the reaction:



	[A]	[B]	[C]	[D]	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.422	1.52 × 10 ⁻²	0	0	2.72 × 10 ⁻⁵
Expt 2	0.638	1.21 × 10 ⁻²	0	0	4.93 × 10 ⁻⁵
Expt 3	0.921	1.52 × 10 ⁻²	0	0	1.29 × 10 ⁻⁴

Find the rate law that best fits this data.

Q521-02 For the reaction between hydrogen peroxide and iodide ions in acid solution, represented by the equation:



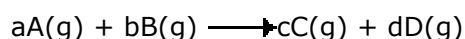
these kinetic data were gathered:

	[H ₂ O ₂]	[I ⁻]	[H ⁺]	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.010	0.010	0.00050	1.15 × 10 ⁻⁶
Expt 2	0.020	0.010	0.00050	2.30 × 10 ⁻⁶
Expt 3	0.020	0.020	0.00050	4.60 × 10 ⁻⁶
Expt 4	0.020	0.020	0.00100	4.60 × 10 ⁻⁶

What is the rate law for the reaction?

Q521-03 A certain zero-order reaction has a value for the rate constant, $k = 0.025 \text{ mol dm}^{-3} \text{ s}^{-1}$ for the disappearance of A. What will be the concentration of A after 15 seconds, if the initial concentration is 0.50 mol dm^{-3} ?

Q521-04 The following initial rate data were collected for the reaction:

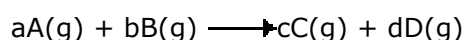


	[A]	[B]	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.42	1.5 × 10 ⁻²	2.7 × 10 ⁻⁵
Expt 2	0.42	3.0 × 10 ⁻²	5.4 × 10 ⁻⁵
Expt 3	0.84	1.5 × 10 ⁻²	1.1 × 10 ⁻⁴

Find the orders of reaction with respect to [A] and [B], and hence the rate expression.

Exercise 5.21 – The rate expression

Q521-05 The following initial rate data were collected for the reaction:



	[A]	[B]	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.42	1.5 × 10 ⁻²	2.7 × 10 ⁻⁵
Expt 2	0.42	3.0 × 10 ⁻²	5.4 × 10 ⁻⁵
Expt 3	0.84	1.5 × 10 ⁻²	5.4 × 10 ⁻⁵

Find the orders of reaction with respect to [A] and [B], and hence the rate expression.

Q521-06 The following initial rate data were collected for the reaction:



	[NO]	[H ₂]	initial rate/ mol N ₂ dm ⁻³ s ⁻¹
Expt 1	0.1	0.1	2.53 × 10 ⁻⁶
Expt 2	0.1	0.2	5.05 × 10 ⁻⁶
Expt 3	0.2	0.1	1.01 × 10 ⁻⁵
Expt 4	0.3	0.1	2.28 × 10 ⁻⁵

Find the orders of reaction with respect to [NO] and [H₂], and hence the rate expression.

Q521-07 The following data were obtained for the reaction of nitrogen monoxide gas, NO(g) with oxygen gas to form nitrogen dioxide gas, NO₂(g) at 25°C.

	[NO]	[O ₂]	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.50	0.2	2.7 × 10 ⁻⁵
Expt 2	0.50	0.4	5.4 × 10 ⁻⁵
Expt 3	1.00	0.8	5.4 × 10 ⁻⁵

Find the orders of reaction with respect to [NO] and [O₂], and hence the rate expression.

Q521-08 The following data were obtained for the reaction of compounds A and B at constant temperature:

	initial [A]/mol dm ⁻³	initial [B]/mol dm ⁻³	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.15	0.24	0.45 × 10 ⁻⁵
Expt 2	0.30	0.24	0.90 × 10 ⁻⁵
Expt 3	0.60	0.48	7.20 × 10 ⁻⁵

Find the orders of reaction with respect to [A] and [B], and hence the rate expression.

Exercise 5.21 – The rate expression

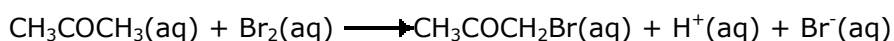
Q521-09 The following data were obtained for the reaction of compounds P and Q at constant temperature. The reaction can be represented by the rate expression:

$$\text{Rate} = [\text{P}]^2[\text{Q}]$$

	initial [P]/mol dm ⁻³	initial [Q]/mol dm ⁻³	initial rate/ mol dm ⁻³ s ⁻¹
Expt 1	0.20	0.30	4.80 × 10 ⁻³
Expt 2	0.10	0.10	
Expt 3	0.40		9.60 × 10 ⁻³
Expt 4		0.60	19.2 × 10 ⁻³

Find the concentration of Q in experiment 3.

Q521-10 The bromination of acetone that occurs in acid solution is represented by this equation.



These kinetic data were obtained for given reaction concentrations:

Initial Concentrations, / mol dm ⁻³			Initial Rate of disappearance of Br ₂ , / mol dm ⁻³ s ⁻¹
[CH ₃ COCH ₃]	[Br ₂]	[H ⁺]	
0.30	0.050	0.050	5.7 × 10 ⁻⁵
0.30	0.10	0.050	5.7 × 10 ⁻⁵
0.30	0.10	0.10	1.2 × 10 ⁻⁴
0.40	0.050	0.20	3.1 × 10 ⁻⁴

Based on these data, what is the rate equation?