G

KU   PS

Total Marks

0300/401

NATIONAL
QUALIFICATIONS
2002

FRIDAY 24 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. A sports club wants to find out how well a weedkiller will get rid of dandelions on the rugby pitch. One area of the pitch was sampled using $1m^2$ quadrats before spraying with the weedkiller and again three weeks after spraying. The results are shown below.

Quadrat	Number of dandelions	
	Before spraying	After spraying
1	3	1
2	5	1
3	1	0
4	4	2
5	7	2
6	2	1
7	6	2
8	3	2
9	5	2
10	4	2
Average number per m^2		1·5

(a) (i) Complete the table by writing in the average number of dandelions per m^2 before spraying.

Space for calculation

1

(ii) The area sampled was 1000 m^2.

Calculate the estimated total number of dandelions present after spraying.

Space for calculation

Total _____

1

(b) How could the reliability of these results have been improved?

_____

1

1. (continued)

(*c*) (i) Name **two** abiotic factors that may affect the distribution of dandelions on the pitch.

1 _____

2 _____

1

(ii) Select **one** of the named abiotic factors and describe how you would measure it.

Factor _____

Description _____

_____

1

[Turn over

2. (a) The food of eight animals is listed in the table.

Animal	Food
beetles	oak bark
caterpillars	oak leaves
slugs	oak leaves
woodmice	oak bark
spiders	beetles, caterpillars
chaffinches	spiders, caterpillars, slugs
owls	woodmice
hawks	woodmice, chaffinches

(i) Use the information in the table to place each animal into the correct position on the food web below.

chaffinches

oak bark

oak leaves

3
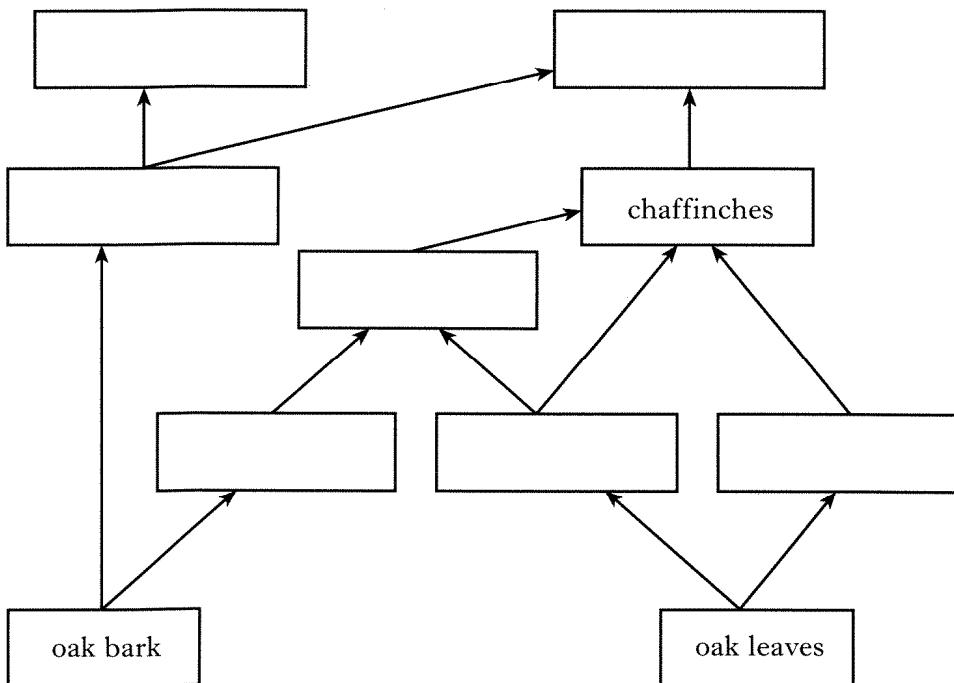
(ii) Choose **one** of the animals from the table and name or describe a suitable sampling technique.

Animal _____

Sampling technique _____

_____

1

2. (*a*) **(continued)**

    (iii)   The owls and the hawks are in competition with each other. Explain what this means.

         _____

1

    (iv)   State **one** possible effect of competition between organisms.

         _____

         _____

1

(*b*) Complete the sentences below by using the correct words from the list.

    List   community   producers   habitat

                 population   biosphere   consumers

    The place where an organism lives is its _____ .

    All the members of one species living together are called a

    _____ .

    The _____ and habitats make up an ecosystem.   **2**

[Turn over

3. An experiment was set up to investigate the effect of light intensity on the rate of photosynthesis.

bubbles of gas

water

Canadian pondweed (*Elodea*)

lamp
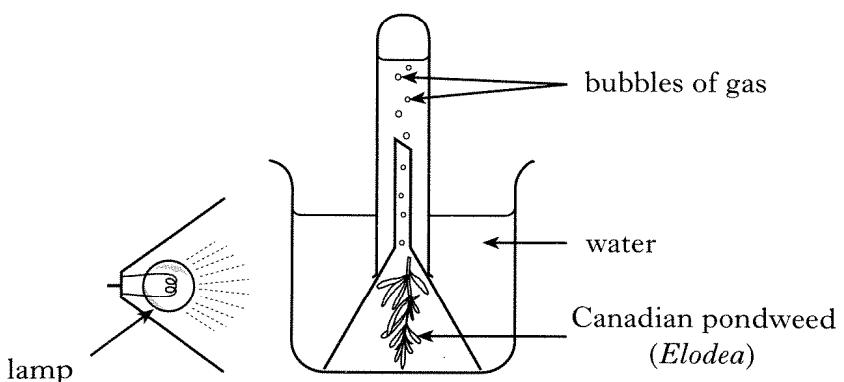
The *Elodea* was exposed to different light intensities and the rate of photosynthesis was estimated by counting the number of bubbles of gas produced per minute. The results are shown below.

Light intensity (units)	0	1	2	3	4	5	6	7
Average number of bubbles per minute	0	7	14	20	25	27	27	27

(*a*) On the grid below, complete a **line graph** of the results by

   (i)   completing the vertical y-axis   1

   (ii) putting a scale on the horizontal x-axis   1

   (iii) plotting the graph.   1

   (An additional grid, if needed, will be found on page 30.)

Light intensity (units)

Marks
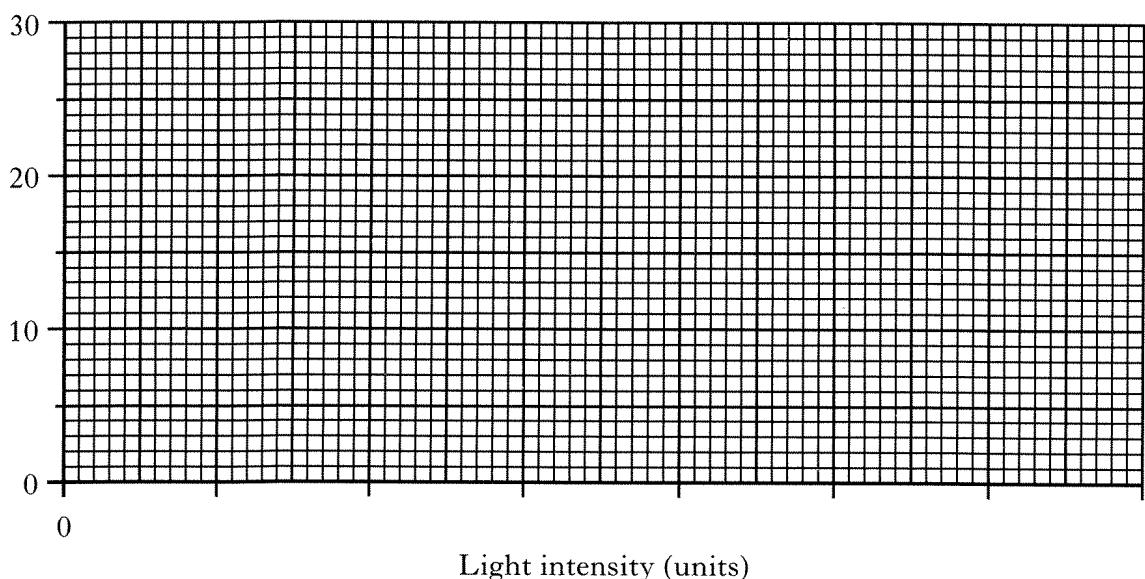
3. (continued)

(*b*) Describe the effect on the rate of bubbling of increasing the light intensity **from 5 to 7 units**.

_____

1

(*c*) Suggest a method for changing the light intensity in this experiment.

_____

1

(*d*) The number of bubbles per minute at each light intensity was counted four times and an average calculated.
Explain why this was good experimental technique.

_____

1

(*e*) Name the gas that forms the bubbles in this experiment.

_____

1

[Turn over

4. (*a*) Five tubes were set up as shown in the diagram below.
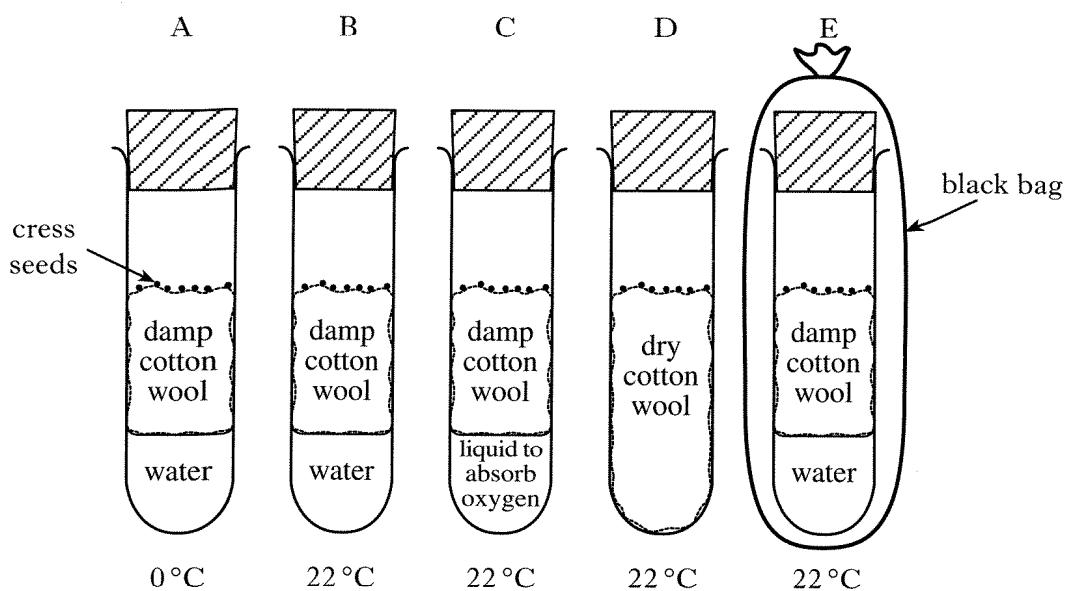
(i) In which **two** tubes would germination occur?
Tick the correct boxes.

☐ A

☐ B

☐ C

☐ D

☐ E

(ii) Name the **four** factors being investigated in this experiment.

1 _____

2 _____

3 _____

4 _____

1

2

4. (continued)

(b) Stages in the reproduction of a flowering plant are named below.

     flowering   fruit formation   fertilisation   pollination

Show the correct sequence of these stages by writing them in the appropriate boxes.
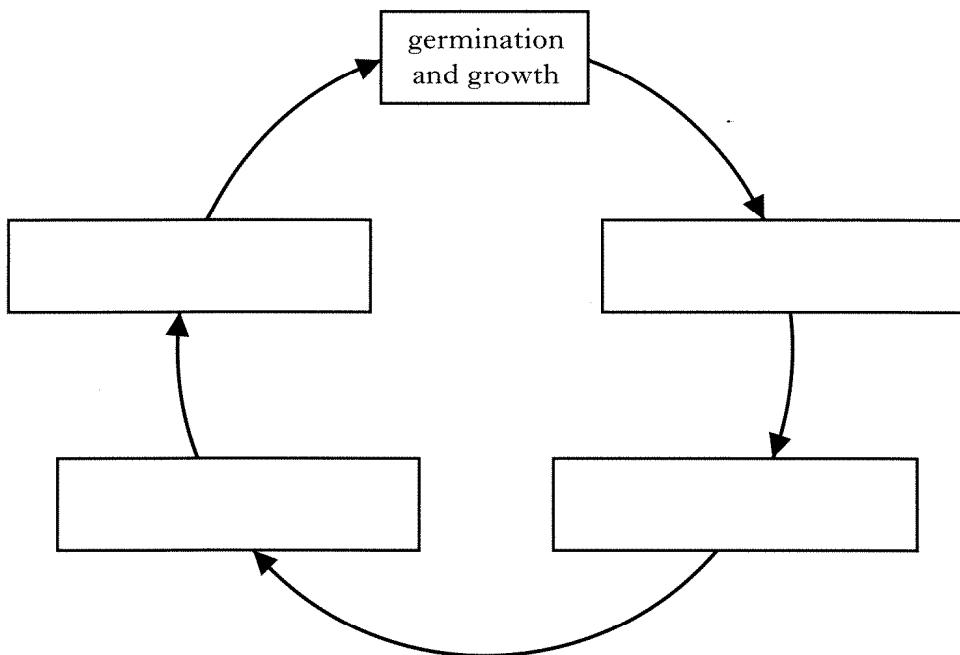
2

(c) Name **two** ways in which pollen can be transferred from one plant to another.

1 _____

2 _____   1

[Turn over

5. (a) The experiment below was set up to show that carbon dioxide is essential for photosynthesis.

Leaf X

air tight container

chemical to absorb
carbon dioxide

geranium plant
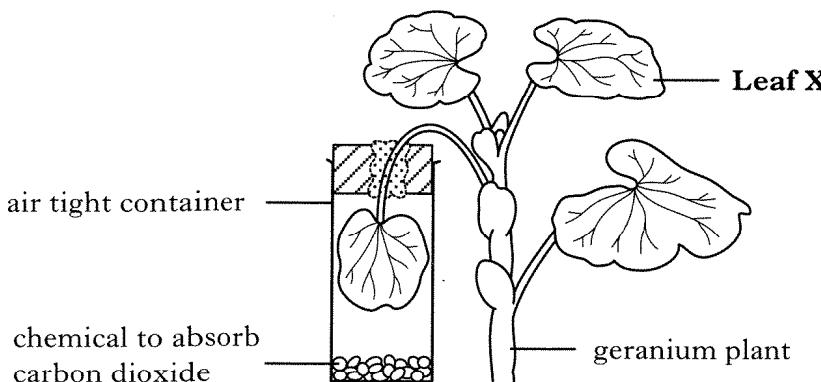
(i) The plant was placed in the dark for 24 hours before setting up the experiment.

Suggest a reason for this.

_____

_____   1

(ii) Describe a suitable control for this experiment.

_____

_____   1

(b) (i) Name the storage carbohydrate produced in **Leaf X** as a result of photosynthesis.

_____   1

(ii) Complete the following sentence.

_____ is a green chemical, found in plant leaves,

that converts light energy into _____energy

during photosynthesis.   1

6. The pie charts show the sources of Vitamins A and C in the diet.
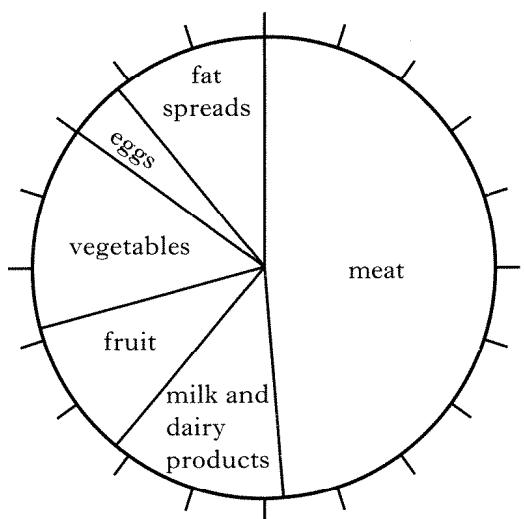
Vitamin A   **Vitamin C**
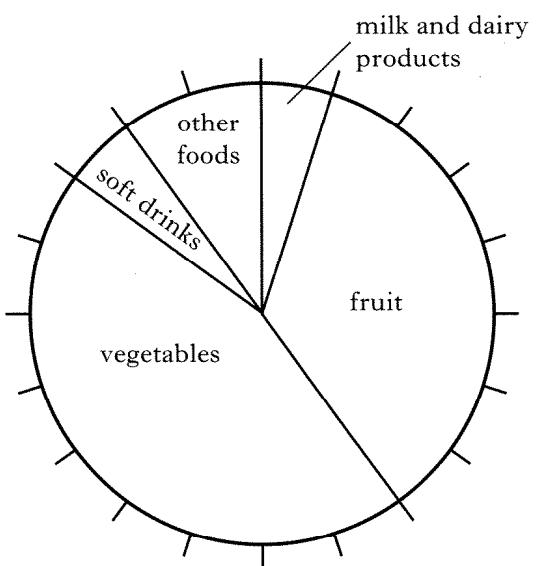
(a) Use the information from the pie charts to complete the table for Vitamin C.

Source of Vitamin A	Percentage of daily intake
Milk and dairy products	12
Fruit	10
Vegetables	14
Eggs	4
Fat spreads	11
Meat	49

Source of Vitamin C	Percentage of daily intake
Milk and dairy products	
Fruit	
Vegetables	
Soft drinks	
Other foods	

2

(b) What named foods supply the greatest proportion of

    (i) Vitamin A? _____

    (ii) Vitamin C? _____   1

(c) What **named** source of Vitamin C does not provide any Vitamin A?

_____   1

[Turn over

7. The diagram shows part of the digestive system of a rabbit.
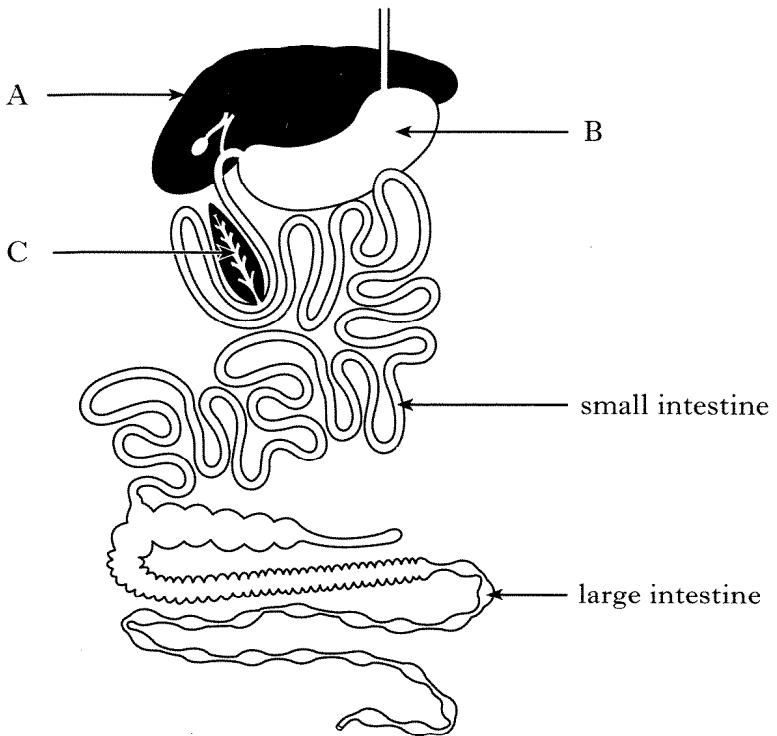
(a) Name the organs labelled on the diagram.

A _____

B _____

C _____   **2**

(b) In which part of the digestive system does most absorption of digested food occur?

_____   **1**

(c) Name the type of protein that carries out the reactions of digestion when mixed with food in the digestive system.

_____   **1**

(d) Food is required to provide animals with energy.
Name **one** other reason why food is required by animals.

_____   **1**

Marks | KU | PS

8. (*a*) Complete the table below by naming **one** organ that receives protection from each of the given parts of the skeleton.

Part of skeleton	Organ receiving protection
Skull	
Rib cage	
Backbone	

2

(*b*) Movement of the skeleton is caused by the contraction of muscles.
Name the structures that connect muscles to bones.

_____

1

(*c*) The following statements refer to experiments carried out on bone.

1. When a bone is soaked in acid for a few days it becomes soft and flexible.
2. When a bone is roasted it becomes hard and brittle.

Choose **one** of the statements and state which component of the bone has been removed by the experiment.

Statement number   _____

Component removed   _____

1

(*d*) The diagrams below represent a human arm.

Position A   Position B
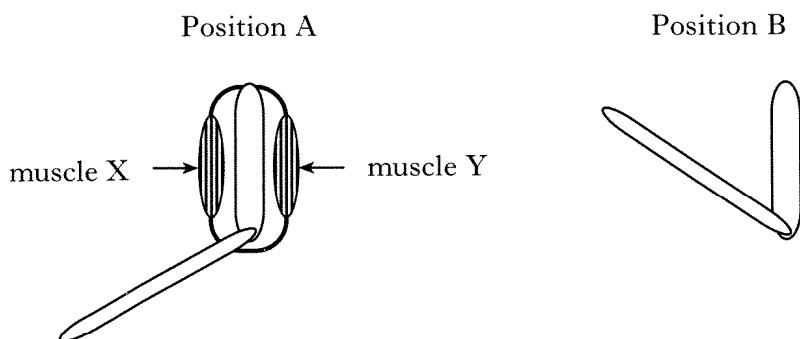
muscle X →   ← muscle Y

(i) Which muscle, X or Y, contracts to move the arm from position A to position B?

_____

1

(ii) Name the chemical that builds up in muscles which contract repeatedly for long periods.

_____

1

Marks | KU | PS

9. Read the passage below and answer the questions which follow it.

Designing a sports drink. Adapted from an article in *Biological Sciences Review*, September 2000.

Advertisements claim that athletes can improve their performance by drinking specially formulated sports drinks which reduce or delay fatigue. One of the causes of fatigue during exercise is the reduction of energy stores such as the glycogen in the muscles. Other causes of fatigue include problems associated with overheating and fluid loss.

During intense exercise the body mainly uses carbohydrate as an energy source. Taking carbohydrate during exercise can delay fatigue by conserving the energy stores in the muscles.

There is a dramatic increase in heat production during vigorous exercise. This does not result in a large increase in body temperature because heat is lost from the body by the evaporation of sweat from the skin surface. This reduces the risk of a raised body temperature but results in dehydration (a reduction in the body water content). Dehydration decreases performance during exercise by reducing the volume of blood available to meet the needs of all the tissues.

Most sports drinks have a similar composition—carbohydrate, water and sodium. Improvement in the taste and "mouthfeel" of drinks can be achieved by using different forms of carbohydrate such as glucose, fructose and sucrose. The sodium content of most sports drinks is normally less than half that in sweat largely for taste reasons.

(*a*) Name the energy store mentioned in the passage which is found in muscles.

_____   1

(*b*) State **one** of the causes of fatigue during exercise.

_____   1

(*c*) Explain why taking carbohydrate during exercise may improve performance.

_____   1

(*d*) Give **one** way in which sweating during exercise can

    (i) decrease fatigue _____   1

    (ii) increase fatigue. _____   1

9. **(continued)**

(e) State the **three** main components of sports drinks.

1 _____

2 _____

3 _____

1

(f) Why do sports drinks contain less than half the sodium content of sweat?

_____

1

[Turn over

10. The diagram shows the life cycle of the Atlantic Salmon. The salmon are able to migrate between their breeding grounds in Scottish rivers and their feeding grounds in the Atlantic Ocean. Adult salmon migrate between the rivers and the ocean every year.
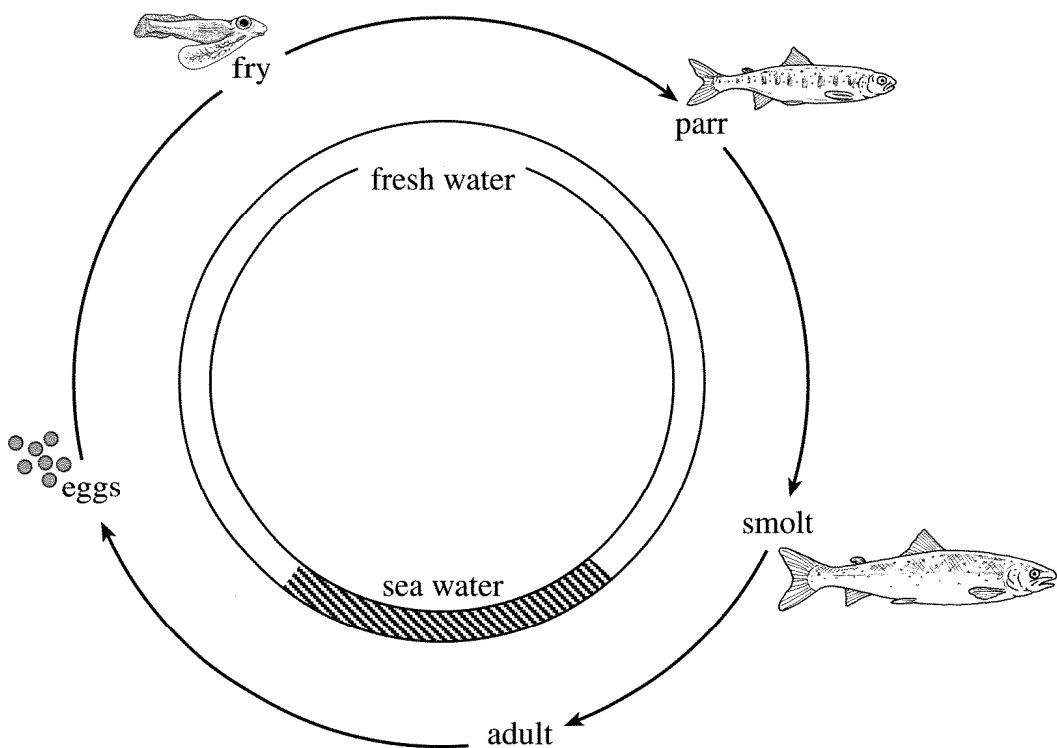
(a) What term is used to describe regular repeated behaviour patterns, such as the migration of the salmon?

_____

1

(b) Sea lice are a pest of adult salmon. Suggest why they never attack fry or parr.

_____

1

(c) From where do the young fry obtain their food?

_____

1

10. (continued)

(d) A female salmon lays 8000 eggs but only 5% of them hatch.
How many fry will be produced?

Space for calculation

Number of fry _____

1

(e) The table shows the number of salmon caught in a Scottish river over a six year period.

Month	Number of fish caught					
	1991	1992	1993	1994	1995	1996
May	1	9	15	3	0	0
June	103	125	139	109	171	234
July	207	390	267	225	216	276
August	76	168	159	103	72	48
September	17	57	41	13	21	1
Total	404	749	621	453	480	559

(i) During which month were the greatest number of fish caught?

_____

1

(ii) What percentage was the August catch of the total for 1995?

Space for calculation

_____ %

1

(iii) What was the average number of fish caught during September over the six year period?

Space for calculation

_____

1

11. (a) <u>Underline</u> **one** word in each set of brackets to make the sentences correct.

$\left\{\begin{array}{l} \textit{Cells} \\ \textit{Tissues} \\ \textit{Organs} \end{array}\right\}$ are the basic units of living organisms.

Most of them are too small to be seen with the naked eye and are almost transparent. A microscope magnifies them so that we can see them, and coloured chemicals called

$\left\{\begin{array}{l} \textit{indicators} \\ \textit{stains} \\ \textit{pigments} \end{array}\right\}$ can be added to make certain parts easier to see.

1

(b) The following are drawings of cells. They are not drawn to the same scale.
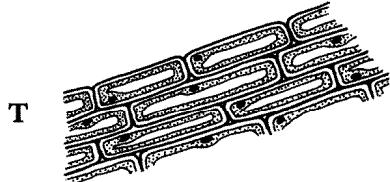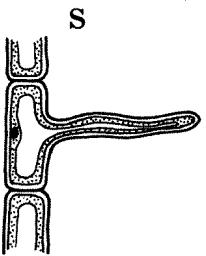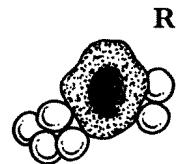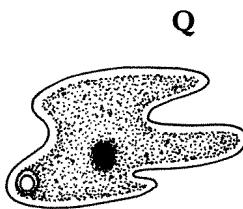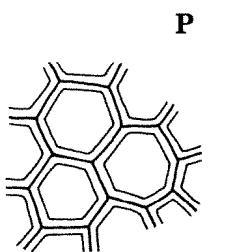
Give the letters of **all** the animal cells.

Animal cells _____

1

11. (continued)

(c) (i) Complete the following sentence to give a definition of the process of diffusion.

Diffusion is the movement of a substance

from an area of _____

to an area of _____ .

1

(ii) The list below names three substances which diffuse into and out of living cells.

List   dissolved food   carbon dioxide   oxygen

Complete the diagram to show correctly the movement of each named substance into or out of the cell.
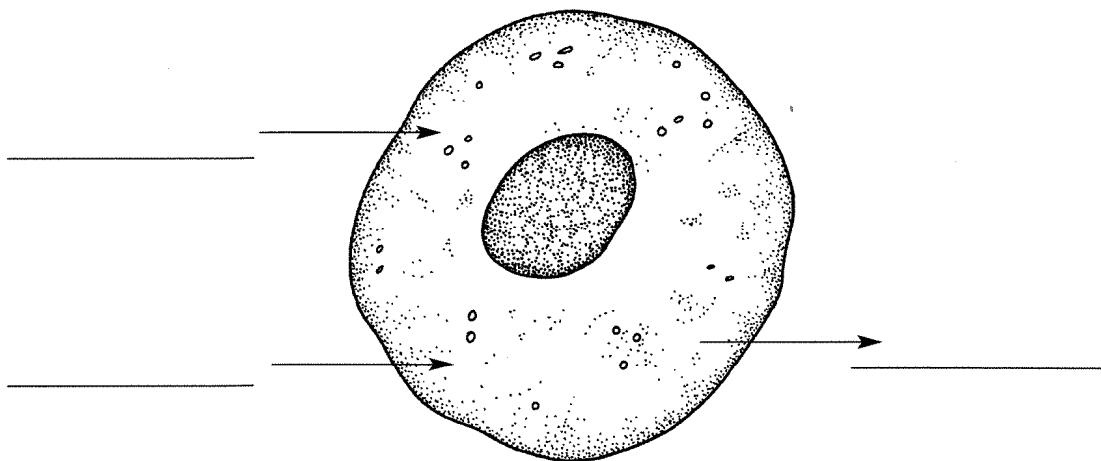
2

(iii) Which part of the cell controls the passage of substances into or out of the cell?

_____

1

(iv) What name is given to the "special case" of the diffusion of water into or out of cells?

_____

1

[Turn over

12. The graph shows the time from fertilisation to hatching of trout eggs kept at different temperatures at a Scottish trout farm.
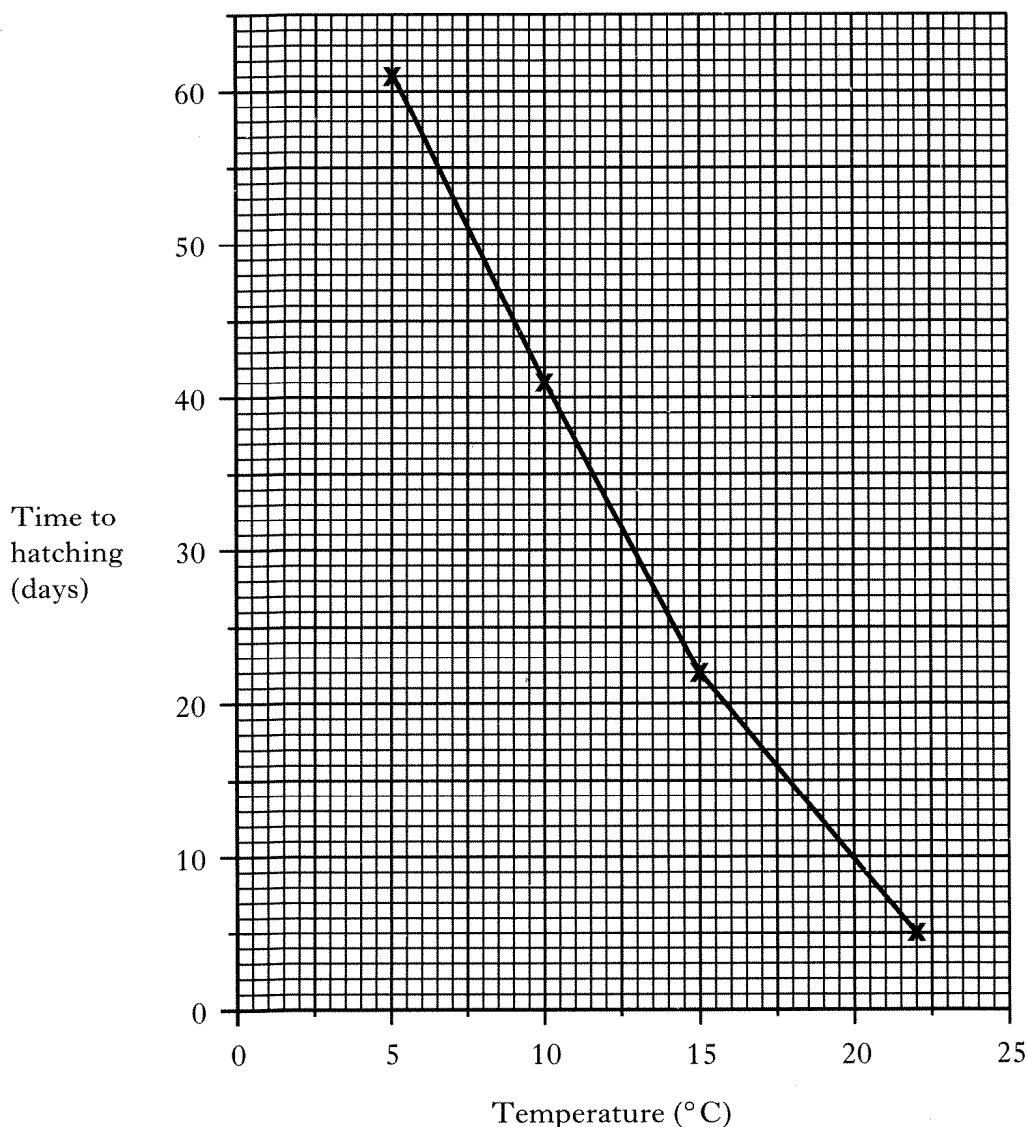
(a) (i) Give the length of time for the eggs to hatch at 10 °C.

_____ days

1

(ii) Describe the effect of increasing the temperature on the time to hatching.

_____

_____

1

12. **(a)** **(continued)**

(iii) Predict the effect that raising the temperature of the water to 50 °C would have on the hatching of the eggs. Give a reason for your answer.

Effect _____ 1

Reason _____

_____ 1

(b) (i) The trout eggs would not hatch if it were not for the presence of enzymes to act as catalysts.
Explain the meaning of the term "catalyst".

_____

_____ 1

(ii) Give the name of **one** enzyme involved in the chemical breakdown of a substance and **one** enzyme involved in synthesis (build up).

Breakdown _____ 1

Synthesis _____ 1

[Turn over

13. The diagram represents stages in sexual reproduction of mammals.
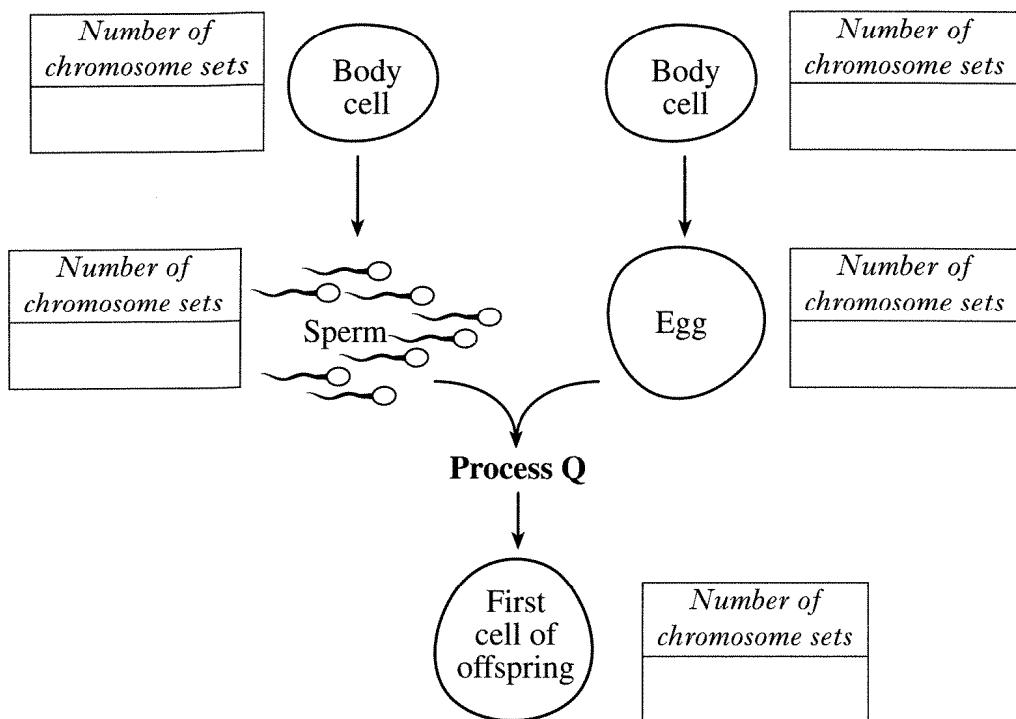
(a) Complete the diagram by writing in each box the number of **complete chromosome sets** for each cell type shown.

2

(b) What general name is given to sex cells such as eggs and sperm?

_____

1

(c) What name is given to **Process Q** in the diagram?

_____

1

13. (continued)

(*d*) The sex of an offspring is determined by the sex chromosomes **X** and **Y**. Complete each diagram below to identify the sex chromosomes present and the sex of the offspring **2** and **3**.

sperm	egg
sex chromosome	sex chromosome
	X

sperm	egg
sex chromosome	sex chromosome

sperm	egg
sex chromosome	sex chromosome
X	

offspring 1
sex chromosomes
sex of offspring 1
male

offspring 2
sex chromosomes
XX
sex of offspring 2

offspring 3
sex chromosomes
sex of offspring 3

3

[Turn over

Marks | KU | PS

14. (*a*) The table below shows the percentage of household waste recycled in Strathclyde compared to the overall Scottish average over a three year period.

Year	Household waste recycled (%)	
	Strathclyde	Scottish average
1990	1·4	2·2
1991	1·5	3·0
1992	1·6	3·2

(i) Use the information from the table to complete the bar chart below by

1 adding a scale to the y-axis   1

2 plotting the remaining bars.   1

(An additional grid, if needed, will be found on page 30.)

Household
waste
recycled (%)

□ Strathclyde
◼ Scottish average

0

1990   1991   1992

Year
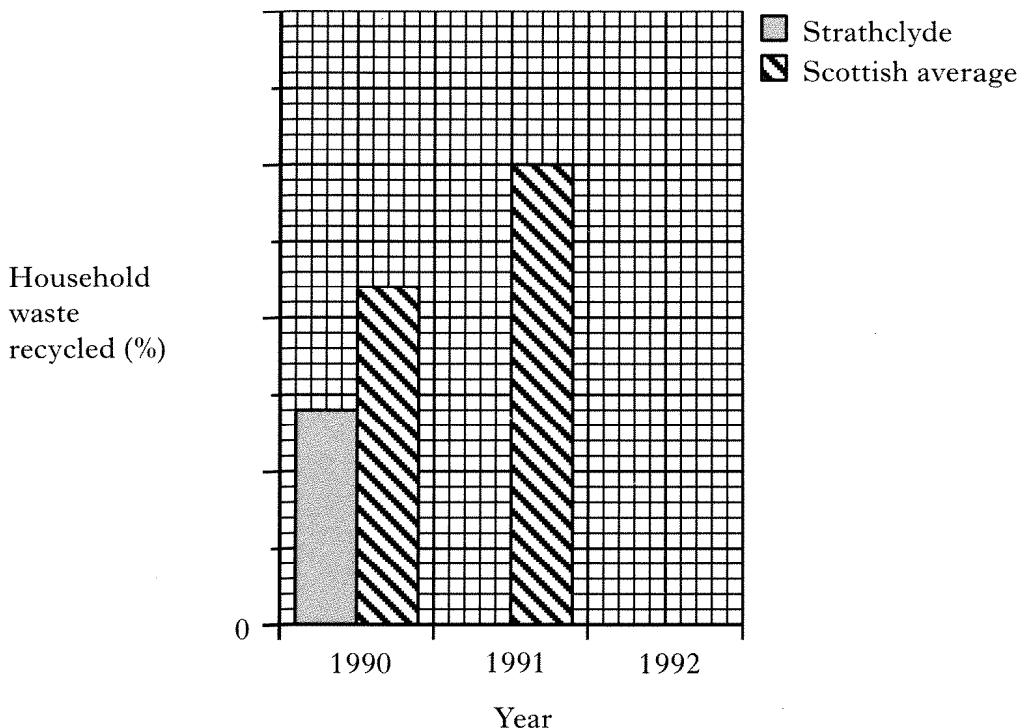
(ii) Express as a single whole number ratio the proportion of household waste recycled in Strathclyde to the Scottish average, in 1992.

Space for calculation

‾‾‾‾‾‾ : ‾‾‾‾‾‾
Strathclyde   Scottish average

1

14. (*a*) (**continued**)

    (iii)   Describe the trend in the recycling of household waste in Scotland.

        _____   **1**

  (*b*)   Household waste is a domestic pollutant which can damage land ecosystems.

      Sewage is another example of a domestic pollutant.

    (i)   Name the ecosystem which may be damaged by the discharge of untreated sewage.

        _____   **1**

    (ii)   Name a disease that can be spread by untreated sewage.

        _____   **1**

[Turn over

15. (*a*) The graph shows the number of bacteria in a liquid nutrient over 24 hours.
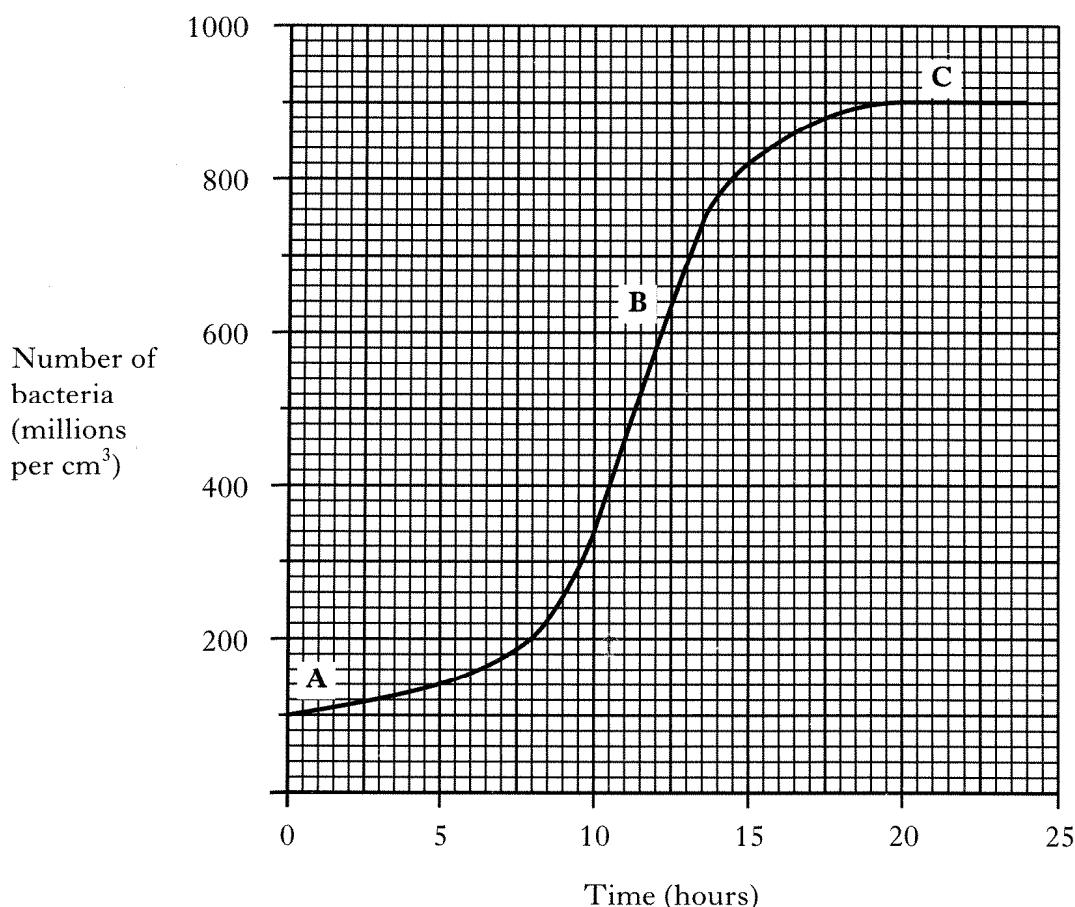
(i) How many bacteria were present at eight hours?

_____ millions per cm^3

1

(ii) Identify the stages at which the number of new bacteria being produced is greater than the number dying.

Stages _____ and _____

1

(iii) State **two** factors that could limit the growth of the population at stage C on the graph.

1 _____

2 _____

2

15. (continued)

(*b*) The composition of one type of single-cell protein is shown below.

Component	Percentage
protein	45
fat	10
minerals	5
fibre	5
other nutrients	35

(i) Use the information from the table to complete the pie chart below.
(An additional pie chart, if needed, will be found on page 31.)

Percentage composition of single-cell protein

fibre
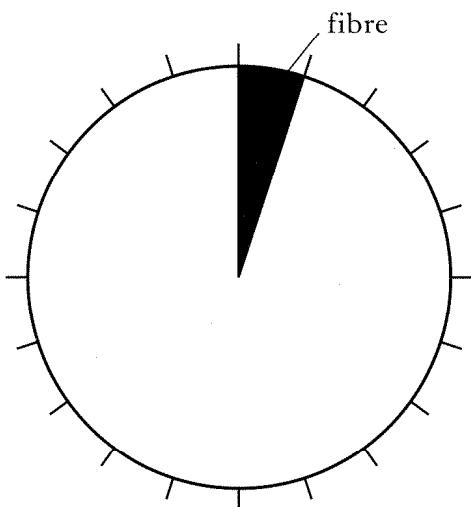
(ii) Calculate the ratio of protein to fat in the single-cell protein.
Express your answer as a simple whole number ratio.
Space for calculation

_____ : _____

protein   fat

(*c*) Micro-organisms are grown for the production of single-cell protein.
Name the type of reproduction involved.

_____

2

1

1

16. A group of pupils investigated the activity of yeast by making some dough with flour, water, sugar and yeast.

Enough water was added to make the dough runny and 50 cm³ was poured into a beaker.

The volume of the dough was noted every 10 minutes and the results are shown in the table.

Time (minutes)	0	10	20	30	40
Volume of dough (cm³)	50	54	62	74	80

(*a*) (i) What was the increase in the volume of the dough during the time of this investigation?

_____ cm³

1

(ii) Express this increase as a percentage of the original volume.
Space for calculation

_____ %

1

(*b*) During which period was there the greatest increase in the volume of the dough?

Tick the correct box

☐ 0–10 minutes

☐ 10–20 minutes

☐ 20–30 minutes

☐ 30–40 minutes

1

(*c*) The teacher suggested that the results might not be typical but could be unusual or a "one-off" result. How could the investigation be improved to overcome this problem?

_____

1

16. (continued)

(d) One of the group suggested that the raising of the dough might not be caused by the yeast but by some other factor.

(i) Describe another experiment which could be set up to test this idea.

_____

_____ 1

(ii) What name is given to an experiment which is designed to make sure that the result of an investigation is only due to the factor being investigated?

_____ 1

[END OF QUESTION PAPER]

SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL GRID FOR QUESTION 3(*a*)

Light intensity (units)

ADDITIONAL GRID FOR QUESTION 14(*a*)(i)

Household
waste
recycled (%)

☐ Strathclyde
▧ Scottish average

1990   1991   1992

Year
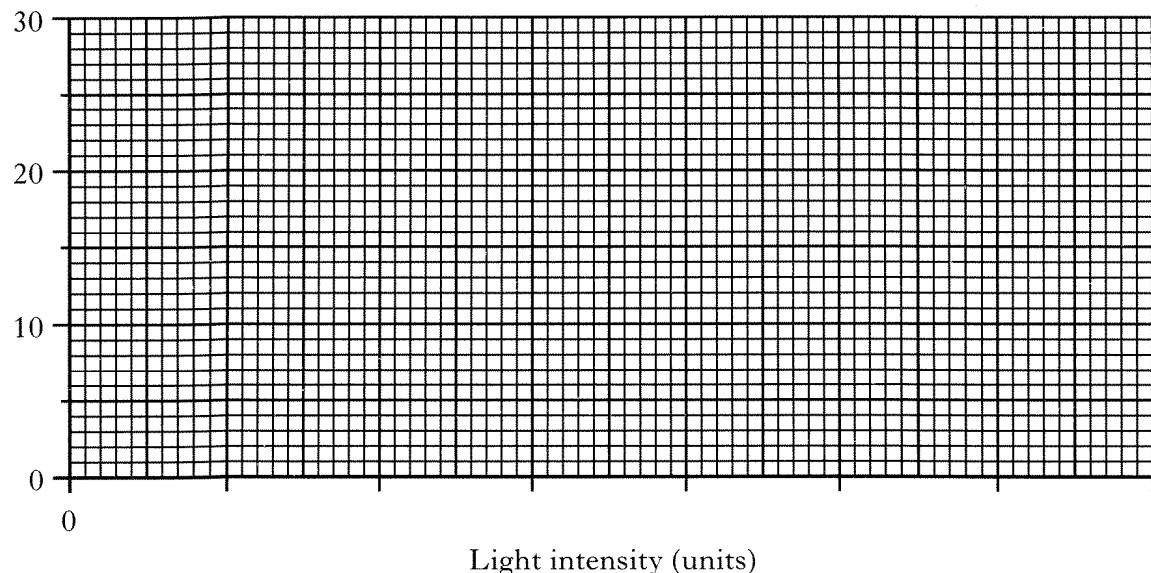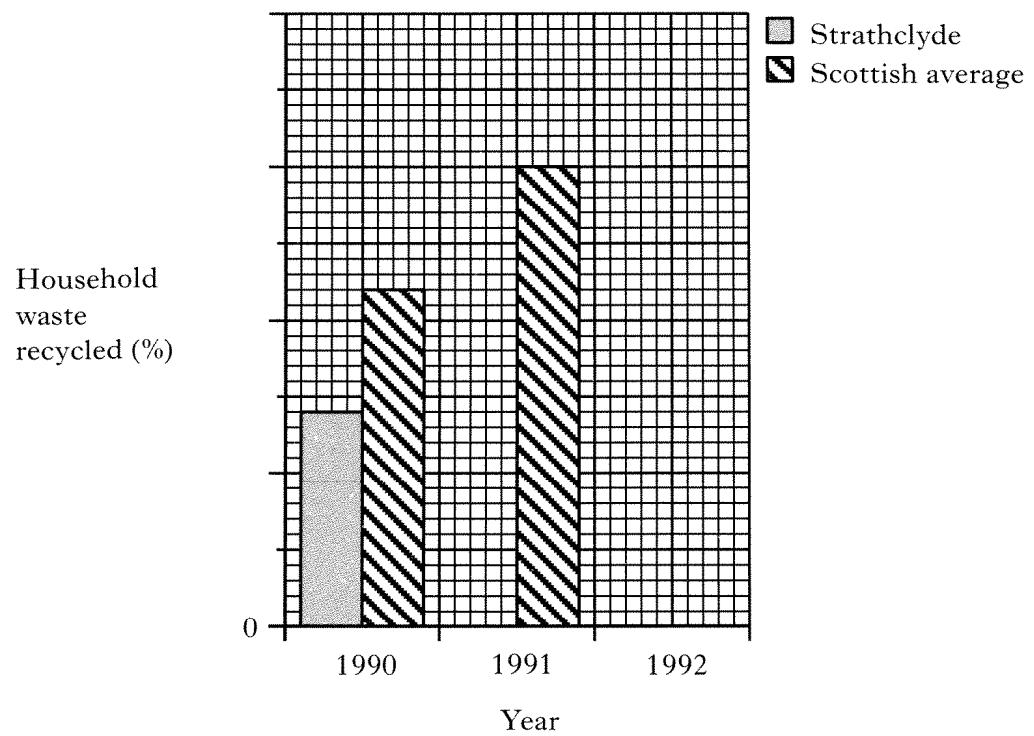
SPACE FOR ANSWERS
AND FOR ROUGH WORKING

ADDITIONAL PIE CHART FOR QUESTION 15(*b*)(i)

Percentage composition of single-cell protein

SPACE FOR ANSWERS
AND FOR ROUGH WORKING