G

KU   PS

Total Marks

0300/401

NATIONAL
QUALIFICATIONS
2000

MONDAY, 29 MAY
9.00 AM – 10.30 AM

BIOLOGY
STANDARD GRADE
General Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day   Month   Year   Scottish candidate number   Number of seat

1 All questions should be attempted.

2 The questions may be answered in any order but all answers are to be written in the
   spaces provided in this answer book, and must be written clearly and legibly in ink.

3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this
   book. Additional spaces for answers and for rough work will be found at the end of the
   book. Rough work should be scored through when the fair copy has been written.

4 Before leaving the examination room you must give this book to the invigilator. If you do
   not, you may lose all the marks for this paper.

SCOTTISH
QUALIFICATIONS
AUTHORITY

1. The diagram shows the positions of some 1 m² quadrats under an oak tree.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | quadrat number
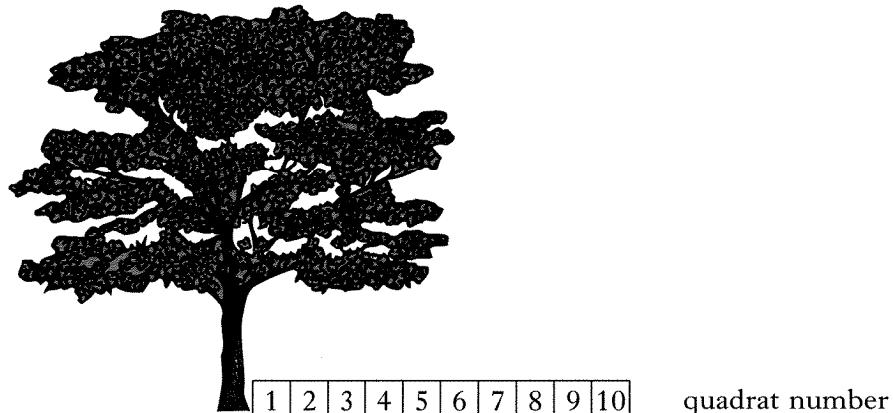
The graph below shows the results of an investigation into the number of daisies growing under the tree.

Number of
daisies per m²
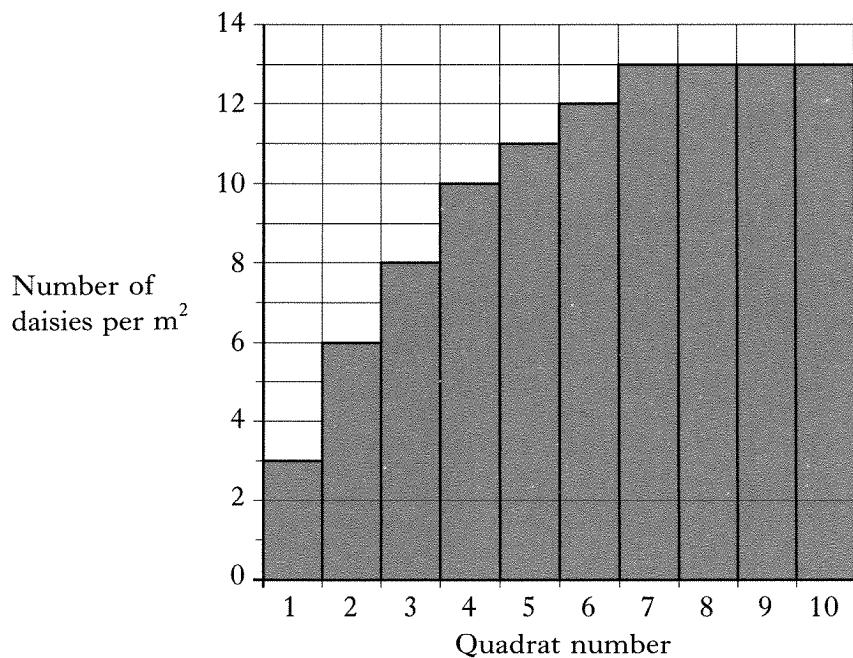
Quadrat number

(a) How many daisies per m² were found in quadrat 6?

_____

(b) Which quadrat closest to the tree contained more than 10 daisies per m²?

Quadrat _____

Marks | KU | PS

1. (continued)

(*c*)   (i)   Describe the relationship between the number of daisies per m^2 and the distance from the tree trunk in quadrats 1 to 7.

_____

_____   1

(ii)   Suggest a reason why there is no change in the results for quadrats 8, 9 and 10.

_____

_____   1

(*d*)   The area covered by the tree branches was 150 m^2 and the average number of daisies was 9 daisies per m^2.

Calculate the total number of daisies growing under the tree.

Space for calculation

_____ daisies   1

[Turn over

2. (*a*) Decide if each of the following statements is **True** or **False** and tick (✓) the appropriate box.

If the statement is **False**, write the correct word in the **Correction** box to replace the word underlined.

Statement	True	False	Correction
The place where an organism lives is its biosphere			
All the members of one species living together are called a community			
All the living things and their environment together make an ecosystem			

(*b*) Samples of invertebrate animals were collected in two separate areas. The table shows the percentages of each type of animal in the survey.

Type of animal	Area	
	Bushes	Playing field
flies	60%	50%
beetles	35%	36%
spiders	5%	4%
ants	0%	10%

(i) Complete and label the **pie chart** below to show the proportions of animals found in the area of the **bushes**.

(An additional pie chart will be found, if required, on page 29.)

Marks

3

2
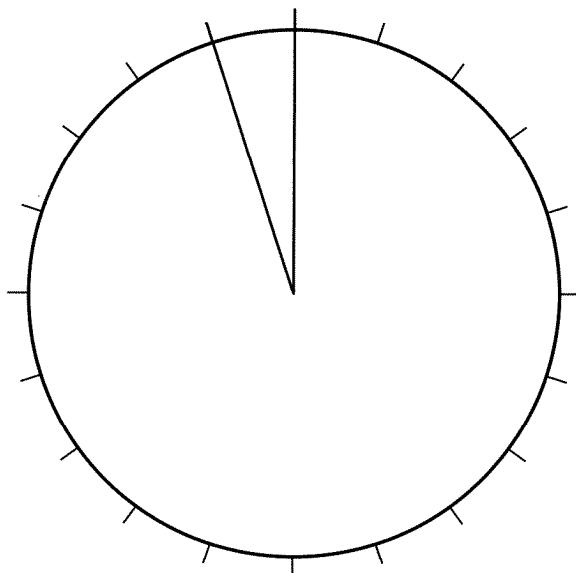
2. (b) (continued)

(ii) 150 animals were collected in the playing field. How many were beetles?

Space for calculation

_____ beetles

1

(iii) What was the ratio of flies to spiders in the area of the **bushes**? Show your answer as a simple whole number ratio.

Space for calculation

_____ : _____

Flies : Spiders

1

(iv) Choose **one** animal from the table and suggest a suitable method for obtaining a sample.

Type of animal _____

Method of obtaining a sample _____

_____

1

(v) Which of the following are **abiotic** factors that may vary between the two areas?

Tick (✓) the correct box.

Number of predators **and** soil pH ☐

Light intensity **and** water availability ☐

Number of producers **and** temperature ☐

Soil pH **and** number of producers ☐

1

[Turn over

3. The following diagram shows a section through a flower.
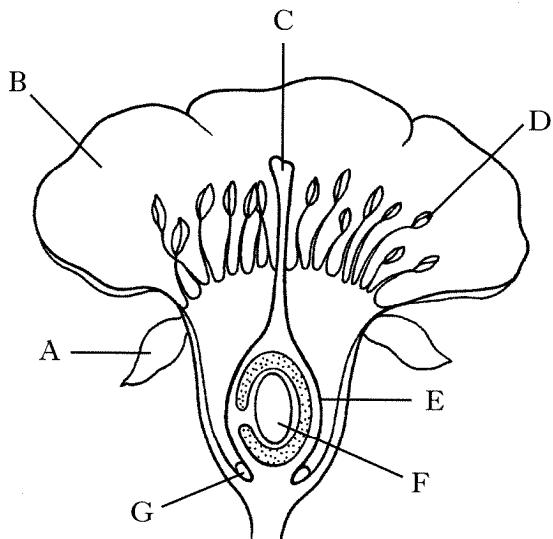
(a) Complete the following table which relates to the flower diagram.

Name of structure	Function	Letter
	produces the male gametes	D
sepal		A
stigma	receives the pollen grains	

(b) Name **two** possible methods of pollination used by flowering plants.

1 _____

2 _____

(c) Identify the site of fertilisation in the flower by naming the structure **or** its letter from the diagram.

_____

3. (continued)

(d) The boxes below show the names and descriptions of some important processes in plant reproduction.

Names of processes   *Descriptions*

| asexual reproduction |

| seeds start to grow |

| pollination |

| pollen is transferred from anther to stigma |

| germination |

| development of the ovary around the seed or seeds |

| fruit formation |

| production of identical offspring from a single parent |

Use lines to join each of the named processes on the left, to its correct description on the right.

2

(e) (i) Name **one** method of natural asexual reproduction used by plants.

_____

1

(ii) Name **one** method of artificial propagation used with plants.

_____

1

[Turn over

4. (*a*) The diagram below shows an investigation into the effect of carbon dioxide on photosynthesis.

Destarched leaves were placed in flasks containing liquids as shown.

A

B
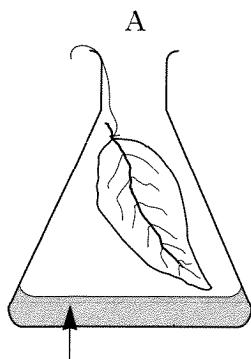
liquid which produces
carbon dioxide gas
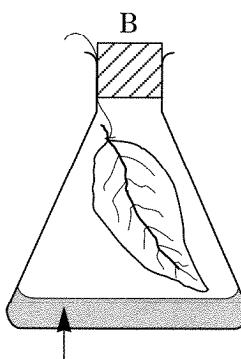
liquid which absorbs
carbon dioxide gas

After 24 hours in well lit conditions, the leaves were tested for starch.

(i) Complete the table below to show the results of the experiment.

Leaf	Starch present (✓ or ✗)
A	
B	

1

(ii) Name **two** factors which must be kept the same for A and B.

1 _____

2 _____

2

(iii) How should the apparatus shown in the diagram be improved to make sure that the experiment is valid?

_____

_____

1

4. (continued)

(b) Another investigation was carried out on photosynthesis.

lamp

leaf disc

tube of water
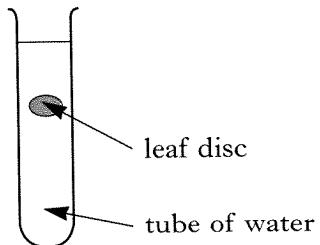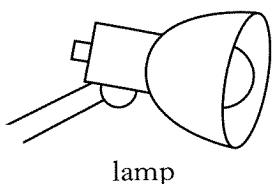
After some time, the leaf disc floated to the surface. The disc floats up because bubbles of a gas are produced in the leaf.

The time taken for this to happen was measured.

(i) The experiment was repeated five times.

The table shows the results.

Time taken for leaf disc to float (seconds)
5
8
12
6
9

Average time	

Complete the table by calculating the average time for the leaf discs to float.

Space for calculation

1

(ii) Why was it good experimental technique to repeat the experiment 5 times?

_____

_____

1
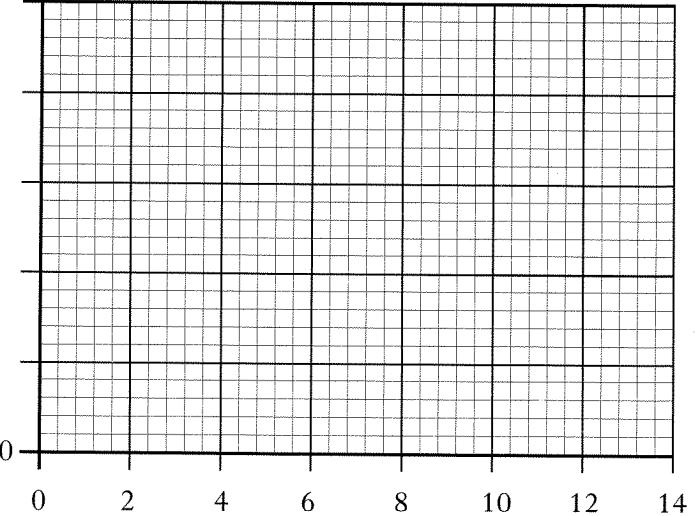
(iii) Name the gas produced during photosynthesis.

_____

1

(iv) Name the green chemical which converts light energy to chemical energy in the leaf.

_____

1

5. (*a*) Rennin is an enzyme that clots milk in the stomach of calves.

The table shows the results of an investigation on the effect of pH on the time taken for rennin to clot milk.

pH	Time to clot milk (minutes)
1	1
5	3
7	7
9	11
13	23

(i) On the grid below, plot a **line graph** by

   1   completing the horizontal **axis**   1

   2   putting a **scale** on the vertical axis   1

   3   plotting the **graph**.   1

(Additional graph paper, if required, will be found on page 29.)

Time to clot milk
(minutes)

0

   0   2   4   6   8   10   12   14

(ii) At which pH did rennin clot the milk the quickest?

pH _____   1

(*b*) (i) Name an enzyme which causes the chemical breakdown of a substance.

_____   1

(ii) Name an enzyme which causes the synthesis (chemical build up) of a substance.

_____   1

6. (*a*) The diagram below shows the result of an experiment using *Euglena*. *Euglena* is a unicellular organism which lives in water.

Even lighting all round   **Bright light coming from one side**
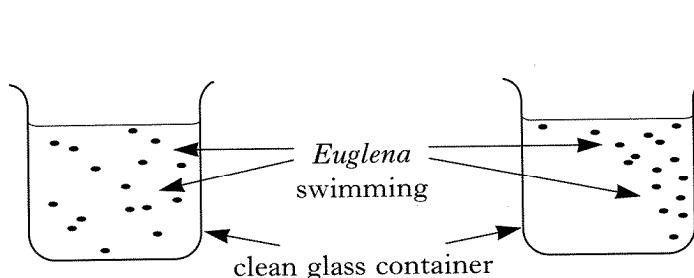
Describe the response of *Euglena* to the light.

_____

_____

1

(*b*) Give **one** example of rhythmical behaviour in animals.
Name the external stimulus which triggers this behaviour.

Example _____

External stimulus _____   1

(*c*) The following list contains the names of structures in the eye.

List   retina
       iris
       cornea
       lens

Write the name of each structure against its function in the table.
Each structure should be used only once.

Structure	Function
	allows light to enter the eye
	converts light to nerve impulses
	controls how much light enters the eye
	focuses light

2

7. Read the following passage.

Life in the compost heap.   Adapted from *Biological Sciences Review*, September 1998.

Far from merely being a pile of rotting rubbish, a compost heap in the garden is an ecosystem with a community of billions of organisms. In a good compost heap, waste materials rot away rapidly to produce a fertile soil improver. This involves providing the right conditions for the decomposer organisms. They require food, water, air and warmth. The food is provided by the material you add to the heap, which can be anything organic—from grass clippings and weeds to kitchen waste and even paper.

Fungi and bacteria start the process of decay by consuming the organic material. There can be as many as one billion in a single teaspoonful of compost. Their respiration produces heat and the heap can increase in temperature by 10 °C every 5 days. The ideal temperature is 45 °C.

Bacteria are excellent food for various creatures such as protozoans and nematodes. Nematodes are tiny threadlike worms which are eaten by larger creatures called mites. Centipedes patrol the heap feeding on both mites and the protozoans, and they themselves are excellent prey for birds such as the robin which visit the heap.

Compost is spread on garden soil to improve the soil structure. In addition, it contains 5% of useful plant nutrients released from the original material.

Answer the following questions, based on the passage.

(*a*) Name the **four** conditions required by decomposer organisms.

_____ _____ _____ _____

1

(*b*) Give **two** ways in which energy may be lost from the compost heap.

1 _____

2 _____

2

(*c*) Select a phrase from the passage which suggests that the compost heap recycles valuable materials for plant growth.

_____

_____

1

(*d*) From the information in the passage, give **two** benefits to a gardener of having a good compost heap.

1 _____

1

2 _____

1

7. (continued)

(*e*) Use information from the passage to calculate the mass of useful plant nutrients which would be contained in 5 kg of compost.

Space for calculation

_____ g

(*f*) Use the information in the passage to complete the food web below.

```
        ┌─────────────────────┐
        │                     │
        └─────────────────────┘
                  ▲
        ┌─────────────────────┐
        │     centipedes      │
        └─────────────────────┘
              ▲          ▲
        ┌─────────────────────┐
        │                     │
        └─────────────────────┘
           ▲              ▲
  ┌──────────────┐   ┌──────────────┐
  │  nematodes   │   │  protozoans  │
  └──────────────┘   └──────────────┘
       ▲      ◄           ▲
  ┌──────────────┐   ┌──────────────┐
  │    fungi     │   │              │
  └──────────────┘   └──────────────┘
         ◄              ►
        ┌─────────────────────┐
        │    garden waste     │
        └─────────────────────┘
```

1

2
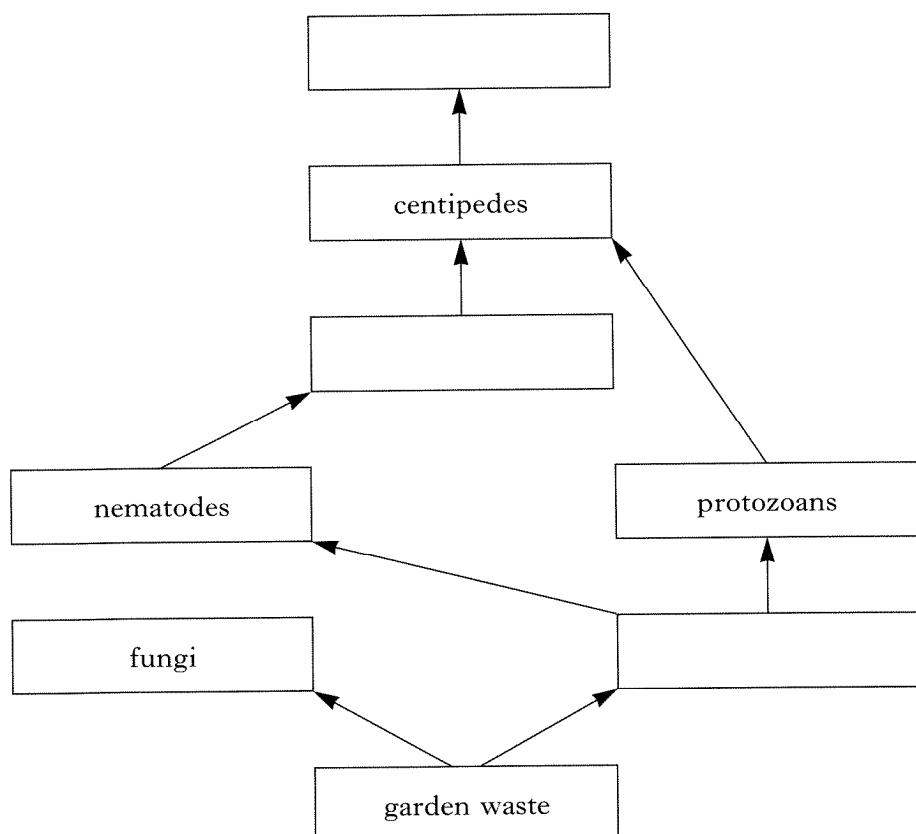
[Turn over

8. In an investigation on the effects of exercise on pulse rate, two 14 year old boys undertook a three minute period of exercise. They measured their pulse rates at three minute intervals, before and after the exercise.

Pulse rate
(beats per minute)

period of
exercise

Time (minutes)
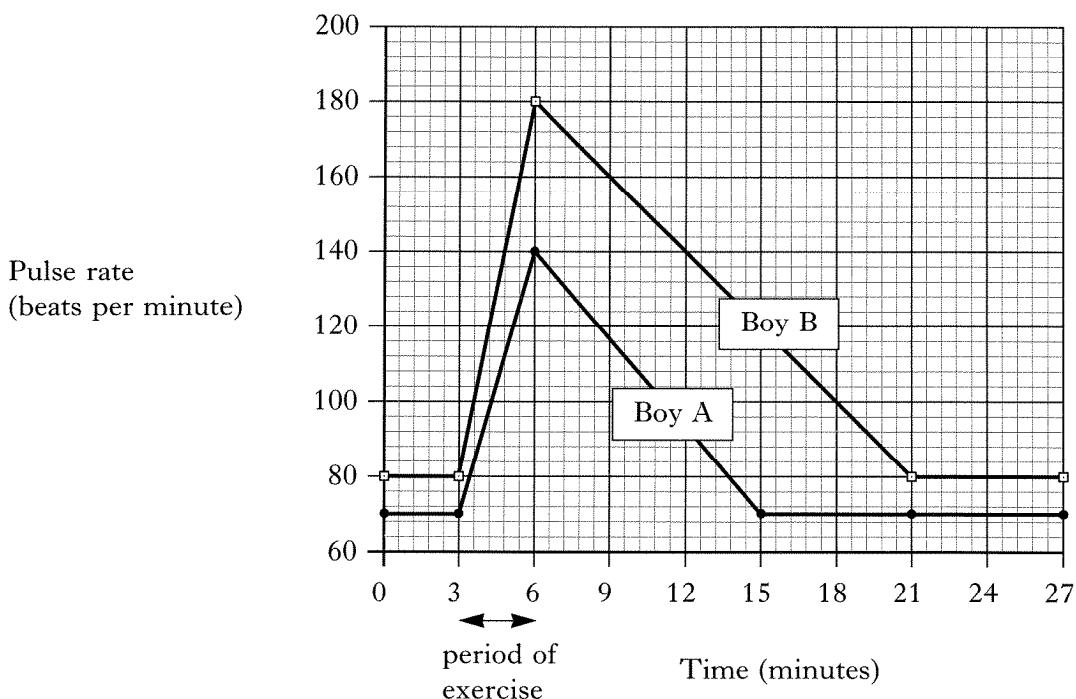
(a) What is the resting pulse rate of each boy?

Boy A _____ beats per minute

Boy B _____ beats per minute

1

(b) How long did it take for Boy A's pulse rate to return to normal after the exercise stopped?

Space for calculation

_____ minutes

1

(c) Calculate the increase in pulse rate of Boy B during the three minute period of exercise.

Space for calculation

_____ beats per minute

1

9. (a) The diagram below shows a healthy human kidney.
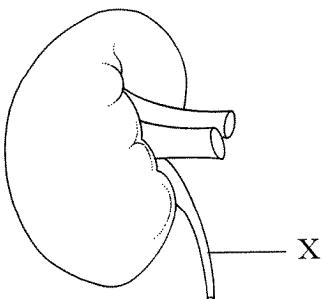
Name the structure labelled X on the diagram.

_____

(b) Complete the following sentences using the words from the box. Each word may be used **once**, **more than once** or **not at all**.

| vein | artery | glucose | protein | excreted | reabsorbed |

Blood is taken to the kidneys in the renal _____ . In the

kidney _____ is filtered out of the blood and then

_____ .

(c) Complete the table below to show the gains and losses of water by a small mammal each day.
Space for calculation

Water gain (cm³)		Water loss (cm³)	
food	170	urine	300
drink		faeces	
		sweat	100
chemical reactions	70	breath	78
Total	500	**Total**	500

(d) Humans will die if water loss reaches 20% of body weight.
What weight of water loss would result in the death of a person weighing 70 kg?
Space for calculation

Weight loss _____ kg

10. (a) The diagram shows an egg cell about to be fertilised by a sperm.

nucleus

nucleus

sperm

egg
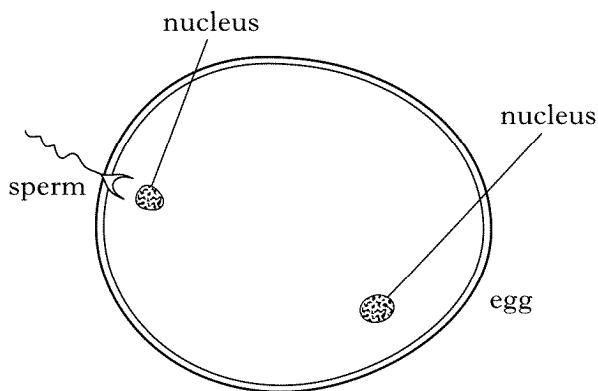
Describe what would happen next, to complete fertilisation.

_____

_____

1

(b) Where are human sperm cells produced?

_____

1

(c) Name the organ in which a human fetus completes its development.

_____

1

(d) A human sperm cell can swim at a rate of 2 mm per minute. How long would it take a sperm cell to swim 15 cm, to reach an egg inside the oviduct?

Space for calculation

_____ minutes

1

11. The diagram below shows a magnified root tip. The diagram is divided into regions W, X and Y. One cell from each region is shown.
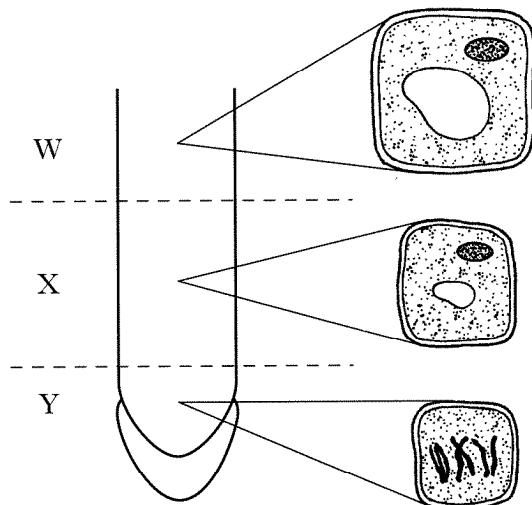
(*a*) (i) Cells from region Y divide by mitosis. Which part of a cell controls cell division?

_____

(ii) The cell shown from region Y is dividing. Which of the following shows the cell during the **next** stage of mitosis?

Tick (✓) the correct box.

☐   ☐   ☐   ☐
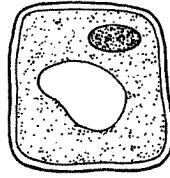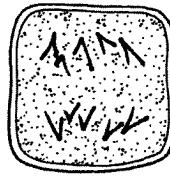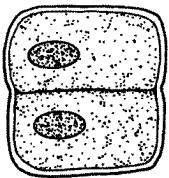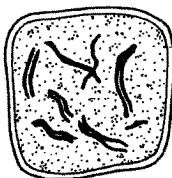
(*b*) (i) Cells from region X swell as water diffuses into them. Describe the difference in water concentration between the inside and outside of the cells.

_____

_____

(ii) What word is used to describe the diffusion of water into or out of cells?

_____

[Turn over

12. An experiment was carried out into the diffusion of water in potato cells. Pieces of potato were cut into cubes as shown.

A

1 cm
1 cm
1 cm

B

2 cm
2 cm
2 cm
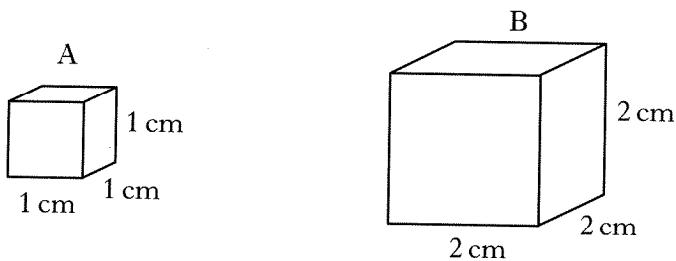
The cubes were weighed before being put into beakers of water. At various times the cubes were removed and re-weighed. The results are shown on the graph.
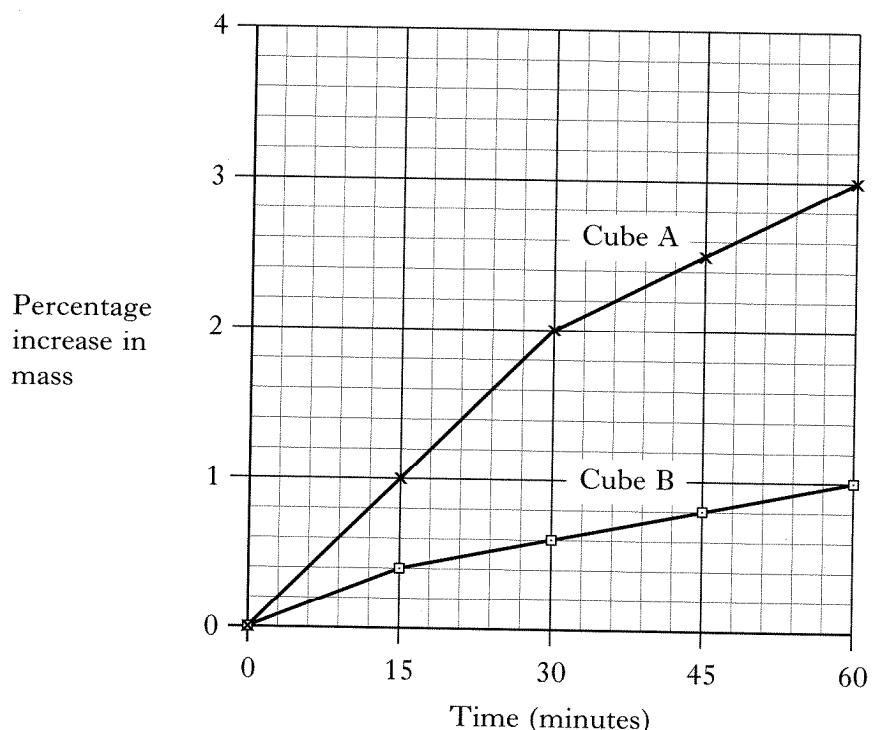
(a) What was the percentage increase in the mass of potato cube B after 30 minutes?

_____ %

1

(b) How long did it take potato cube A to increase in mass by 1%?

_____ minutes

1

12. (continued)

(c) Complete the table below to show the calculation of the total surface area : volume ratio of potato cube B.

Space for calculation.

	Cube A		Cube B	
Surface area of one side	$1\,cm \times 1\,cm$	$= 1\,cm^2$	_____	$=$_____cm^2
Total surface area	$6 \times 1\,cm^2$	$= 6\,cm^2$	_____	$=$_____cm^2
Volume	$1\,cm \times 1\,cm \times 1\,cm$	$= 1\,cm^3$	_____	$=$_____cm^3
Total surface area : volume ratio	6 : 1		3 : 1	

2

(d) Describe the effect of a decrease in total surface area : volume ratio on the movement of water into the potato tissue.

_____

_____

1

[Turn over

13. (a) In cheese making, the milk is separated into curds and whey. Every kilogram of milk produces 125 g of cheese and 875 g of whey. Traditionally, the whey was often dumped into rivers. Nowadays it is upgraded into other products.

The chart below shows some of these products.

Whey

no micro-organisms used   fermentation

bacteria   yeast

| animal feeds | lactose sugar | whey butter | methane | |
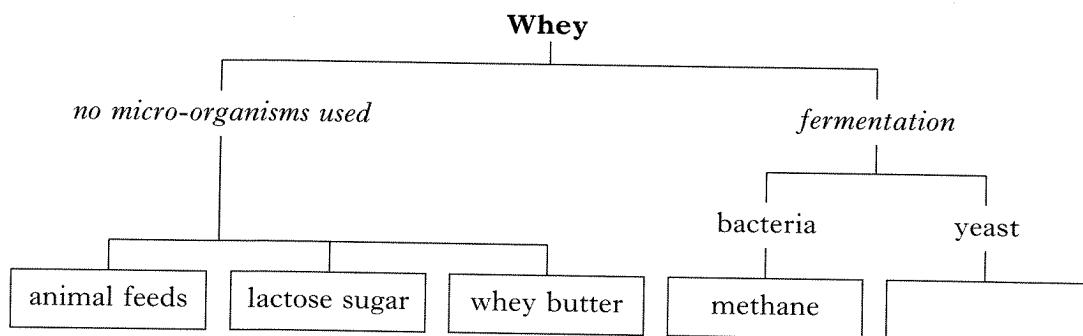
(i) Complete the chart by writing the name of a product of yeast fermentation.

1

(ii) Why is it economically important to upgrade waste whey?

_____

1

(iii) Calculate the ratio of cheese to whey produced in cheese making. Give your answer as a single whole number ratio.

Space for calculation

_____ : _____
Cheese : Whey

1
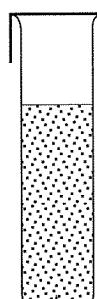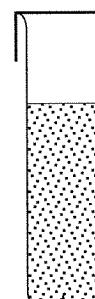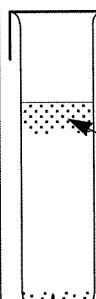
(iv) Methane is a useful fuel gas. What is the advantage of obtaining energy from fermentation products, rather than from fossil fuels?

_____

1

## 13. (continued)

(b) The diagram shows an investigation on the growth of a bacteria with different fungi. The bacteria and fungi were added to tubes of sterile nutrient broth. Their appearance after several days is shown below.

Tube	A	B	C	D
Contents	sterile broth bacteria	sterile broth bacteria fungus X	sterile broth bacteria fungus Y	sterile broth
Appearance	bacteria	bacteria and fungus X	fungus Y dead bacteria	lid broth

(i) Why were lids put on the tubes during the experiment?

_____

1

(ii) In which tube would there have been the greatest bacterial growth?

_____

1

(iii) Suggest a reason why the bacteria in tube C died.

_____

1

[Turn over

14. (*a*) The table shows the energy used per hour by a man for different activities.

Activity	Energy used (kJ/hour)
sleeping	400
sitting	500
walking	1000
swimming	1700
running	2800

(i) Complete the **bar chart** below using information from the table. (An additional bar chart, if required, will be found on page 30).

Energy used
(kJ/hour)

0

sleeping   sitting   walking   swimming   running
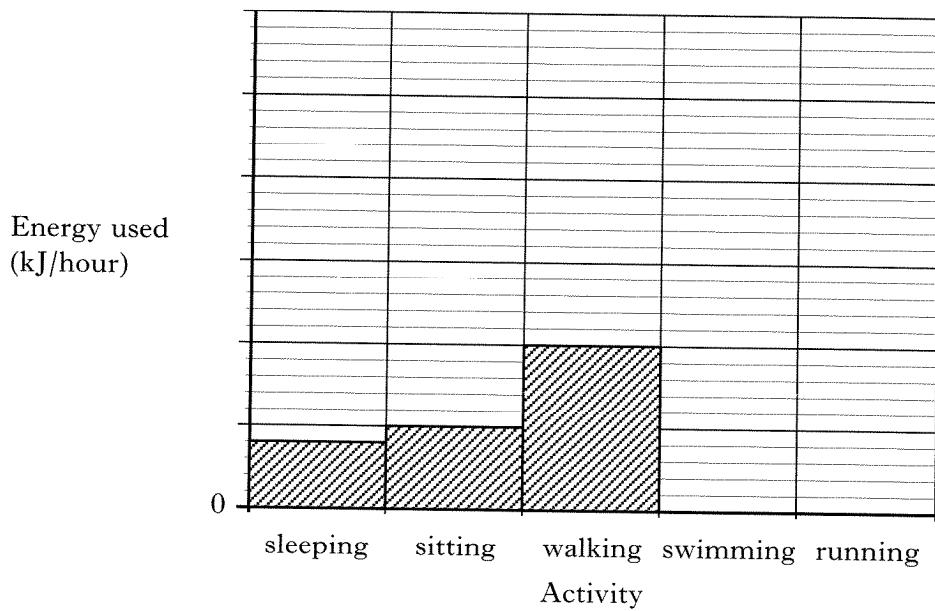
Activity

(ii) Which activity uses 150% more energy than sleeping?
Space for calculation

_____

Marks | KU | PS

14. (continued)

(b) The daily energy needs of three different people are shown in the table below.

Person	Energy needs (kJ/day)	Effect on body weight
pregnant woman	10 010	
plumber	13 500	
bricklayer	21 840	

Each person is placed on a diet providing 13 500 kJ/day for three weeks. Complete the table to show the effect on their body weight.

1

(c) A growing child needs 2 grams of protein **per day** for each kilogram of body weight.

How many grams of protein would a child weighing 10 kg require to eat in **one week**?

Space for calculation

_____ grams

1

[Turn over

15. (a) The ability to taste the chemical PTU is controlled by a single gene. People can be either tasters or non-tasters.

The family tree below shows the inheritance of PTU tasting.

☐ taster males   ◯ taster females

▨ non-taster males   ▨ non-taster females
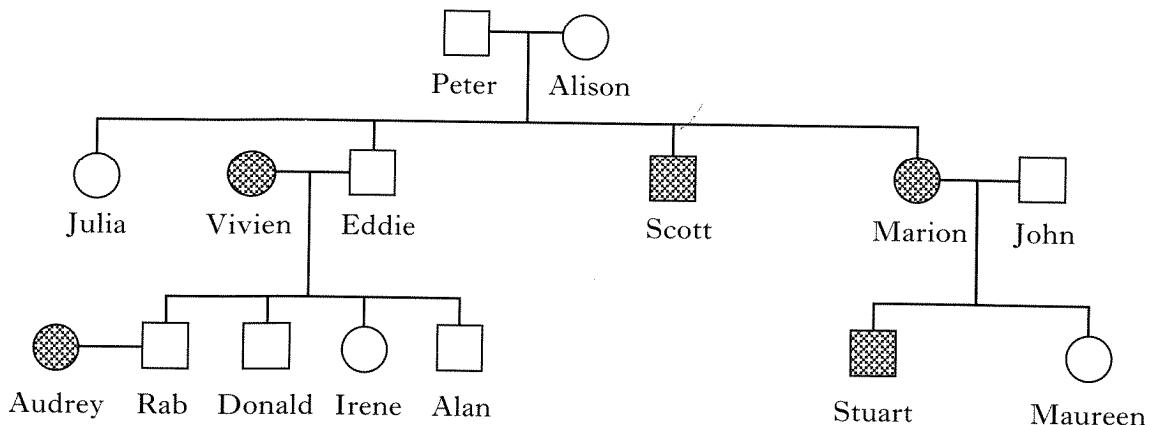
(i) What are the two phenotypes, concerning PTU, that are shown in the family tree?

1 _____ 2 _____

1

(ii) Which of the following couples are both probably true-breeding? *Tick (✓) the correct box.*

Peter and Alison   ☐

Vivien and Eddie   ☐

Marion and John   ☐

1

(iii) Use the letters **T** for tasting and **t** for non-tasting to show the forms of the gene present in the sex cells of Rab and Audrey.

body cells   Rab (**Tt**)   Audrey (**tt**)

sex cells ──◯(**T**)   ◯──   (**t**) ◯

1

15. (continued)

(b) What word is used to refer to sex cells?

_____

1

(c) Which of the following statements about genes is correct?
Tick (✓) the correct box.

Genes are parts of:

chloroplasts ☐

chromosomes ☐

centromeres ☐

cytoplasm ☐

1

(d) What combination of X and Y chromosomes are present in human males and females?

Male chromosomes _____ and _____ .

Female chromosomes _____ and _____ .

1

(e) Differences between individuals can be caused by genetic mutations. Name a human condition caused by a chromosome mutation.

_____

1

[Turn over

16. (a) An experiment was carried out into the anti-fungal properties of the juice of rowan berries.

Pieces of bread were placed in petri dishes. They were soaked in different concentrations of rowan berry juice and left in a warm room for several days with the lids off.
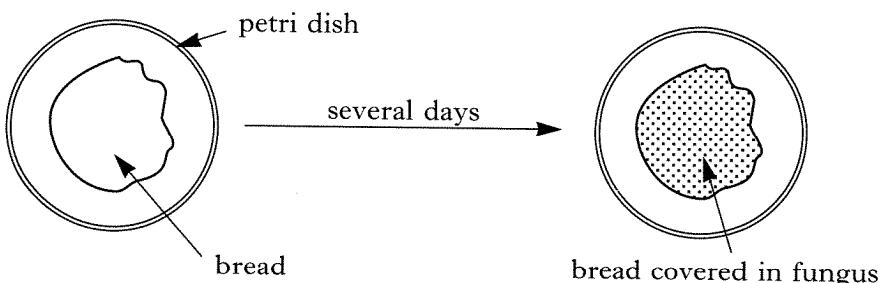
The results are shown below.

Time (days)	Concentration of rowan berry juice (g/cm^3)			
	0	0·1	0·5	1·0
0	–	–	–	–
2	–	–	–	–
4	+	–	–	–
6	++	–	–	–
8	+++	+	–	–
10	++++	++	–	–
12	+++++	+++	++	+

Key

–	no fungal growth
+	
++	increasing
+++	
++++	
+++++	fungal growth

(i) What effect does increasing the concentration of rowan berry juice have on the growth of the fungus?

_____

1

(ii) When was the fungal growth first recorded on the bread with a rowan berry juice concentration of 0·1 g/cm^3?

_____ days

1

(iii) At which concentration of juice was there the **least** growth of fungus observed?

_____ g/cm^3

1

16. **(a) (continued)**

    (iv) The bread with no rowan berry juice was a control. What was the purpose of the control in this experiment?

_____

_____   **1**

    (b) A second similar experiment was carried out to investigate the effects of using different types of berries.

Give **two** precautions that would have to be taken to ensure that a valid comparison could be made between the two experiments.

1 _____   **1**

2 _____   **1**

    (c) What name is given to a chemical produced by one organism and which inhibits the growth of micro-organisms?

_____   **1**

[Turn over for Question 17 on _Page twenty-eight_

17. (*a*) The following diagram represents the human heart.

(i) Name chamber 2.

_____
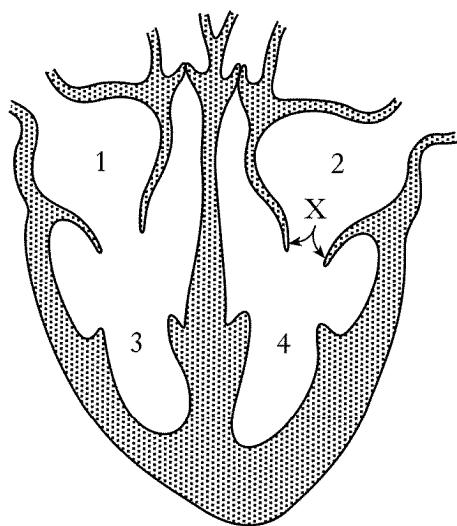
1

(ii) Describe the function of the structure labelled X on the diagram.

_____

_____

1

(iii) Give the reason why the wall of chamber 4 is thicker than that of chamber 3.

_____

_____

1

(*b*) Name the blood vessel which supplies the heart muscle with oxygenated blood.

_____

1

[END OF QUESTION PAPER]

ADDITIONAL PIE CHART FOR QUESTION 2(*b*)(i)
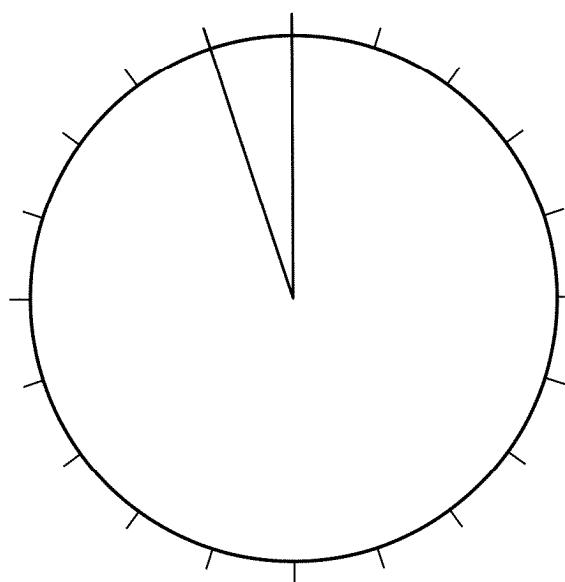
ADDITIONAL GRAPH PAPER FOR QUESTION 5(*a*)(i)

Time to clot milk
(minutes)

0

0   2   4   6   8   10   12   14
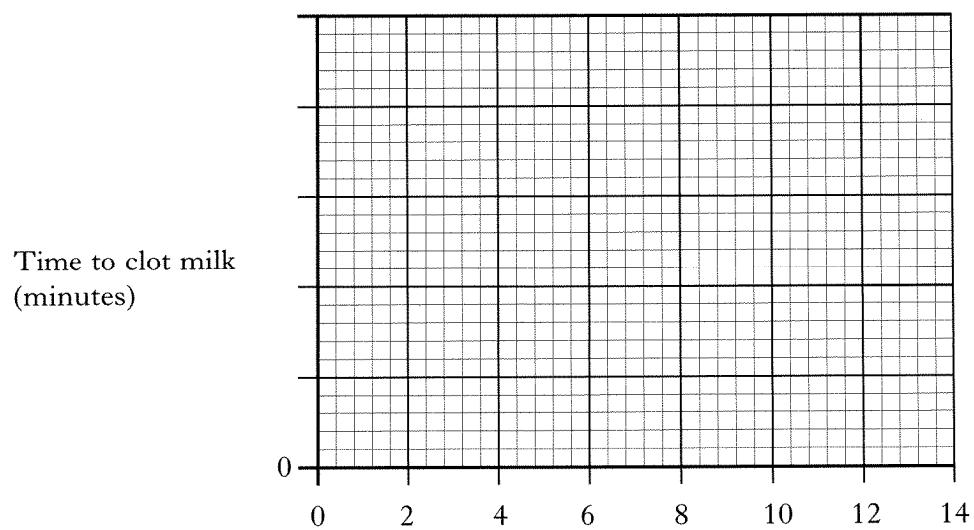
ADDITIONAL BAR CHART FOR QUESTION 14(a)(i)
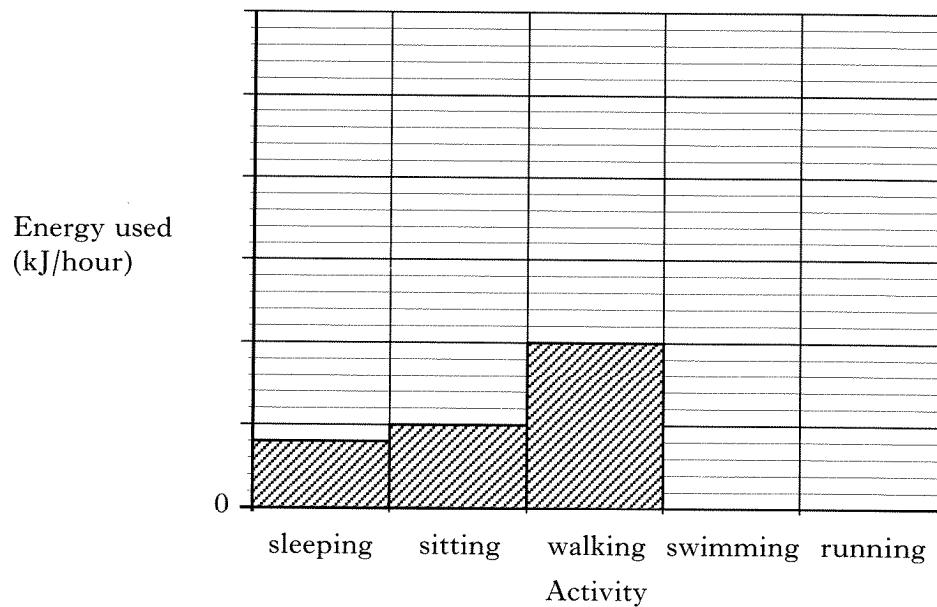
SPACE FOR ANSWERS
AND FOR ROUGH WORKING

SPACE FOR ANSWERS
AND FOR ROUGH WORKING