

## HL Paper 3 Section A Experimental work (8)

A class of students wanted to find a possible mechanism for the reaction between propanone and iodine in the presence of an acid catalyst.

Three different burettes were set up in the laboratory. One contained an aqueous solution of  $2.0 \text{ mol dm}^{-3}$  propanone,  $\text{CH}_3\text{COCH}_3$ , another contained an aqueous solution of  $0.010 \text{ mol dm}^{-3}$  iodine,  $\text{I}_2(\text{aq})$ , and the third contained  $2.0 \text{ mol dm}^{-3}$  hydrochloric acid solution,  $\text{HCl}(\text{aq})$ .

Students were instructed to place the required volumes of the propanone and iodine solution in a test-tube together with the required volume of water. They then added the specified volume of hydrochloric acid, mixed the contents and timed how long it took for the yellow colour of the iodine to disappear.

Table showing volumes to be added

Experiment	Volume of $2.0 \text{ mol dm}^{-3}$ $\text{CH}_3\text{COCH}_3(\text{aq}) / \text{cm}^3$	Volume of $0.010 \text{ mol dm}^{-3}$ $\text{I}_2(\text{aq}) / \text{cm}^3$	Volume of water / $\text{cm}^3$	Volume of $2.0 \text{ mol dm}^{-3}$ $\text{HCl}(\text{aq}) / \text{cm}^3$
1	4.0	2.0	10.0	4.0
2	8.0	2.0	6.0	4.0
3	4.0	1.0	11.0	4.0
4	4.0	2.0	6.0	8.0

The following results show the initial concentrations of the three reagents and the average time taken for the iodine colour to disappear.

Experiment	$[\text{CH}_3\text{COCH}_3] / \text{mol dm}^{-3}$	$[\text{I}_2(\text{aq})] / \text{mol dm}^{-3}$	$[\text{H}^+(\text{aq})] / \text{mol dm}^{-3}$	Time for yellow colour to disappear / s
1	0.40	0.0010	0.40	800
2	0.80	0.0010	0.40	400
3	0.40	0.0005	0.40	400
4	0.40	0.0010	0.80	400

- (a) Explain how the value for the initial concentration of the iodine solution in Experiment number 3 was calculated. [1]
- (b) Explain why the colour of the iodine disappears as the reaction proceeds. [1]
- (c) Determine the order of reaction with respect to iodine. [1]

- (d)** Determine the rate equation for the reaction. **[1]**
- (e)** State what can be deduced about the slow step of the reaction in terms of the reactants. **[1]**
- (f)** Use your knowledge of chemistry to suggest a possible first step in the mechanism of the reaction if it is assumed that the first step is the slowest step. **[1]**