

### EXAMINATION

1. The following information is given for the reaction of ethyl acetate with sodium hydroxide:

$$\text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{OH}^- \rightarrow \text{CH}_3\text{COO}^- + \text{CH}_3\text{CH}_2\text{OH}$$

At 25°C, the rate constant for the reaction is  $1.5 \times 10^{-4} \text{ s}^{-1}$ . The initial concentration of ethyl acetate is  $0.1 \text{ mol dm}^{-3}$  and the initial concentration of hydroxide ions is  $0.1 \text{ mol dm}^{-3}$ .

(a) Write the rate equation for the reaction.

(b) Calculate the half-life of the reaction.

(c) Calculate the concentration of ethyl acetate after 10 minutes.

### ANSWERS

(a)  $\text{Rate} = k[\text{CH}_3\text{COOCH}_2\text{CH}_3][\text{OH}^-]$

(b)  $t_{1/2} = \frac{1}{k} \ln 2 = \frac{1}{1.5 \times 10^{-4} \text{ s}^{-1}} \ln 2 = 4620 \text{ s} = 77 \text{ min}$

(c)  $\ln \frac{[\text{A}]_t}{[\text{A}]_0} = -kt$   
 $\ln \frac{[\text{A}]_t}{0.1} = -1.5 \times 10^{-4} \text{ s}^{-1} \times 600 \text{ s}$   
 $\ln \frac{[\text{A}]_t}{0.1} = -0.09$   
 $\frac{[\text{A}]_t}{0.1} = e^{-0.09} = 0.914$   
 $[\text{A}]_t = 0.0914 \text{ mol dm}^{-3}$

### KINGSTON



Time / min	Concentration of ethyl acetate / mol dm <sup>-3</sup>	Concentration of hydroxide ions / mol dm <sup>-3</sup>
0	0.100	0.100
10	0.091	0.091
20	0.082	0.082
30	0.074	0.074
40	0.066	0.066
50	0.058	0.058
60	0.051	0.051
70	0.044	0.044
80	0.038	0.038
90	0.032	0.032
100	0.027	0.027

Use the data in the table to plot a graph of  $\ln \frac{[\text{A}]_t}{[\text{A}]_0}$  against time  $t$ .