Friday 9 June 2017   Morning   Time allowed: 1 hour

Materials
For this paper you must have:
- a ruler
You may use a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer all questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 7 should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.
1 Green plants make their own food.

1 (a) (i) What is the name of the process that plants use to make food? [1 mark]

Draw a ring around the correct answer.

digestion                growth                photosynthesis                respiration

1 (a) (ii) Plants need energy to make food.

Where does this energy come from? [1 mark]

Draw a ring around the correct answer.

light                         oxygen                         soil                         water

1 (b) In plants, most of the food is made by the leaves.

**Figure 1** shows a section through a plant leaf.

In the leaf, many of the cells contain chloroplasts.

**Figure 1**

1 (b) (i) Chloroplasts contain a green substance. [1 mark]

Name this green substance.

__________________________________________________________________
1 (b) (ii) How does this green substance help chloroplasts to make food? [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

1 (b) (iii) What is the function of the vein shown in Figure 1? [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

1 (b) (iv) Plants make glucose.

Name two substances a plant must take in to make glucose. [2 marks]

1 ______________________________
2 ______________________________

Turn over for the next question
2 (a) Figure 2 shows layers of rock in the Grand Canyon.

![Figure 2](image)

Scientists found fossils of three different species of animal, X, Y and Z, at the positions shown in Figure 2.

2 (a) (i) What is a fossil? [2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

2 (a) (ii) Scientists think that animal Y was alive at an earlier time than animal X.

How does Figure 2 provide evidence for this? [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________
2 (a) (iii) Which two of the following are evidence that animal Y may have evolved from animal Z?

Tick (✓) two boxes.

The fossils of animals X, Y and Z are the same size. [ ]

The fossils of animals Y and Z have many features in common. [ ]

The fossils of animals Y and Z have the same skin colour. [ ]

The fossil of animal Y is more complex than the fossil of animal Z. [ ]

The fossil of animal Y is more similar to the fossil of animal X than to the fossil of animal Z. [ ]

2 (b) Animals X, Y and Z are all now extinct.

2 (b) (i) Give two possible causes of extinction. [2 marks]

1 ____________________________________________________________________________________
_____________________________________________________________________________________

2 ____________________________________________________________________________________
_____________________________________________________________________________________

2 (b) (ii) Scientists cannot be sure about what caused animals X, Y and Z to become extinct.

Suggest why. [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

Turn over for the next question
3 (a) What is an enzyme? [2 marks]

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

3 (b) Enzymes are sometimes used in the home and in industry.

Draw one line from each enzyme to the correct use of that enzyme. [3 marks]

<table>
<thead>
<tr>
<th>Enzyme</th>
<th>Use of enzyme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protease</td>
<td>Removes grease stains from clothes</td>
</tr>
<tr>
<td>Lipase</td>
<td>Pre-digests protein in some baby foods</td>
</tr>
<tr>
<td>Isomerase</td>
<td>Breaks down DNA in genetic fingerprinting</td>
</tr>
<tr>
<td></td>
<td>Changes glucose syrup into fructose syrup</td>
</tr>
</tbody>
</table>

3 (c) Fructose and glucose are two types of sugar.

Fructose tastes much sweeter than glucose. This means that a smaller amount of fructose can be used to give the same sweetness.

3 (c) (i) Why is it an advantage to use fructose instead of glucose in slimming foods? [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________
3 (c) (ii) Figure 3 shows how an enzyme can be used to change glucose into fructose. The enzyme molecules are firmly attached to beads of gel in a glass tube.

**Figure 3**

![Diagram of enzyme attached to beads of gel in a glass tube, with glucose solution in, beads of gel with enzyme attached, glass tube, and fructose solution out]

Give **two** advantages of attaching the enzyme to beads of gel. **[2 marks]**

Tick (✓) **two** boxes.

- The enzyme can be used for more than one type of reaction.  
- The enzyme can easily be used again.  
- The enzyme would be denatured.  
- The fructose solution produced does not have any enzyme in it.  
- There is less contact between the enzyme and the glucose.

**Turn over for the next question**
Alkaptonuria (AKU) is a rare, inherited condition.

(a) The allele that causes AKU is on chromosome number 3.

(a) (i) How many chromosomes are there in most human cells? [1 mark]

Draw a ring around the correct answer.

23 24 46 48

(a) (ii) The allele for AKU is recessive.

What is a recessive allele? [1 mark]

Tick (✓) one box.

An allele that causes a genetic disorder.

An allele that shows its effect only if the dominant allele is not present.

An allele that shows its effect when only one chromosome carries it.
4 (b) Two parents, who do not have AKU, have a child with AKU.

Figure 4 shows how this can happen.

**Figure 4**

<table>
<thead>
<tr>
<th>Man</th>
<th>Woman</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>n</td>
<td>n</td>
</tr>
</tbody>
</table>

Key:
- N  Allele for not having AKU
- n  Allele for AKU

4 (b) (i) Figure 4 is incomplete.

Complete Figure 4 to show the missing combinations of alleles.

Write the correct letters in the two empty boxes.

4 (b) (ii) Draw a ring around one pair of alleles in Figure 4 to show a child with AKU.

4 (b) (iii) The man and woman in Figure 4 want to have another child.

What is the chance that their next child will have AKU?

Draw a ring around the correct answer.

- 0 in 4
- 1 in 4
- 2 in 4
- 3 in 4

Turn over for the next question
A 20-year-old student investigated the effect of exercise on his heart rate. The student:
- measured his resting pulse rate for 15 seconds
- pedalled a stationary exercise bike at a fast pace
- stopped at various time intervals during the exercise to measure his pulse rate for 15 seconds.

5 (a) The student measured his pulse rate each time for 15 seconds. He calculated his pulse rate per minute at the end of the investigation.

5 (a) (i) Suggest why the student measured his pulse rate for only 15 seconds instead of for a full minute.

[1 mark]
_____________________________________________________________________________________
_____________________________________________________________________________________

5 (a) (ii) Table 1 shows the student’s results.

Table 1

<table>
<thead>
<tr>
<th>Time spent exercising in minutes</th>
<th>Measured pulse rate in beats per 15 seconds</th>
<th>Calculated pulse rate in beats per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (resting)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>38</td>
<td>152</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>176</td>
</tr>
<tr>
<td>4</td>
<td>47</td>
<td>188</td>
</tr>
</tbody>
</table>

One of the results is missing from Table 1.

Calculate the missing result.

[1 mark]

Calculated pulse rate = ___________________ beats per minute
5 (b) Doctors recommend that people of different ages should exercise at different intensities. **Figure 5** shows the range of target heart rates during exercise recommended for people of different ages.

**Figure 5**

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Mean heart rate in beats per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td>15</td>
<td>190</td>
</tr>
<tr>
<td>20</td>
<td>180</td>
</tr>
<tr>
<td>25</td>
<td>170</td>
</tr>
<tr>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>35</td>
<td>150</td>
</tr>
<tr>
<td>40</td>
<td>140</td>
</tr>
<tr>
<td>45</td>
<td>130</td>
</tr>
<tr>
<td>50</td>
<td>120</td>
</tr>
<tr>
<td>55</td>
<td>110</td>
</tr>
<tr>
<td>60</td>
<td>100</td>
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<tr>
<td>65</td>
<td>90</td>
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<tr>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>85</td>
<td>50</td>
</tr>
</tbody>
</table>

5 (b) (i) Describe two ways that the target heart rate zone changes as age increases. [2 marks]

1. 

2. 

5 (b) (ii) What range of heart rates during exercise is recommended for the 20-year-old student? Use information from **Figure 5**. [1 mark]

From __________________ to __________________ beats per minute

Question 5 continues on the next page

Turn over ➤
5 (b) (iii) At 4 minutes, the 20-year-old student was cycling at a pace that caused his heart rate to be 188 beats per minute. This was higher than the upper limit of the target heart rate for exercising.

How much higher? [1 mark]

Use your answer to part (b)(ii).

_______________________ beats per minute

5 (b) (iv) The student continued to exercise at this rate for a further 30 minutes.

Suggest one reason why the student should not continue to exercise above the recommended range for 30 minutes. [1 mark]

_____________________________________________________________________________________
_____________________________________________________________________________________

5 (b) (v) The student took part in a training programme for 6 months.

He exercised within the recommended range.

Suggest what effect the training programme would have on his resting heart rate. [1 mark]

_____________________________________________________________________________________

5 (c) Muscles need extra energy during exercise. This energy comes from glucose. Some glucose is stored in the muscles.

5 (c) (i) In what form do muscles store glucose? [1 mark]

Draw a ring around the correct answer.

fructose glycogen protein starch
5 (c) (ii) The increased heart rate during exercise supplied more glucose to the student’s muscle cells.

Which other substance is needed to release energy from glucose?

[1 mark]

_____________________________________

5 (c) (iii) Name the process that releases energy from glucose in cells.

[1 mark]

_____________________________________
6 There are many different types of cell in the human body.

6 (a) (i) Describe where epithelial cells are found in the human body. [1 mark]
_____________________________________________________________________________________
_____________________________________________________________________________________

6 (a) (ii) Figure 6 shows an epithelial cell.

**Figure 6**

- Nucleus
- Ribosomes
- Mitochondria
- A
- B

Name part A and part B. [2 marks]

A ____________________________
B ____________________________

6 (b) What is the function of ribosomes? [1 mark]

Tick (✓) one box.

- Aerobic respiration
- Digestion
- Photosynthesis
- Protein synthesis
6 (c) Carbon dioxide moves out of an epithelial cell by diffusion. [2 marks]
What is diffusion?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Turn over for the next question
In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

**Figure 7** shows part of a plant called cross-leaved heath.

A student noticed that some areas of marshland contained cross-leaved heath plants and some areas did not.

The student made the following hypothesis:

‘Soil pH affects the amount of cross-leaved heath plants that grow in an area.’

How could the student use apparatus, including the quadrat and pH meter shown in **Figure 8**, to find the range of pHs where the cross-leaved heath plants grew best?

You should include details of how the student could make sure the results are valid.

[6 marks]
Amylase is an enzyme that breaks down starch.

8 (a) Complete the equation to show the breakdown of starch.

\[ \text{Starch} \xrightarrow{\text{amylase}} \] 

[1 mark]

8 (b) Some students investigated the effect of pH on the activity of amylase.

The students:
- put 5 cm\(^3\) of pH5 solution + 1 cm\(^3\) of amylase solution into a test tube
- put 4 cm\(^3\) of starch suspension into a second test tube
- left both test tubes at room temperature for 5 minutes
- mixed the contents of the two test tubes
- removed a small sample of the mixture at 1-minute intervals
- tested each sample for starch
- timed how long it took to break down all the starch
- repeated each of the above steps at pH6, pH7 and pH8.

Figure 9 shows the students’ results.
8 (b) (i) Give two variables which were controlled in this investigation. [2 marks]

1

2

8 (b) (ii) The students tested samples of the reaction mixture for starch. In each test, they added one drop of the reaction mixture to one drop of iodine solution on a white tile.

- Iodine solution = light brown colour
- Iodine solution + starch = dark blue colour

Predict the colour seen in the iodine test on the samples of the pH6 reaction mixture at 4 minutes and at 6 minutes. [1 mark]

4 minutes _____________________________
6 minutes _____________________________

8 (b) (iii) The students concluded that amylase works best at pH7. This may not be a valid conclusion.

Suggest two improvements to the investigation that would increase the validity of the students’ conclusion. [2 marks]

1

2

Question 8 continues on the next page
8 (b) (iv) The students repeated the investigation at pH3.

What result would you expect at pH3?

Give a reason for your answer. [2 marks]

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

_____________________________________________________________________________________

END OF QUESTIONS