1  You are provided with part of a citrus fruit.

   • Remove the plastic film and place the fruit on the white tile to show the cut surface.

   (a) Make a large, labelled drawing of the cut surface of this fruit to show the internal structure.

Juice can be extracted from fruits on a commercial scale. This process uses an enzyme to digest part of the plant structure to release a larger volume of juice.

You are going to investigate the effect of pH on this enzyme when it is added to a sample of fresh fruit.

You will be using buffer solutions to change the pH.

   • Dip a piece of Universal Indicator paper into buffer X.

   • Repeat for buffer Y using another piece of Universal Indicator paper.
(b)  

(i) Observe and record the colour of these pieces of Universal Indicator paper after they have been placed in the buffer solutions.

buffer X ............................

buffer Y ............................

(ii) Use the colour chart provided to determine the pH of buffer X and Y.

pH of buffer X ...............................  pH of buffer Y ............................... [1]

• Label four empty cups, A1, B1, C1, and D1.
• Add 25 cm³ of crushed fruit to each of the four labelled cups.

You are provided with four beakers labelled water, enzyme, buffer X and buffer Y.

• Use the syringes to add the volumes of contents shown in Table 1.1 to the crushed fruit in each of the cups.

<table>
<thead>
<tr>
<th>contents</th>
<th>volume of contents added/cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A1</td>
</tr>
<tr>
<td>crushed fruit</td>
<td>25</td>
</tr>
<tr>
<td>buffer X</td>
<td>5</td>
</tr>
<tr>
<td>buffer Y</td>
<td>–</td>
</tr>
<tr>
<td>water</td>
<td>2</td>
</tr>
<tr>
<td>enzyme</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 1.1
Leave cups A₁, B₁, C₁ and D₁ to stand for 10 minutes and proceed with the later questions.

- Label four empty cups, A₂, B₂, C₂ and D₂.
- Place one filter paper into each of the cups.

Spoon the mixture from cup A₁ into the filter paper placed into cup A₂ as shown in Fig. 1.2.

Repeat the procedure for cups B₁, C₁ and D₁.

Fig. 1.2

Record the time. .............................

Leave the mixtures in cups A₂, B₂, C₂ and D₂ to filter for **10 minutes** and proceed with later questions.

- After 10 minutes, remove the filter paper and remaining crushed fruit mixture within it.
- Measure the volume of filtered juice in cups A₂, B₂, C₂ and D₂.

(c) Complete Table 1.2 by recording:

- the units in the appropriate place
- the volume of juice filtered in each cup.

**Table 1.2**

<table>
<thead>
<tr>
<th>volume of juice filtered / ........</th>
<th>A₂</th>
<th>B₂</th>
<th>C₂</th>
<th>D₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>.................................</td>
<td>....</td>
<td>....</td>
<td>....</td>
<td>....</td>
</tr>
</tbody>
</table>
(d) Compare the volumes and describe the appearance of the filtered juice in cups:

(i) A2 and B2
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................[2]

(ii) C2 and D2.
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
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...........................................................................................................................................
...........................................................................................................................................[2]

(e) Describe the effect of pH on the enzyme by comparing the volumes and the appearance of the filtered juice in cups B2 and D2.
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...................................................................................................................................................
...................................................................................................................................................[3]

(f) (i) Suggest why water was added to cups A1 and C1.
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................[1]

(ii) State two variables that were controlled in this investigation.
1 ...........................................................................................................................................
2 ...........................................................................................................................................
...........................................................................................................................................[2]
(iii) Suggest two ways in which you could modify this investigation to produce more accurate results.

1 ........................................................................................................................................
........................................................................................................................................

2 ........................................................................................................................................
........................................................................................................................................

[2]

[Total: 22]
The heart pumps blood to the body through the arteries. The rate of blood flow can be determined at certain sites around the body as a pulse. This can be used to estimate the heart rate.

(a) (i) On Fig. 2.1, label two sites where you can feel a pulse.

(i) Suggest one feature of these sites that makes it possible to feel a pulse.

...........................................................................................................................................
...........................................................................................................................................
...........................................................................................................................................[1]
(b) Fig. 2.2. shows a section through two blood vessels, a vein and an artery, as seen on a prepared slide when viewed with the use of a microscope.

Fig. 2.2

The diameter of the blood vessel in Fig. 2.2, shown by line XY, can be calculated using:

\[
\text{diameter} = \frac{\text{measured length of line } XY \text{ on image}}{\text{magnification}}
\]

(i) Measure, in mm, the length of line XY on Fig. 2.2.

measured length of XY ................................................... mm [1]

(ii) Use the information above and your answer to (i) to calculate the diameter shown by line XY, in mm.

Show your working. Give your answer to one decimal place.

\[
\text{diameter} ................................................... \text{ mm [1]}
\]
(iii) The length of $XY$ may not be the most accurate measurement of the diameter of the blood vessel in Fig. 2.2.

Suggest how you could determine a more accurate measurement of the diameter.

...........................................................................................................................................
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...........................................................................................................................................[2]

(iv) The vein and artery in Fig. 2.2 have features that are different.

Complete Table 2.1 to name three features that are different and describe the differences that you can observe in Fig. 2.2.

Table 2.1

<table>
<thead>
<tr>
<th>feature</th>
<th>vein</th>
<th>artery</th>
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<tbody>
<tr>
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</table>

[4]
(c) When running the heart rate increases. After running the heart rate returns to normal.

(i) Plan an investigation to compare the increase in heart rate as a result of exercise for students that take regular exercise with those that do not.

(ii) Draw a suitable table with headings and units to show how you would record the measurements.

[Total: 18]