Candidate Name	Centre Number					Candidate Number				
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GCSE

BIOLOGY

UNIT 1: CELLS, ORGAN SYSTEMS AND ECOSYSTEMS
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**7**	
3.	**7**	
4.	**5**	
5.	**16**	
6.	**9**	
7.	**7**	
8.	**5**	
9.	**7**	
10.	**5**	
11.	**6**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **11** is a quality of extended response (QER) question where your writing skills will
be assessed.

*Answer **all** questions*

1.   Samples of water were taken from a river at a sewage outfall and at a number of points downstream from the outfall as shown in the diagram below.
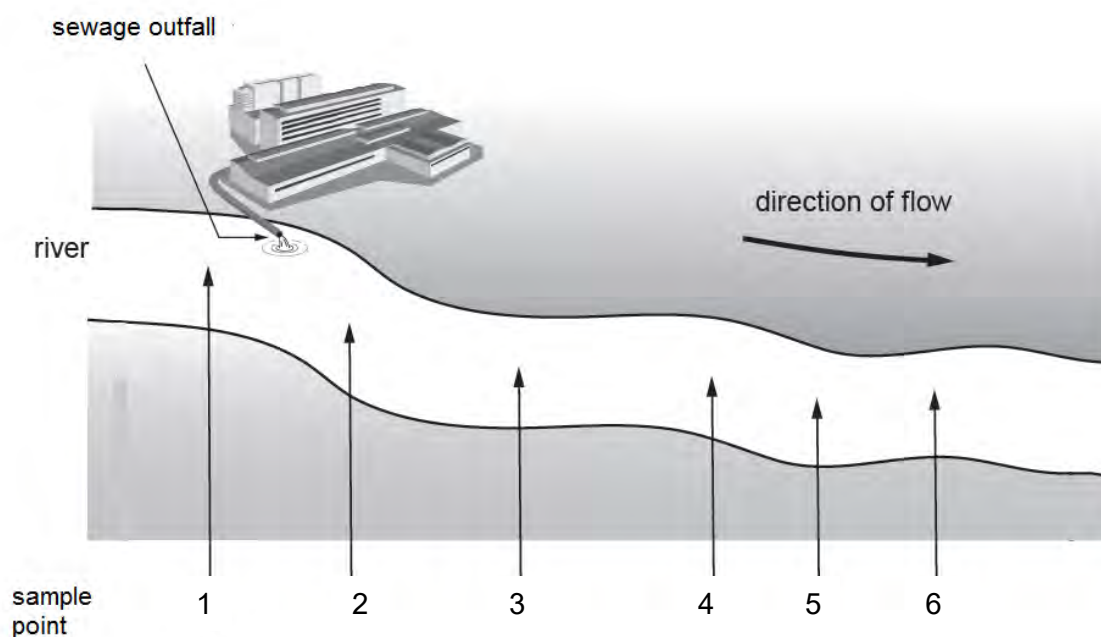
The table shows the oxygen concentration of the water at each of the sample points.

Sample point	Oxygen concentration (arbitrary units)
1	0.10
2	0.04
3	0.20
4	0.40
5	1.00
6	1.28

(a)   The oxygen concentration is twice as great at sample point **4** compared with sample point **3**. Calculate how many times greater is the oxygen content at sample point **3** compared with sample point **2**?   [1]

answer = …………times greater

(b)   Explain what happens to the oxygen content of the water as the distance from the outfall increases.   [2]

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(c)   Identify the sample point at which you would expect there to be the least variety of species. Give a reason for your answer.   [2]

Sample point   ....

Reason   ....

                       ....

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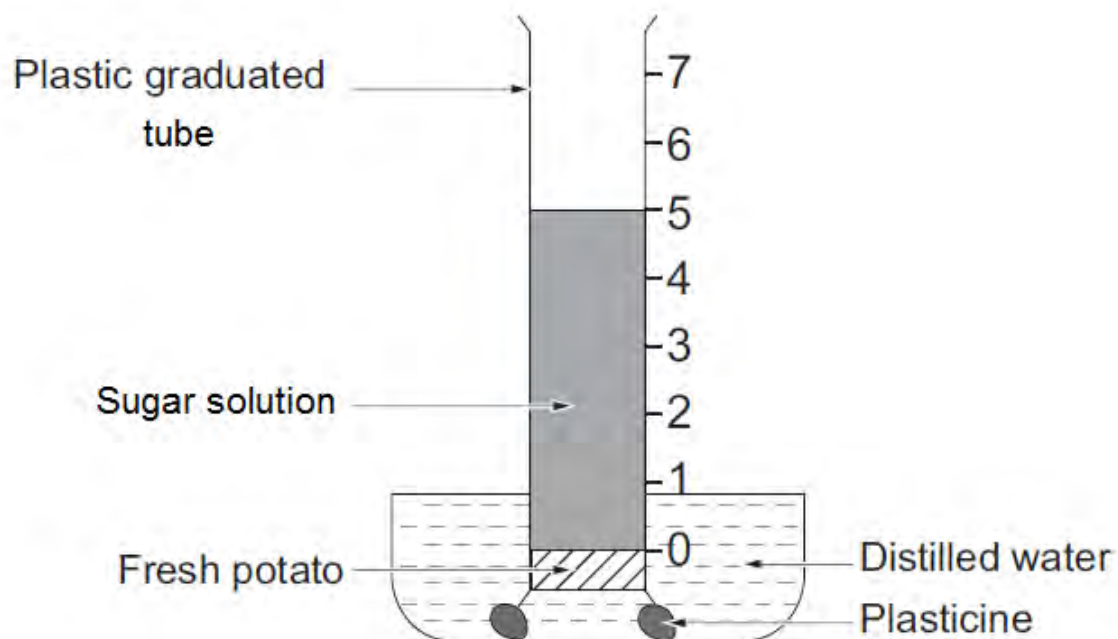
(d)   What term is used to describe a species whose presence or absence may be used to show the level of pollution in a river?   [1]

       ....

6

2. The apparatus below was used to investigate the movement of water through a cell membrane. 5 cm^3 of 1 M sugar solution was added to the graduated tube at the start of the investigation.

After 30 minutes, the volume of the sugar solution was measured. The procedure was repeated with 0.2 M sugar solution.

The results are shown in the table below.

Concentration of sugar solution (M)	Volume of sugar solution at the start (cm^3)	Volume of sugar solution after 30 min (cm^3)
1.0	5	7
0.2	5	5

(a) (i) Name the type of diffusion occurring in this experiment. [1]

....

(ii)   Explain the results for:

I   1.0 M sugar solution;   [4]

....

....

....

II   0.2 M sugar solution.

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(b)   A similar piece of apparatus was set up using **boiled** potato and 1.0 M
        sucrose solution. It was left for 30 minutes. Explain why all the sugar
        solution passed into the distilled water.   [2]

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3.   The effect of pH on the activity of two protein-digesting enzymes, **A** and **B**, was investigated. The enzymes, at the required pH, were placed in holes made in the middle of a layer of gelatin in separate Petri dishes as shown in the diagram. The procedure was carried out for enzymes **A** and **B** for a range of pH from 1 to 11.

petri dish
containing gelatin

hole in gelatin
containing
enzyme solution
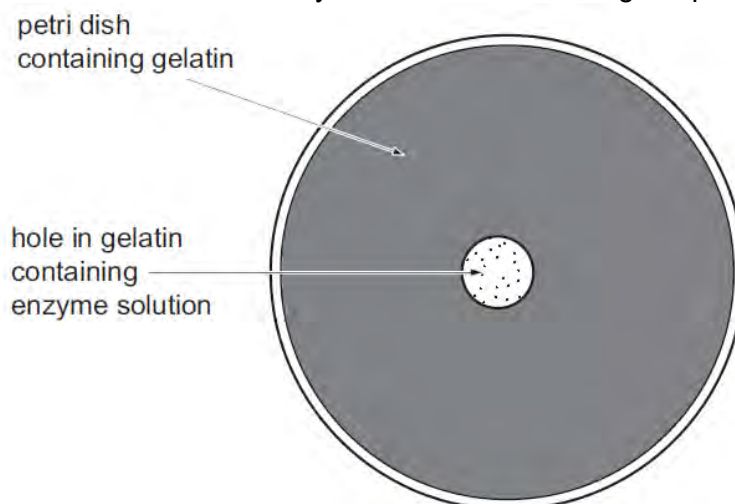
Gelatin is a jelly made of protein.

After one hour, the activity of each enzyme was estimated by measuring the area of gelatin digested by the enzyme.

The results are shown in the following graph.
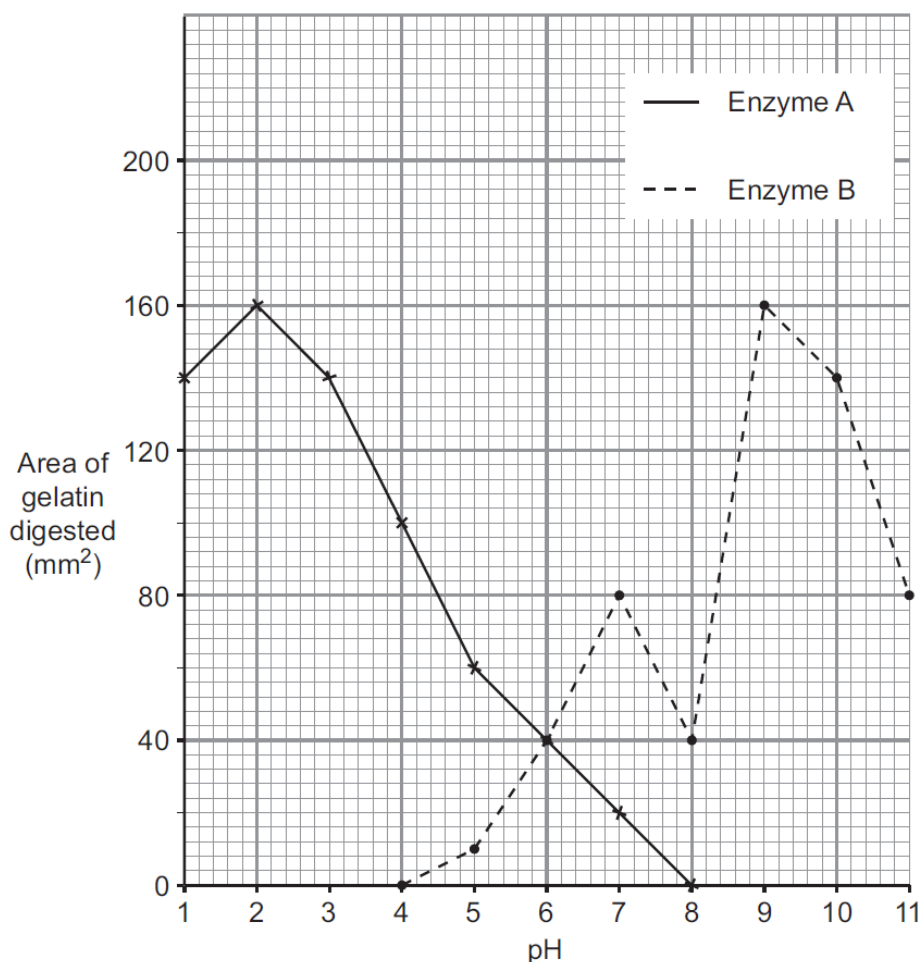
(a)   (i)   At which pH were both enzymes equally active? .... [1]

      (ii)   It was suspected that one of the results may have been due to
             experimental error. Identify this result.   [1]

             Enzyme   ....

             pH   ....

(b)   Name **three** parts of the human digestive system which produce protein-
      digesting enzymes.   [3]

             (I)   ....

             (II)   ....

             (III) ....

(c)   Which part of the human digestive system produces enzyme **A**? Give a
      reason for your answer.   [2]

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4. The following diagrams represent the molecules involved in the lock and key theory of an enzyme-controlled reaction.
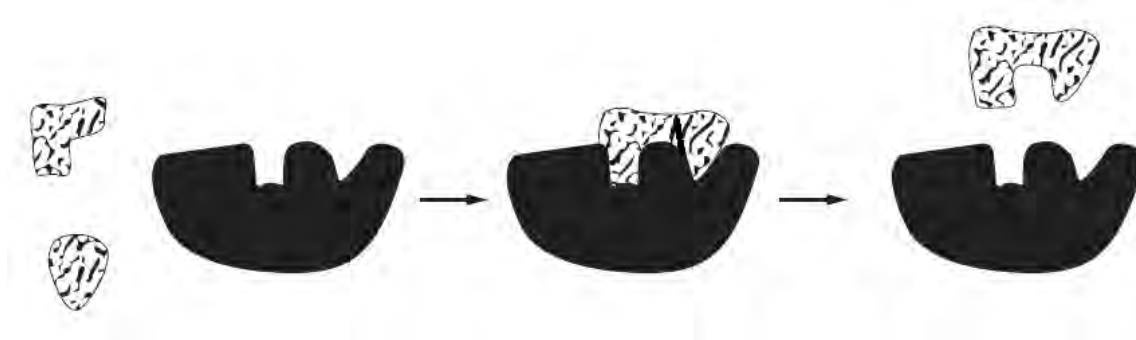
    (a) **On the diagrams** above **label** the: [4]

         (i)   active site;

         (ii)   product;

         (iii)   substrates;

         (iv)   enzyme-substrate complex.

    (b) Underline the correct answer from the choices below.   [1]

         The enzyme-controlled process shown above represents the:

         break down of starch into glucose

         break down of fat into glycerol and fatty acid

         build up of protein from amino acids

         break down of protein into amino acids

5

5.   The diagram below shows all the organisms involved in a food chain in an aquatic environment.

5 small fish
1500 g/m²

1 otter
1022 g/m²

187 insect larvae
1870 g/m²

2187 green water plants
4900 g/m²
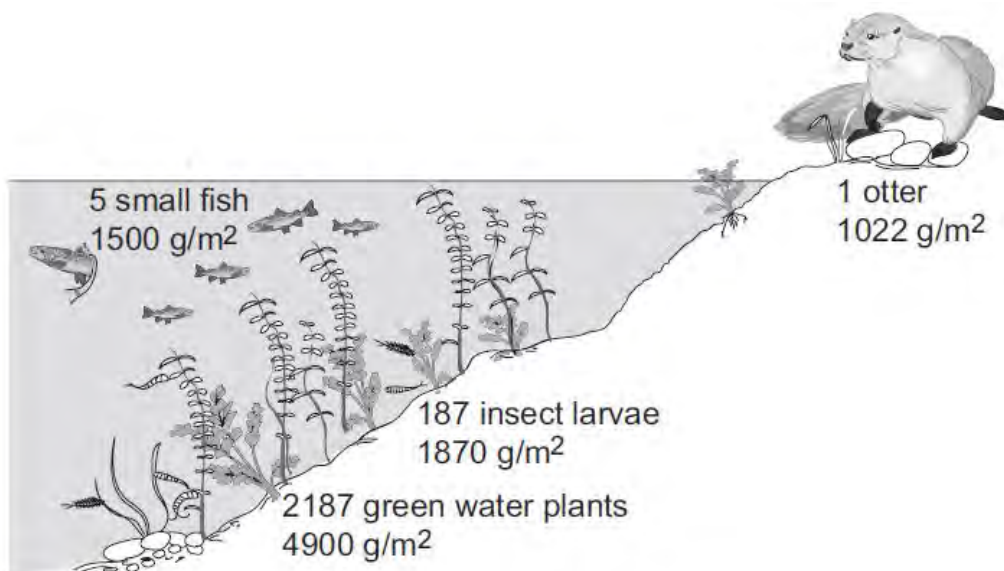
(a)   Use the information in the diagram to answer the following.   [2]

   (i)   Calculate the ratio of the numbers of producers to the number of consumers to the nearest whole number.

   Producers:Consumers   = ... : ....

   (ii)   Draw a labelled pyramid of biomass in the space below for all the organisms labelled in the diagram. Your diagram should include each feeding level and the quantity of biomass it contains.   [3]

(b)   Some people who kept American crayfish illegally released them into the lake. The crayfish are second stage consumers.

Describe and explain the expected effect this will have on **two** of the other living organisms shown in the diagram.   [4]

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(c)   A farmer sprayed pesticides on his crops growing near the lake.   [2]

A few months later, dead fish were found in the lake. Explain what happened to cause the death of the fish.

....

....

....

(d)   The diagram shows the energy flow through the food chain in the lake.

Energy lost through
waste
(kJ)

Energy lost through
heat
(kJ)

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                    ┌─────────────────────┐
                    │  1 kJ converted into │
                    │  a tertiary consumer │
                    │     (3rd stage)      │
                    └─────────────────────┘

59 kJ ◄── X ─────────────────┬──────────── Y ──► 90 kJ

                    ┌─────────────────────┐
                    │ 150 kJ converted into│
                    │ a secondary consumer │
                    │     (2nd stage)      │
                    └─────────────────────┘

┌─────────────┐
│ Z ........kJ │ ◄── X ──────────┬────────── Y ──► 1750 kJ
└─────────────┘

                    ┌─────────────────────┐
                    │ 2500 kJ converted into│
                    │  a primary consumer  │
                    │     (1st stage)      │
                    └─────────────────────┘

10 000 kJ ◄── X ──────────────┬──────────── Y ──► 37 500 kJ

                    ┌─────────────────────┐
                    │50 000 kJ converted into│
                    │       producer        │
                    └─────────────────────┘
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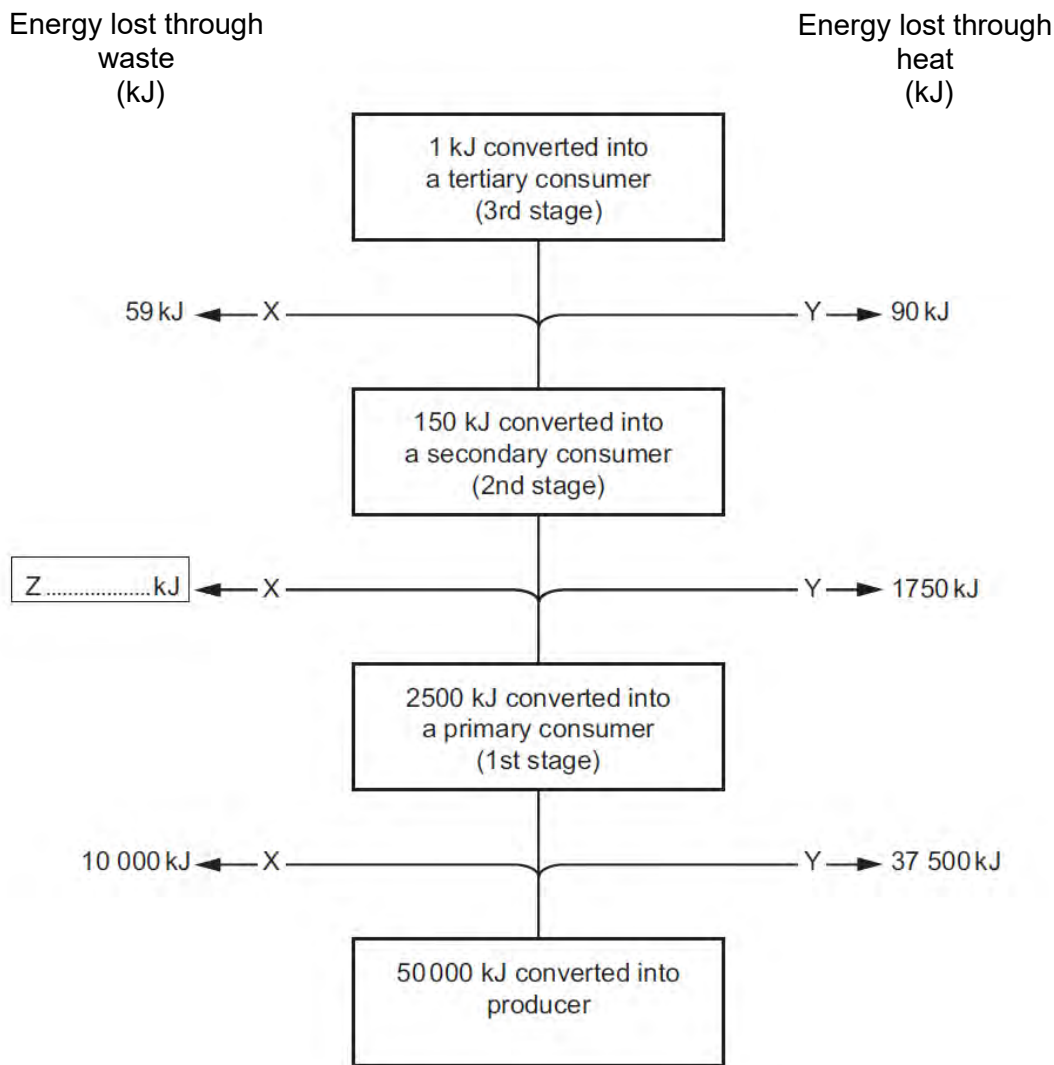
(i)   Calculate the value of **Z** to **complete the box** on the diagram.   [1]

(ii)   Calculate the percentage of the energy in the first stage consumer is transferred to the second stage consumer.   [2]

Percentage of energy transferred = ...%

(iii)   What processes in the consumers account for the energy flow represented by the letters **X** and **Y**?   [2]

X ....   **Y** ....

16

6.   The diagram shows the production of tomatoes in large commercial greenhouses.
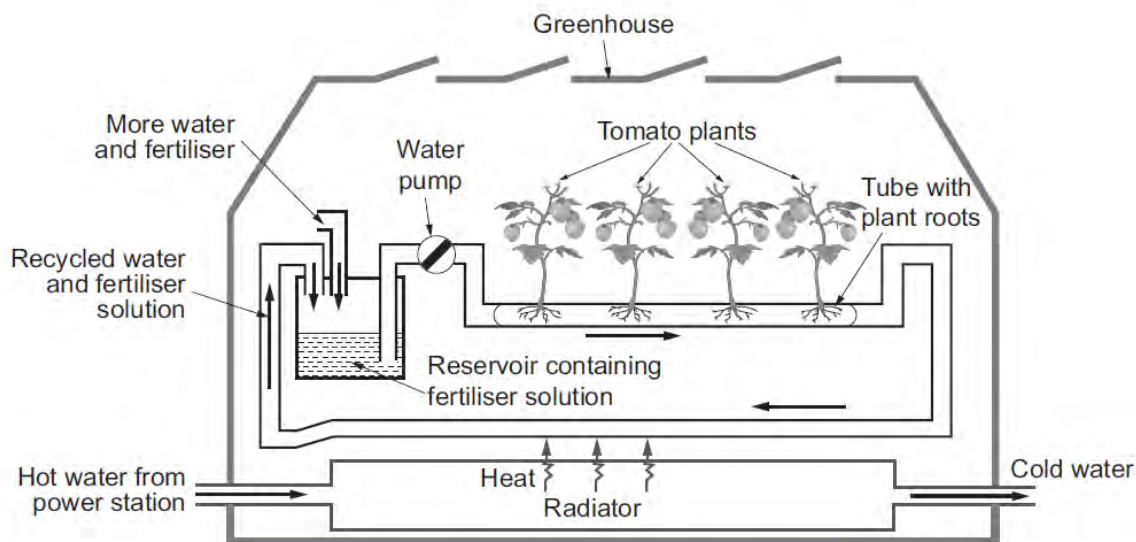
Domestic garden greenhouses are often heated using electricity. Water and fertiliser are given to the plants by people using watering cans.

(a)   Suggest **two** reasons why the greenhouse shown in the diagram is more economical and efficient than the domestic garden greenhouse as described.

[2]

(I)   ....

....

(II)   ....

....

(b)   Why would more water have to be added to the recycled water?   [1]

....

....

(c)   What nutrients should be present in the fertiliser to prevent: [2]

(i)   yellowing of the leaves;...

(ii)   poor root growth? ....

(d)   Explain why, when a petrol driven pump is used in a greenhouse, as shown in the diagram, even higher crop yields are possible.   [2]

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(e)   State **two** *other* ways to improve tomato production in the greenhouse shown.
                                                                                                                            [2]

(I)   ....

(II)   ....

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9
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7.   In 1974 sand eel fishing on a large scale began in the Shetland Isles. Sand eels are small fish which live in the sea. Sea birds feed on sand eels. In 1988, The Royal Society for the Protection of Birds published the following information.
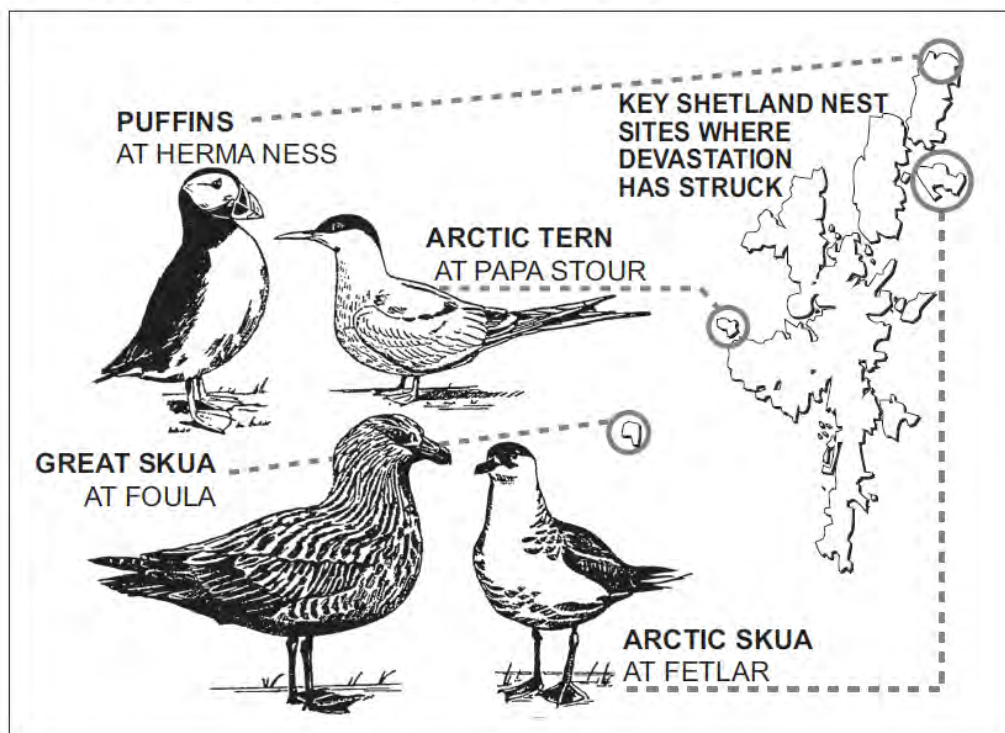
On the Shetland Isles, the number of sea birds has been greatly reduced. Sand eels are caught in large numbers for use as food in dairy and fish farms on Shetland. The sand eel population has decreased rapidly.

The following graphs show

- the tonnes of sand eels caught by net
- the percentage of sand eels fed to sea bird chicks
- the percentage of chicks successfully reared.
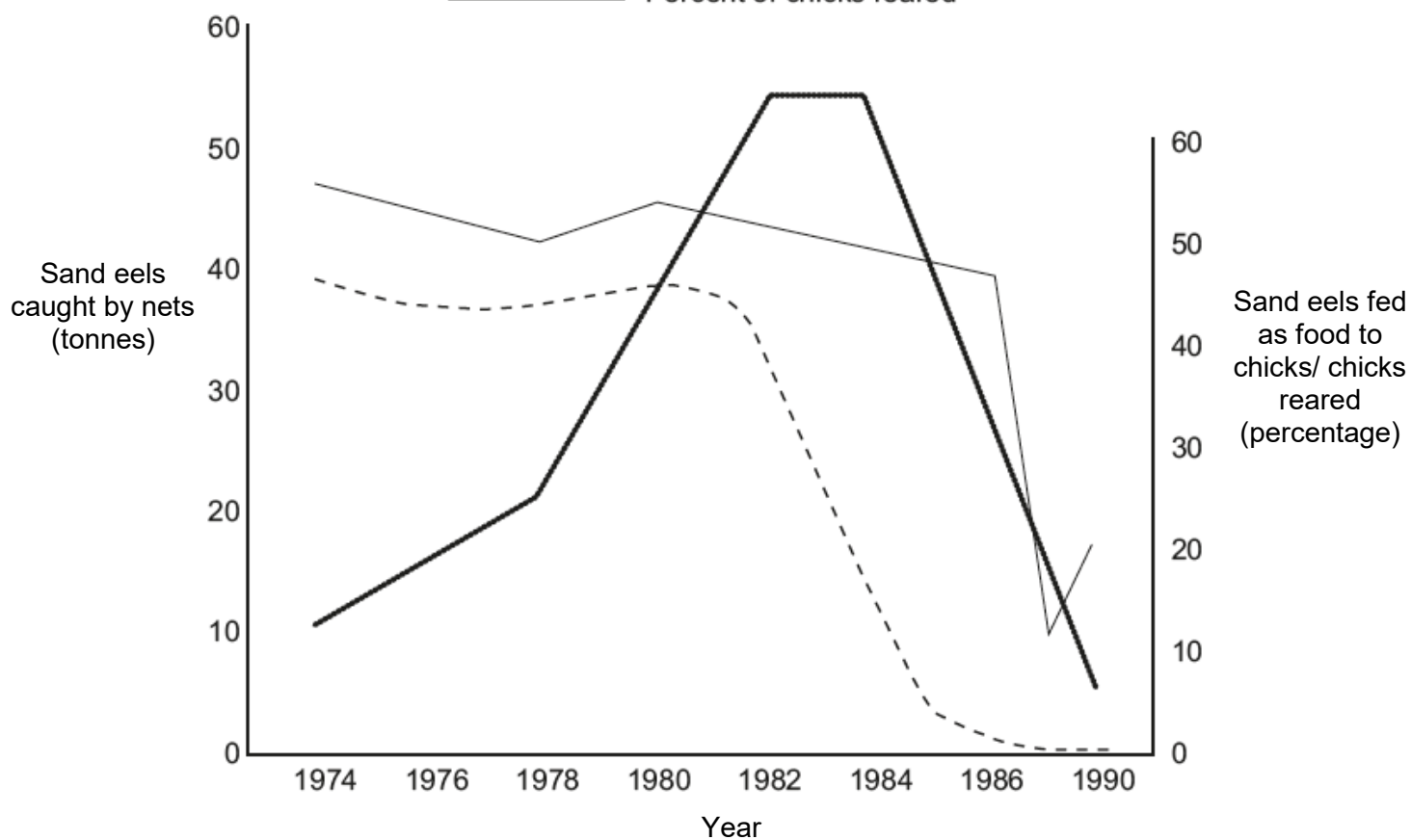
(a)   Explain the effects that sand eel fishing might have had on the seabirds.   [2]

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(b)   In 1986 sand eel fishing near the Shetland Isles was banned, but still took place around nearby islands. Explain what would you expect to happen to the number of seabirds during the next 5 years.   [1]

near the Shetland Isles;

....

....

around the nearby islands?

....

....

(c)   What measure, other than banning sand eel fishing altogether, could be taken to ensure there is enough food to feed the chicks?   [1]

....

(d)   The dairy farmers and fish farmers on Shetland claimed that there was no evidence to prove that sand eel fishing was to blame for the decrease in bird population. As a government scientist, describe how you would set up a long term experiment to obtain evidence?   [3]

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8.   An enzyme implant has successfully reduced the level of the fatty substance, cholesterol, in the blood of rabbits by 40% within 70 minutes. Scientists have developed a way of implanting the enzyme called PLA2 into humans. The enzyme breaks down the cholesterol and the products are taken out of the blood stream into the liver. Several drugs already on the market can be used to lower cholesterol levels but some of these have unwanted side effects.

(a)   Name a group of drugs that are widely used to lower cholesterol in humans.
[1]

....

(b)   Explain the effects of cholesterol on blood pressure in humans.   [2]

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....

(c)   The graph shows changes in blood pressure as blood flows through the circulatory system.
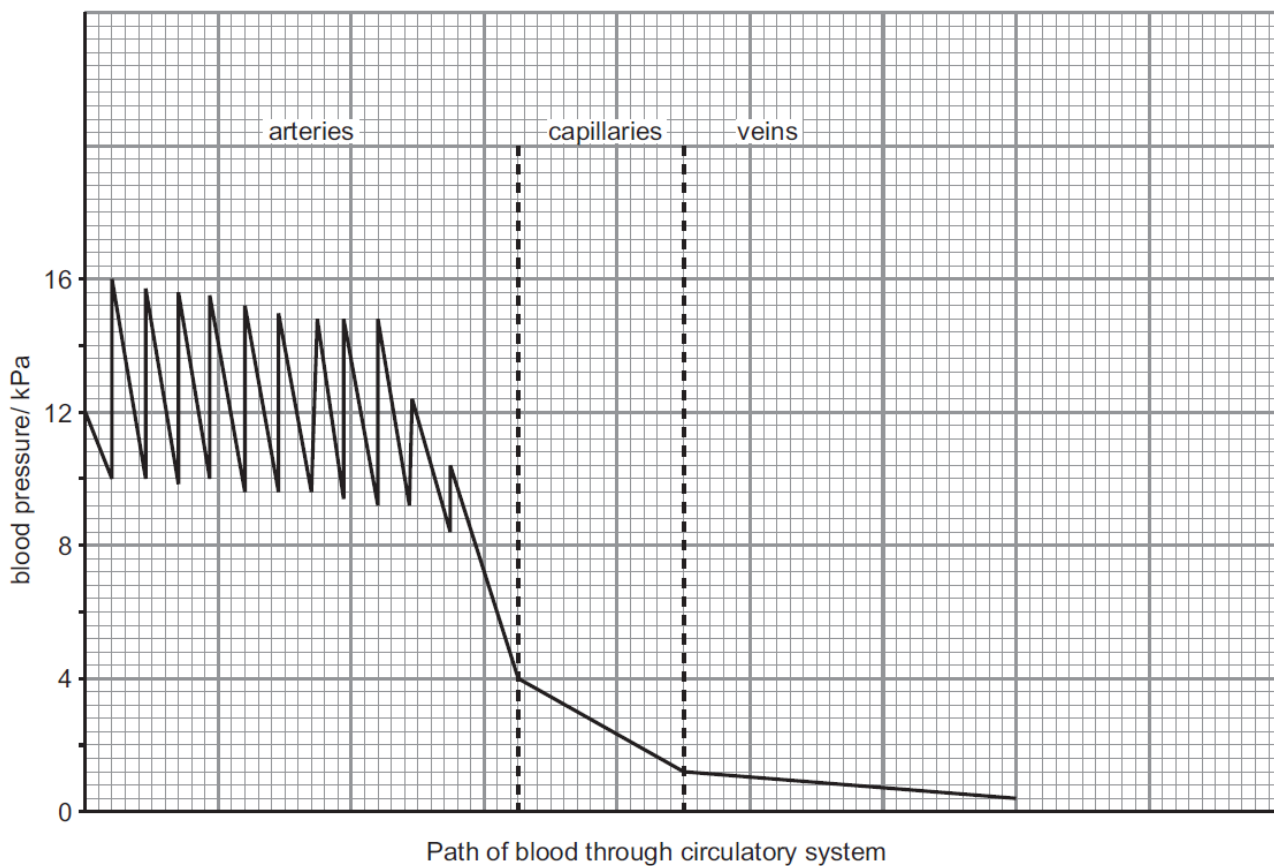
Explain the rise and fall of the blood pressure in the arteries shown in the graph.   [2]

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9.   When muscles contract, they change chemical energy into kinetic energy.

Strands of fresh muscle fibres (cells), measuring 20 mm x 2 mm were placed in ATP solution. After five minutes they were re-measured and the mean length calculated. The results are shown in the table:

Treatment	Mean original length (mm)	Mean final length (mm)
ATP Solution	20.0	16.0

(a)   Calculate the mean percentage change in length of the muscle fibres when placed in ATP solution.   [2]

mean percentage change in length = ...%

(b)   Explain the results shown in the table.   [2]

....

....

(c)   The rate at which dissolved substances move across a cell membrane is directly proportional to the difference in concentration of the dissolved substance inside and outside the cell.

The difference in concentration is calculated using the following expression:

concentration inside cell - concentration outside cell
                concentration outside cell

During exercise, the concentration of carbon dioxide inside the cell is 18 arbitrary units and the concentration outside is 3 arbitrary units.

(i)   Calculate the difference in concentration of the carbon dioxide during exercise.   [1]

difference in concentration = ... arbitrary units

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    (ii)   What effects will increasing the intensity of exercise have on   [2]

    I   the difference in concentration of carbon dioxide inside and outside the muscle cell;

....

    II   the rate of diffusion of carbon dioxide out of the muscle cell?

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10. Scientists investigated the rates of absorption of different sugars by the small intestine as follows:

In one experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it stops respiration in cells.

The results are shown in the table.

Type of Sugar	Rates of absorption (arbitrary units)	
	Intestine without cyanide	Intestine with cyanide
glucose	1.00	0.33
galactose	1.10	0.53
xylose	0.30	0.30
arabinose	0.29	0.29

(a) (i) Name **two** sugars from the table which can be absorbed by active transport.   [1]

.... and ....

(ii) Use the evidence from the table to explain why you chose these sugars.   [2]

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(b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this.   [2]

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11.   The graph shows how the biomass of plants in a **pollution-free** lake varies during one year, along with the concentration of nitrates in the water.

Explain fully the results shown in the graph between March and July. Account for the change in nitrate concentration after October.   [6 QER]

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END OF PAPER