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 x 10-5 $dm^3\ mol^{-1}\ s^{-1}$.

$$2HI(g) \longrightarrow H_2(g) + I_2(g)$$

What is the reaction order in the rate expression?

Q522-03 The rate of the reaction $2NO + Cl_2 \longrightarrow 2NOCl$ is given by the rate equation:

$$\text{rate} = k[NO]^2[Cl_2]$$

The value of the rate constant can be increased by:

A. increasing the concentration of the NO.
B. increasing the concentration of the Cl2.
C. increasing the temperature.
D. doing all of these.

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

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

Q522-05 For the following reaction: $H_2(g) + I_2(g) \longrightarrow 2HI(g)$; the experimental rate law is: Rate = $k[H_2][I_2]$. When time is given in seconds and the concentration is in mol dm^{-3}, the units for the rate constant are:

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

Q522-06 At 800ºC, the instantaneous rate of the reaction $2NO + 2H_2 \longrightarrow N_2 + 2H_2O$ is 3.5 mol $dm^{-3}\ s^{-1}$ when the concentrations of nitrogen(II) oxide and hydrogen are each 0.30 mol dm^{-3}. If the rate expression for this reaction is: Rate = $k[NO]^2[H_2]$, the numerical value of the specific rate constant is:

A. 1.2
B. 3.5
C. 3.90×10^1
D. 1.30×10^2

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Q522-07 The reaction A + B ⟶ 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 mol dm^{-3}. After 1.5 hours the concentration of B has dropped to 0.060 mol dm^{-3}. What is the approximate value of the specific rate (reaction rate) constant for this reaction?

A. 0.15 hr^{-1}
B. 0.33 hr^{-1}
C. 0.61 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 (mol dm^{-3}) A	B	Initial rate of reaction (mol dm^{-3} h^{-1})
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

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

$$2NO(g) + 2H_2(g) \longrightarrow N_2(g) + 2H_2O(g)$$

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

Experiment	Initial concentration of reactants (mol dm^{-3}) NO	H_2	Initial rate (mol N_2 dm^{-3} s^{-1})
1	0.100	0.100	2.53×10^{-6}
2	0.100	0.200	5.05×10^{-6}
3	0.200	0.100	10.10×10^{-6}
4	0.300	0.100	22.80×10^{-6}

i) Determine the order with respect to NO and with respect to H_2.
ii) Write the rate expression for the reaction.
iii) Calculate the value for the rate constant including units.

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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^{-3}) A	B	Initial rate (mol dm^{-3} s^{-1})
1	1.0×10^{-3}	2.0×10^{-3}	3.0×10^{-4}
2	2.0×10^{-3}	2.0×10^{-3}	3.0×10^{-4}
3	1.0×10^{-3}	4.0×10^{-3}	1.2×10^{-3}

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