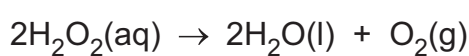


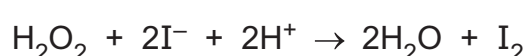
- 3 (a) Solid manganese(IV) oxide, MnO_2 , catalyses the decomposition of hydrogen peroxide.



State the type of catalysis for this reaction. Explain your answer.

.....
 [1]

- (b) Hydrogen peroxide reacts with iodide ions in acidic conditions as shown.



The initial rate of this reaction is investigated with different concentrations of H_2O_2 , I^- and H^+ . The results obtained are shown in Table 3.1.

Table 3.1

experiment	$[\text{H}_2\text{O}_2]/\text{mol dm}^{-3}$	$[\text{I}^-]/\text{mol dm}^{-3}$	$[\text{H}^+]/\text{mol dm}^{-3}$	initial rate/ $\text{mol dm}^{-3}\text{s}^{-1}$
1	0.0450	0.0300	0.0125	2.42×10^{-3}
2	0.0225	0.0600	0.0125	2.42×10^{-3}
3	0.0225	0.120	0.0125	4.84×10^{-3}
4	0.0450	0.120	0.0500	9.68×10^{-3}

- (i) Use the information in Table 3.1 to deduce the rate equation for this reaction.

Explain your reasoning.

.....

 [4]

- (ii) Use your rate equation from (b)(i) and the data from Experiment 1 to calculate the rate constant, k , for this reaction. Include the units of k .

$k = \dots\dots\dots$ units $\dots\dots\dots$ [2]

- (c) The rate of the thermal decomposition of azomethane, $\text{CH}_3\text{N}=\text{NCH}_3$, is investigated.

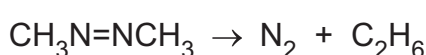


Fig. 3.1 shows the results obtained. The reaction is first order with respect to $\text{CH}_3\text{N}=\text{NCH}_3$.

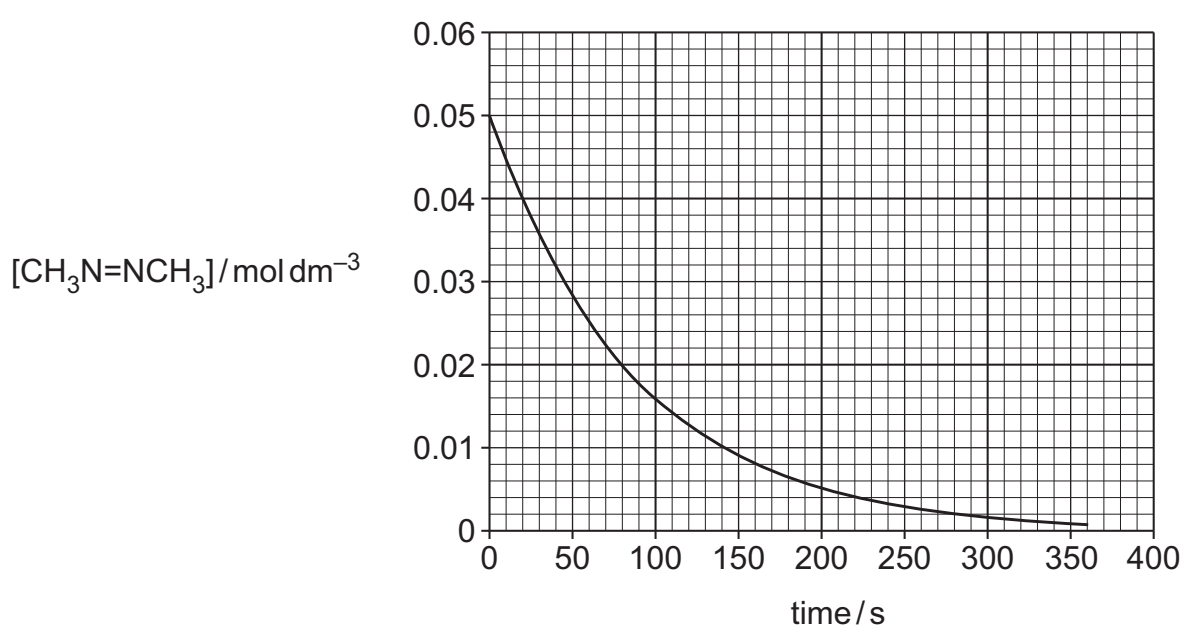


Fig. 3.1

- (i) Use Fig. 3.1 to calculate **two** half-lives, $t_{\frac{1}{2}}$, to show that the reaction is first order.

.....

 [2]

- (ii) Use your answer to (c)(i) to calculate the rate constant, k , for the decomposition of azomethane.

$k = \dots\dots\dots \text{s}^{-1}$ [1]

- (d) Describe the effect of increasing temperature on the rate constant and on the rate of a reaction.

.....

 [1]