



MINISTRY OF EDUCATION, SINGAPORE  
in collaboration with  
CAMBRIDGE ASSESSMENT INTERNATIONAL EDUCATION  
General Certificate of Education Ordinary Level

CANDIDATE  
NAME

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CENTRE  
NUMBER

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INDEX  
NUMBER

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## BIOLOGY

**6093/02**

Paper 2

**For examination from 2024**

SPECIMEN PAPER

**1 hour 45 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

### READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, glue or correction fluid.

**DO NOT WRITE ON ANY BARCODES.**

#### Section A

Answer **all** questions.

Write your answers in the spaces provided.

#### Section B

Answer **one** question.

Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **18** printed pages and **2** blank pages.



Singapore Examinations and Assessment Board



Cambridge Assessment  
International Education

**Section A**

Answer **all** questions.

1 (a) Proteins are digested in the stomach and small intestine.

(i) State the type of enzyme that breaks down proteins.

..... [1]

(ii) State how the environment necessary for the digestion of proteins in the stomach is different from that in the small intestine.

.....  
..... [1]

(b) When carbohydrates have been digested, excess glucose is stored.

(i) State where in the body the excess glucose is stored.

..... [1]

(ii) State the name of the molecule it is stored as.

..... [1]

(c) Excess amino acids cannot be stored.  
Describe how they are removed from the body.

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.....  
..... [4]

**[Total: 8]**

2 Gaseous exchange takes place in the alveoli in the lungs. Oxygen diffuses from the alveoli into the blood.

(a) (i) Define the term *diffusion*.

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

(ii) State what causes oxygen to diffuse from the alveoli into the blood.

.....  
..... [1]

(iii) Describe the journey taken by blood from the heart to the lungs, and back to the heart again.

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.....  
.....  
.....  
..... [3]

(b) (i) At high altitudes there is less oxygen in the air than at sea level. Suggest and explain how this might affect the uptake of oxygen from the alveoli into the blood in a person climbing a mountain.

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

(ii) In the past, some athletes have injected themselves with extra red blood cells before a major competition. Predict how this increase in red blood cells might affect their performance.

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..... [2]

[Total: 10]

[Turn over

3 Fig. 3.1 represents four genes on a part of the X chromosomes from a body cell of a woman.

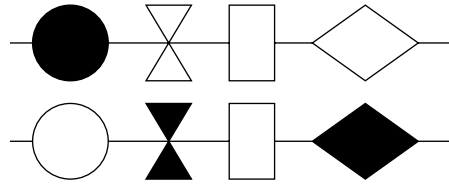


Fig. 3.1

(a) (i) In the space below, draw **one** allele shown in Fig. 3.1.

[1]

(ii) In the space below, draw the genes in Fig 3.1 as they would appear in a gamete.

[2]

(b) Fig. 3.2 shows the same section of an X chromosome in another cell of the same person in which the structure of one of the genes has changed.

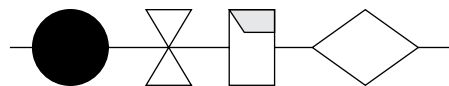


Fig. 3.2

(i) State the name given to such a change in a gene.

..... [1]

(ii) Suggest a possible cause of such changes in genes.

..... [1]

(c) A person's blood group is determined by genes inherited from each parent. Explain why a person with blood group AB would **not** be expected to have an offspring with blood group O.

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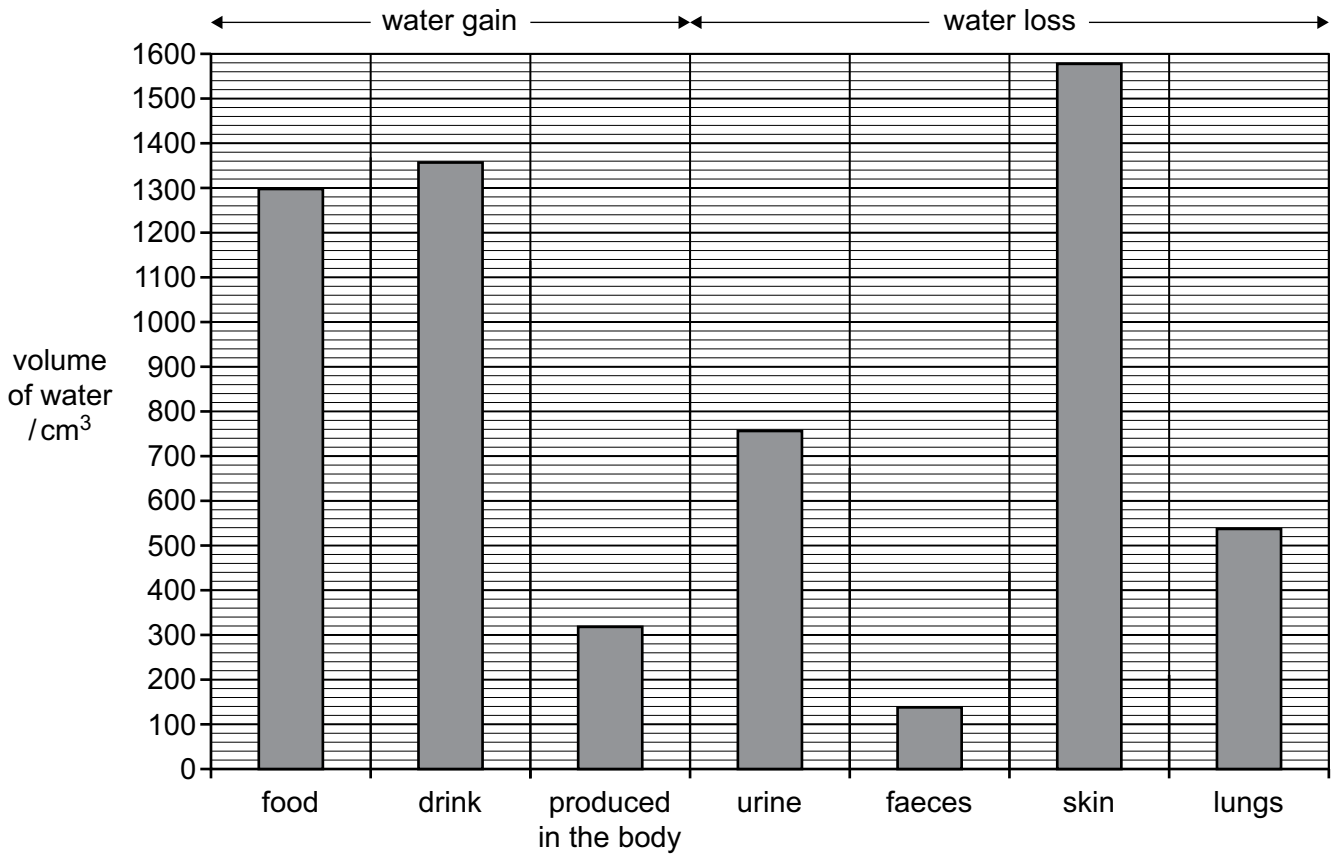
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..... [3]

**[Total: 8]**

4 Fig. 4.1 shows the volume of water gained and lost per day by a person living in a tropical climate.



**Fig. 4.1**

(a) (i) State the form in which water is lost from the lungs.

..... [1]

(ii) Name a process which produces water in the body.

..... [1]

(b) With reference to Fig. 4.1, what is the total gain of water in a day?  
(You may use the space below for your working.)

..... [1]

(c) Suggest and explain two ways in which the figures in the bar chart would change in a cold climate.

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..... [4]

(d) Approximately 190 dm<sup>3</sup> of water is filtered through the kidneys each day. Use this information and the figures in the bar chart to explain what happens to this water in the kidneys.

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..... [2]

**[Total: 9]**

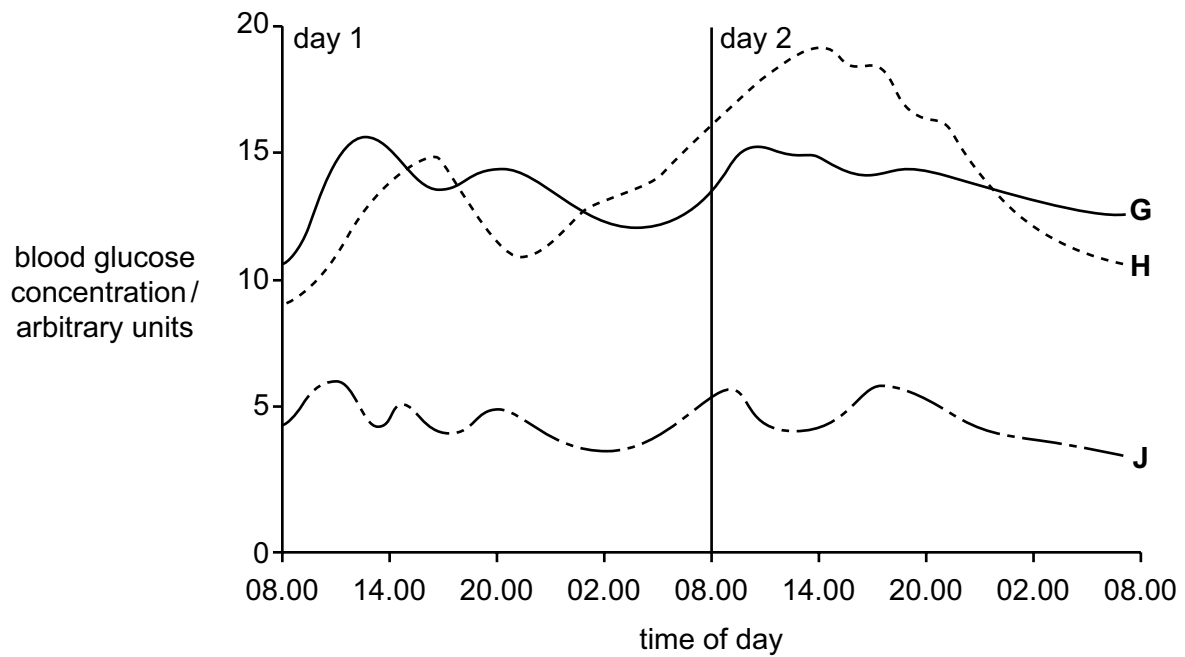
- 5 (a) (i) State the name for chemicals that are secreted by glands into the blood and that affect organs elsewhere in the body.

..... [1]

- (ii) State the term used to describe the organs that are affected by these chemicals.

..... organs [1]

- (b) Fig. 5.1 shows the blood glucose concentrations of three different people, **G**, **H** and **J**, over a 48-hour period.



**Fig. 5.1**

Two of the people are diabetic. The pancreas of the first diabetic person produces small quantities of insulin. In the second person, the pancreas produces no insulin. The third person is **not** diabetic.



Using the information in Fig. 5.1 and giving a reason for your answer in each case, identify:

(i) the person without diabetes

.....  
*reason* .....

(ii) the person who produces no insulin

.....  
*reason* .....

[4]

(c) Diabetes can be treated by injection of insulin.  
Insulin can now also be taken by breathing it in.  
Suggest how insulin taken by breathing it in enters the blood.

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[2]

[Total: 8]

- 6 A student investigated the distribution of stomata in the upper and lower epidermis of plant leaves. Five different plant species were investigated and the results are shown in Table 6.1.

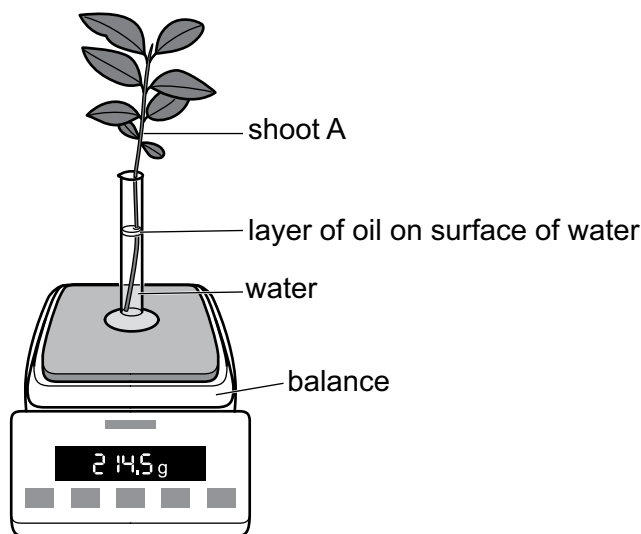
**Table 6.1**

species	number of stomata per mm <sup>2</sup>	
	upper epidermis	lower epidermis
A	0	141
B	40	176
C	85	156
D	12	130
E	77	88

- (a) Identify a pattern in the data about the distribution of stomata in the five species.

.....  
 ..... [1]

- (b) The student placed a shoot of species A in a measuring cylinder of water for 48 hours. The apparatus was weighed at the start and the end of the experiment to determine the mass of water lost. The apparatus is shown in Fig. 6.1.



**Fig. 6.1**

- (i) Suggest why there is a layer of oil on the surface of the water in the measuring cylinder.

.....  
 ..... [1]

- (ii) Plant shoot A has an estimated leaf surface area of  $45\text{ cm}^2$ . The mass of the apparatus at the start of the experiment was  $214.5\text{ g}$  and after 48 hours it was  $211.8\text{ g}$ . Calculate the mass of water lost per  $\text{cm}^2$  of leaf surface area per day.

Show your working.

mass of water lost .....  $\text{g/cm}^2/\text{day}$  [2]

- (iii) Using information in Table 6.1, predict and explain which species will lose the most water per  $\text{cm}^2$  of leaf area per day.

species .....

explanation .....

..... [2]

- (iv) Suggest **one other** feature of a leaf's surface structure that may affect the mass of water lost per  $\text{cm}^2$ .

..... [1]

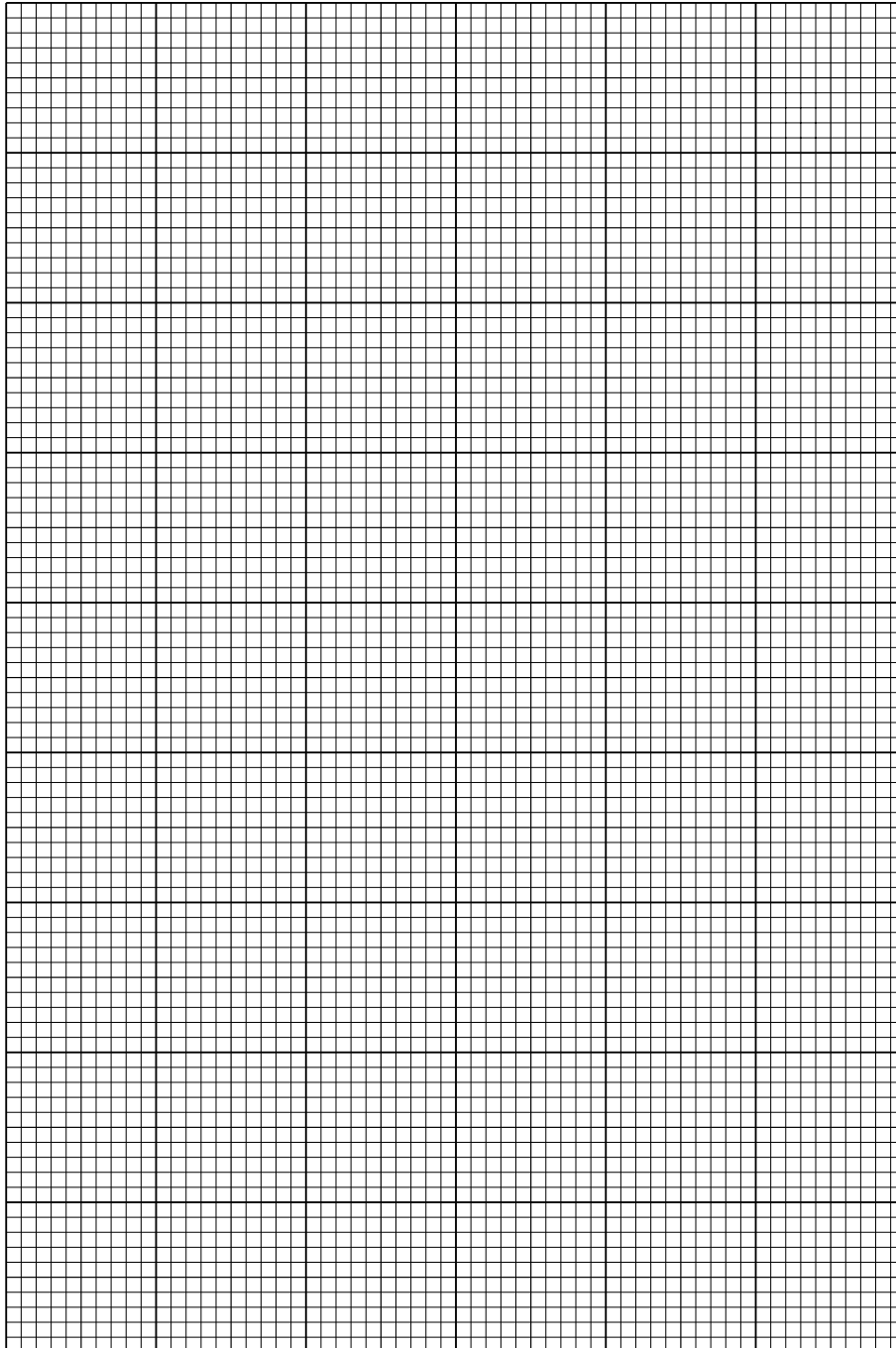
**[Total: 7]**

- 7 Table 7.1 shows the effect of temperature on the clotting time of the blood. The clotting of blood involves enzymes.

**Table 7.1**

temperature/°C	10	15	20	25	30	35	40	45
clotting time/s	86	58	48	40	30	24	32	58

- (a) Plot a graph of these data.



[4]

(b) With reference to Table 7.1 and to the graph drawn in (a), describe the relationships between temperature and blood clotting.

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..... [3]

(c) Describe the role of platelets in protecting the body from infection by pathogens.

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..... [3]

**[Total: 10]**

8 (a) Explain the role of chlorophyll in photosynthesis.

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..... [2]

(b) (i) A young, growing plant was planted in a pot of soil. The parts of the plant that were above the soil were placed in a sealed transparent bag containing radioactive carbon dioxide. It was then left in the light.  
After six hours radioactive carbon was found in the leaves, roots and the soil.  
Explain the presence of the radioactive carbon in the leaves, roots and the soil.

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..... [5]

(ii) Explain how the radioactive carbon in the plant could become part of the tissues of a primary consumer, such as a cow.

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..... [3]

[Total: 10]



**Section B**

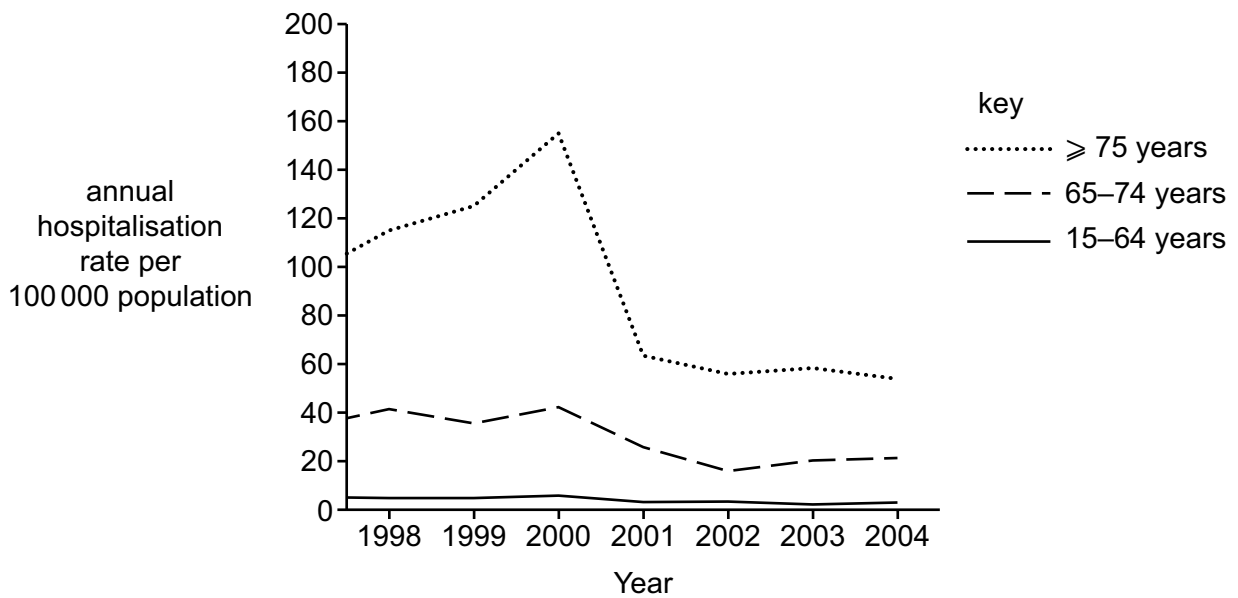
Answer **one** question from this section.

**9** Pneumococcal disease is caused by a bacterium called *Streptococcus pneumoniae*.

(a) Describe **two** features of a bacterial cell that are different from an animal cell.

- 1 .....
- 2 ..... [2]

(b) Fig. 9.1 shows the annual hospitalisation rate for pneumococcal disease by age group in Singapore between 1998 and 2004.



**Fig. 9.1**

Using Fig. 9.1, describe the differences in the hospitalisation rate for people aged 75 and above with people aged 15 to 74.

Suggest a reason for the differences.

- .....
- .....
- .....
- .....
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- .....
- .....
- ..... [3]



- (c) Vaccines and antibiotics are used in different ways to reduce the number of deaths from pneumococcal disease.

Explain the different ways in which vaccines and antibiotics are used.

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[5]

**[Total: 10]**

- 10 A student investigated the flow of biomass and energy on a farm. The farm grows wheat to feed to the animals, which are kept in sheds where they are not allowed to move very much.

The student investigated the efficiency of this method of producing food for humans.

The student found that an area of 250 m<sup>2</sup> of wheat provided 140 kg of animal feed from the wheat crop.

Table 10.1 shows the results of the investigation.

**Table 10.1**

area of wheat field /m <sup>2</sup>	250
energy from the Sun that is available to the wheat crop/kJ	90 000 000
biomass of animal feed from the harvested wheat crop/kg	140
energy in 140 kg of animal feed /kJ	2 000 000
increase in mass of animals fed 140 kg feed/kg	50
energy in 50 kg meat that could be transferred to humans/kJ	380 000

- (a) Table 10.1 shows how much energy the wheat crop receives from the Sun while it is growing in the field.

Suggest **three** reasons why only a small proportion of that energy is available in the animal feed from the harvested wheat.

- 1 .....
- .....
- 2 .....
- .....
- 3 .....
- .....

[3]

- (b) Calculate the energy in the meat that could be transferred to humans, as a percentage of the energy in the animal feed. Show your working.

answer .....% [2]

(c) Using the information in Table 10.1, explain why it is more efficient for humans to gain their food from the first trophic level rather than from the second trophic level.

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..... [3]

(d) Another student repeated the investigation and obtained a different set of results. Suggest **two** reasons for the different set of results obtained.

1 .....  
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2 .....  
..... [2]

**[Total: 10]**

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