1 A student investigated the effect of concentration on diffusion.

The student used pieces of agar which contained universal indicator. Universal indicator is green in substances with a neutral pH and red in substances with an acidic pH.

The student placed the pieces of agar into different concentrations of hydrochloric acid solution and measured the time taken for the acid to diffuse to the centre of each piece of agar. At the start of the investigation the agar was green.

The student used this method:

Step 1 Label four test-tubes **0.4**, **0.6**, **0.8**, **1.0**.

Table 1.1 shows the volumes of 1.0 mol per dm^3 hydrochloric acid solution and distilled water used to make the different concentrations of hydrochloric acid solution.

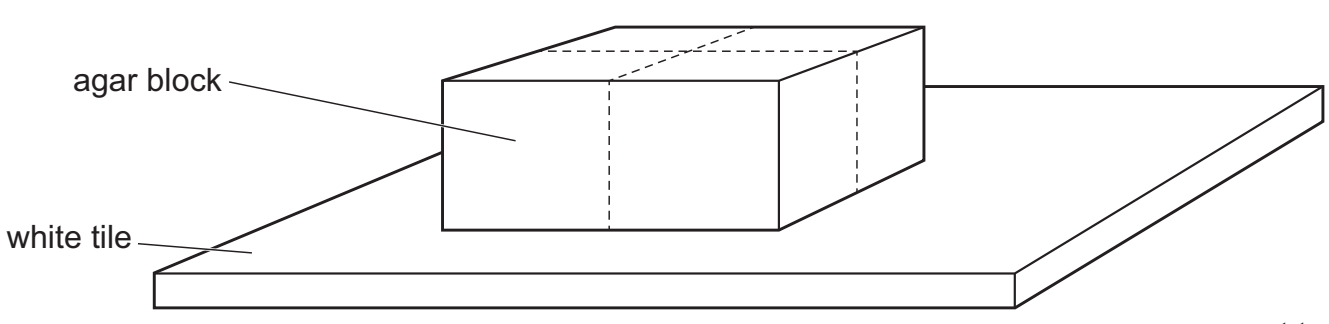
Table 1.1

concentration of hydrochloric acid solution / mol per dm^3	volume of 1.0 mol per dm^3 hydrochloric acid solution / cm^3	volume of distilled water / cm^3
0.4	4	6
0.6	6	4
0.8	8	2
1.0	10	0

Step 2 Use a 10 cm^3 syringe to put the volumes of 1.0 mol per dm^3 hydrochloric acid solution shown in Table 1.1 into the test-tubes labelled **0.4**, **0.6**, **0.8**, **1.0**.

Step 3 Use the 10 cm^3 syringe to put the volumes of distilled water shown in Table 1.1 into the test-tubes labelled **0.4**, **0.6**, **0.8**, **1.0**.

Step 4 A block of agar which measures approximately 1 cm × 2 cm × 2 cm is provided. Use the knife to cut the agar block into four pieces.



not to scale

Fig. 1.1

Step 5 Place all the test-tubes into a warm water-bath.

Step 6 Put **one** agar piece into each of the test-tubes and immediately start the stop-clock. Observe the colour of the agar pieces as they change from green to red.

The student recorded the time taken for each piece of agar to become completely red.

The stop-clocks from step 6 are shown in Fig. 1.2.

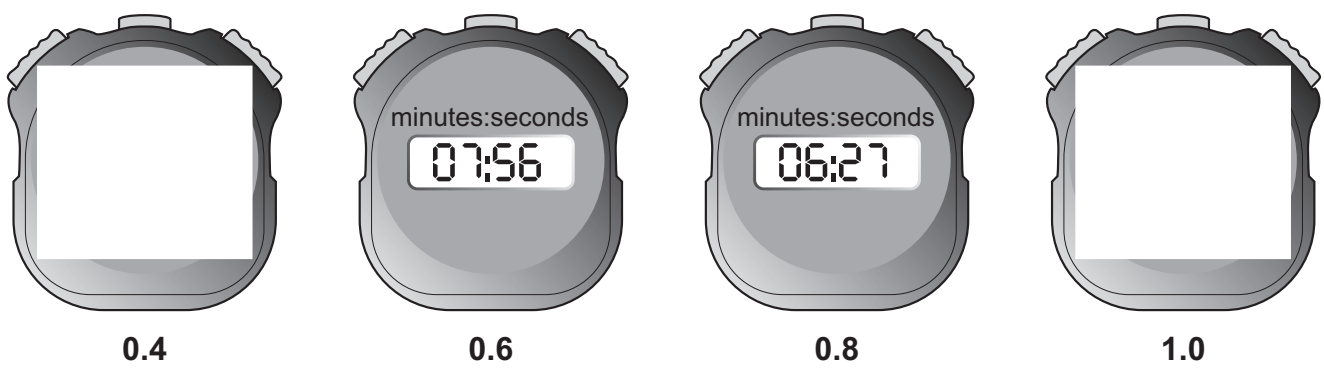


Fig. 1.2

(a) (i) Prepare a table to record the results of the investigation.

Convert the times on the stop-clocks shown in Fig. 1.2 to seconds and record these times in your table.

[4]

(ii) State a conclusion for the results.

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..... [1]

(iii) State the independent and dependent variables in this investigation.

independent variable .....

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dependent variable .....

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[2]

(iv) Suggest **two** improvements to the method used for this investigation.

1 .....

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2 .....

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[2]

(v) Identify **two** hazards in this investigation.

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(b) Plan an investigation to determine the effect of temperature on osmosis in potato plant tissue.

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[Total: 16]