2 A student uses the following method to investigate the kinetics of the reaction between iodine and tin to produce tin(IV) iodide, SnI_4.

step 1 Rinse a block of tin with distilled water and then rinse it with propanone.

step 2 Place 50.0 cm^3 of a 0.400 $mol\,dm^{-3}$ solution of iodine dissolved in methylbenzene in a 100 cm^3 beaker.

step 3 Suspend the block of tin from a three decimal place balance as shown in Fig. 2.1. Start a timer.

step 4 Record the balance reading every 100 seconds.

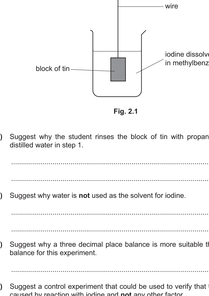

Fig. 2.1

(a) (i) Suggest why the student rinses the block of tin with propanone after rinsing it with distilled water in step 1.

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..... [1]

(ii) Suggest why water is **not** used as the solvent for iodine.

.....

..... [1]

(iii) Suggest why a three decimal place balance is more suitable than a two decimal place balance for this experiment.

..... [1]

(iv) Suggest a control experiment that could be used to verify that the loss in mass of tin is caused by reaction with iodine and **not** any other factor.

.....

..... [1]

(b) The student's results are shown in Table 2.1.

Complete Table 2.1.

Table 2.1

time / s	balance reading / g	total mass of tin reacted / g
0	4.979	0.000
100	4.910	
200	4.859	
300	4.761	
400	4.688	
500	4.620	

[1]

(c) (i) Use the results from Table 2.1 to plot a graph on the grid in Fig. 2.2 to show the relationship between total mass of tin reacted and time.

Use a cross (×) to plot each data point. Draw a straight line of best fit.

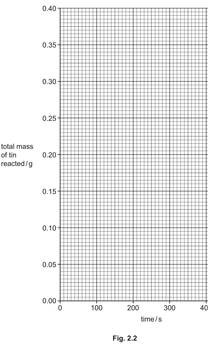

Fig. 2.2

[2]

(ii) Circle the point on the graph in Fig. 2.2 that you consider to be most anomalous.

Suggest **one** reason why this anomaly may have occurred during this experimental procedure.

Assume all measurements of mass are accurate.

.....

..... [1]

(d) Use your graph in Fig. 2.2 to determine the gradient of the line of best fit.

State the coordinates of both points you used in your calculation. These must be selected from your line of best fit.

Give your gradient to **three** significant figures.

coordinates 1 ..... coordinates 2 .....

gradient = ...

[2]

(e) Another student makes various concentrations of solutions of iodine dissolved in methylbenzene by dilution of the 0.400 $mol\,dm^{-3}$ I_2 solution.

The student repeats the experiment at a different temperature using these solutions.

Table 2.2

volume of 0.400 $mol\,dm^{-3}$ I_2 solution used / cm^3	volume of methylbenzene used / cm^3	$[I_2]$ / $mol\,dm^{-3}$	relative rate of reaction
100.0	0.0	0.400	4.76
		0.300	3.57
		0.200	2.35
		0.100	1.15

(i) Complete Table 2.2 by adding the volumes of solutions that are mixed to make 100.0 cm^3 of a solution of iodine dissolved in methylbenzene for each required concentration. [1]

(ii) Identify the independent variable in this experiment.

..... [1]

(iii) The student concludes that the rate equation for the reaction between iodine and tin is as follows.

$$\text{rate} = k\,[I_2]^2$$

State whether the results support the student's conclusion.

Explain your answer using values from Table 2.2.

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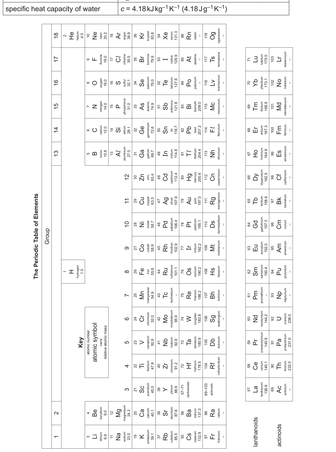
..... [2]

[Total: 14]

Important values, constants and standards

molar gas constant	$R = 8.31\,JK^{-1}\,mol^{-1}$
Faraday constant	$F = 9.65 \times 10^4\,Cmol^{-1}$
Avogadro constant	$L = 6.02 \times 10^{23}\,mol^{-1}$
electronic charge	$e = -1.60 \times 10^{-19}\,C$
molar volume of gas	$V_m = 22.4\,dm^3\,mol^{-1}$ at s.t.p. (101kPa and 273K) $V_m = 24.0\,dm^3\,mol^{-1}$ at room conditions
ionic product of water	$K_w = 1.00 \times 10^{-14}\,mol^2\,dm^{-6}$ (at 298K (25°C))
specific heat capacity of water	$c = 4.18\,kJkg^{-1}K^{-1}$ (4.18 $Jg^{-1}K^{-1}$)