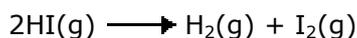


## Exercise 5.22 – The rate constant

**Q522-01** A small increase in temperature often causes a large increase in the rate of a chemical reaction. This effect is best attributed to

- A. a decrease in the activation energy of the reaction
- B. more frequent collisions at the higher temperature
- C. the occurrence of more collisions with the needed energy
- D. different reaction pathways at the higher temperature

**Q522-02** The dissociation of HI molecules, as shown below, occurs at a temperature of 629 K. If the rate constant,  $k = 3.02 \times 10^{-5} \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ .



What is the reaction order in the rate expression?

**Q522-03** The rate of the reaction  $2\text{NO} + \text{Cl}_2 \longrightarrow 2\text{NOCl}$  is given by the rate equation:

$$\text{rate} = k[\text{NO}]^2[\text{Cl}_2]$$

The value of the rate constant can be increased by:

- A. increasing the concentration of the NO.
- B. increasing the concentration of the Cl<sub>2</sub>.
- C. increasing the temperature.
- D. doing all of these.

**Q522-04** For a certain second order decomposition reaction, the rate is  $0.30 \text{ mol dm}^{-3} \text{ s}^{-1}$ , when the concentration of the reactant is 0.20 M. What is the rate constant ( $\text{dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$ ) for this reaction?

- A. 1.5
- B. 2.2
- C. 3.0
- D. 7.5

**Q522-05** For the following reaction:  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \longrightarrow 2\text{HI}(\text{g})$ ; the experimental rate law is:  $\text{Rate} = k[\text{H}_2][\text{I}_2]$ . When time is given in seconds and the concentration is in  $\text{mol dm}^{-3}$ , the units for the rate constant are:

- A.  $\text{mol dm}^{-3} \text{ s}^{-1}$
- B.  $\text{mol}^{-1} \text{ dm}^3 \text{ s}^{-1}$
- C.  $\text{s}^{-1}$
- D.  $\text{mol}^{-1} \text{ dm}^3 \text{ s}$

**Q522-06** At 800°C, the instantaneous rate of the reaction  $2\text{NO} + 2\text{H}_2 \longrightarrow \text{N}_2 + 2\text{H}_2\text{O}$  is  $3.5 \text{ mol dm}^{-3} \text{ s}^{-1}$  when the concentrations of nitrogen(II) oxide and hydrogen are each  $0.30 \text{ mol dm}^{-3}$ . If the rate expression for this reaction is:  $\text{Rate} = k[\text{NO}]^2[\text{H}_2]$ , the numerical value of the specific rate constant is:

- A. 1.2
- B. 3.5
- C.  $3.90 \times 10^1$
- D.  $1.30 \times 10^2$

### Exercise 5.22 – The rate constant

**Q522-07** The reaction  $A + B \longrightarrow AB$  is 1st order with respect to A and zero order with respect to B. The reaction is begun with the initial concentration of both reactants at  $0.100 \text{ mol dm}^{-3}$ . After 1.5 hours the concentration of B has dropped to  $0.060 \text{ mol dm}^{-3}$ . What is the approximate value of the specific rate (reaction rate) constant for this reaction?

- A.  $0.15 \text{ hr}^{-1}$
- B.  $0.33 \text{ hr}^{-1}$
- C.  $0.61 \text{ hr}^{-1}$
- D. the specific rate constant cannot be determined unless the mechanism of the reaction known.

**Q522-08** The following data were obtained for the reaction between A and B:

Experiment	Initial concentration of reactants ( $\text{mol dm}^{-3}$ )		Initial rate of reaction ( $\text{mol dm}^{-3} \text{ h}^{-1}$ )
	A	B	
1	0.200	0.200	0.50
2	0.400	0.200	2.00
3	0.400	0.800	8.00

- i) Give the order with respect to A
- ii) Give the order with respect to B
- iii) Write the rate expression for this reaction
- iv) Using the data from the first experiment, calculate the value of the rate constant giving the units

**Q522-09** Nitrogen (II) oxide reacts with hydrogen as shown by the following equation:



The table below shows how the rate of reaction varies as the reactant concentrations vary:

Experiment	Initial concentration of reactants ( $\text{mol dm}^{-3}$ )		Initial rate ( $\text{mol N}_2 \text{ dm}^{-3} \text{ s}^{-1}$ )
	NO	H <sub>2</sub>	
1	0.100	0.100	$2.53 \times 10^{-6}$
2	0.100	0.200	$5.05 \times 10^{-6}$
3	0.200	0.100	$10.10 \times 10^{-6}$
4	0.300	0.100	$22.80 \times 10^{-6}$

- i) Determine the order with respect to NO and with respect to H<sub>2</sub>.
- ii) Write the rate expression for the reaction.
- iii) Calculate the value for the rate constant including units.

## Exercise 5.22 – The rate constant

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**Q522-10** The following data were obtained for the reaction between gases A and B:

Experiment	Initial concentration of reactants (mol dm <sup>-3</sup> )		Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> )
	A	B	
1	1.0 × 10 <sup>-3</sup>	2.0 × 10 <sup>-3</sup>	3.0 × 10 <sup>-4</sup>
2	2.0 × 10 <sup>-3</sup>	2.0 × 10 <sup>-3</sup>	3.0 × 10 <sup>-4</sup>
3	1.0 × 10 <sup>-3</sup>	4.0 × 10 <sup>-3</sup>	1.2 × 10 <sup>-3</sup>

- Define the term overall order of reaction.
  - Deduce the order of the reaction with respect to A and the order of the reaction with respect to B
  - Write the rate expression for the reaction between A and B
  - Use the data from experiment 1 to calculate the value of the rate constant for the reaction and state its units.
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