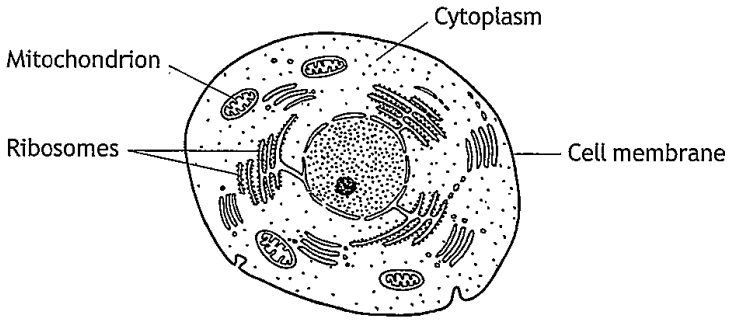
Candidate 2 evidence

MARKS

SECTION 2 — 75 marks
Attempt ALL questions

1. (a) The diagram shows a typical animal cell and some of its structures.



Choose two of the structures labelled and state their functions. 2

1 Structure Ribosomes

Function The site of protein synthesis in the cell

2 Structure mitochondrion

Function The site of ~~aerobic~~ aerobic respiration. in the cell.

(b) The field of view of a light microscope measures 2 mm in diameter.
20 plant cells were counted in a line across the diameter.

1 mm = 1000 micrometres

Calculate the average size of a cell in micrometres. 1

Space for calculation

2000 ÷ 20

= 100 micrometres

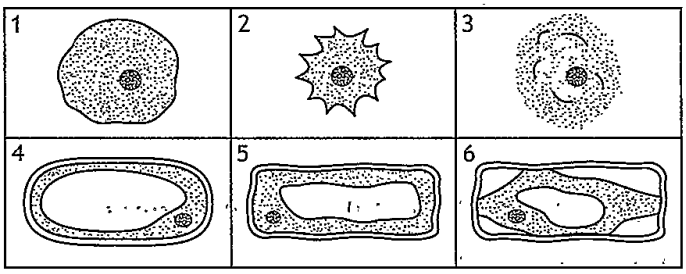
100 micrometres

MARKS

2. A student examined plant and animal cells using a microscope.

Animal cell Plant cell

The animal and plant cells were placed in solutions of different salt concentrations. After several minutes a sample of cells was taken from each solution and examined. One cell from each solution is shown.



(a) Changes in the cells were due to osmosis.

Explain why osmosis is described as a passive process. 1

Because the water is moving from an area of high water concentration to an area of low water concentration with/down a concentration gradient and therefore needs no energy which makes it passive

(b) Identify the animal cell shown which had been placed in a solution of higher salt concentration than its cell contents. 1

Cell number 2

(c) State the term used to describe the condition of cell 6. 1

plasmolysed

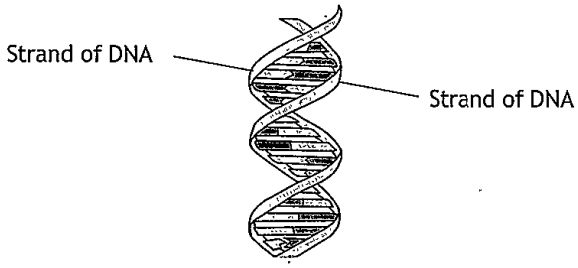
(d) Cells 3 and 4 had been placed in solutions which were both of the same concentration.

Explain why the results observed were different. 2

- both have been placed in a solution with a high water concentration so have gained water and swelled up.
- an animal cell has no cell wall to keep it from bursting.

MARKS

3. The diagram represents part of a DNA molecule.



(a) (i) Give the term which describes the shape of a DNA molecule as shown in the diagram. 1

Double helix.

(ii) Describe the way in which the DNA strands are linked together. 1

each base has another which only that one can be paired with so that holds it together.

(b) Name the organelle in animal cells which stores the DNA. 1

Nucleus.

MARKS

4. The diagrams represent stages in an enzyme-controlled reaction.

Stage 1 Stage 2 Stage 3

(a) Enzymes are involved in two types of reaction.
Identify the type of reaction shown in the diagrams above. 1

Degradation.

(b) Describe the events occurring in the enzyme reaction shown. 3

- enzyme and substrate are put together
- enzyme and substrate react in a degradation reaction.
- After the reaction two products are produced.

MARKS

5. (a) The table shows information about two types of respiration in animal cells.

Tick the boxes in the table to indicate whether the statements apply to aerobic respiration, fermentation or both. **2**

	Type of respiration	
Statement	*Aerobic*	*Fermentation*
Oxygen is required	✓	
Pyruvate is formed	✓	
Lactate is formed		✓
Carbon dioxide is formed		✓

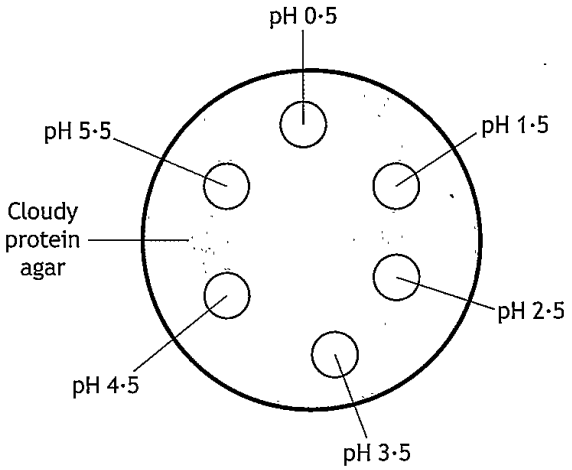
(b) ATP is an energy-rich molecule formed by respiration.

Name a cellular process which requires energy from ATP. **1**

production of new cells

6. An investigation was carried out into the effect of pH on the activity of the enzyme pepsin.

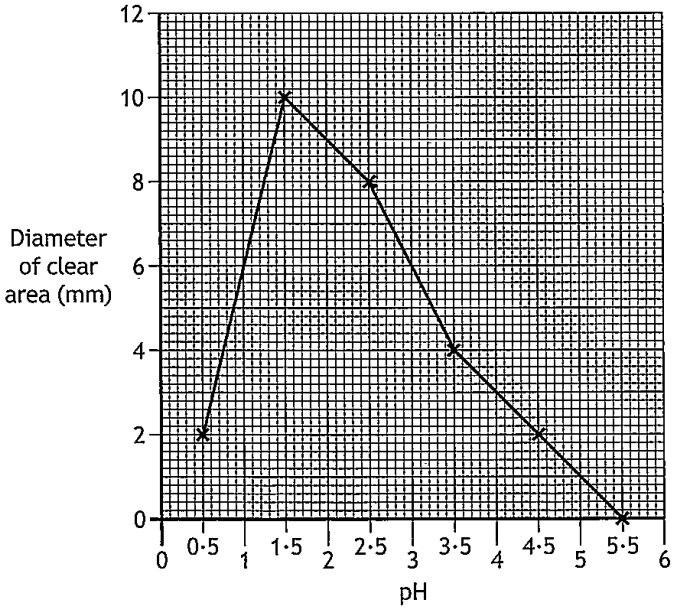
A Petri dish was filled with cloudy protein agar. Six holes were made in the agar and each was filled with pepsin solution at the pH values shown.



When the protein is broken down, cloudy agar becomes clear.

The dish was examined after 24 hours and the diameter of the clear area around each hole was measured. The larger the clear area, the more active the enzyme.

The results are shown in the graph.



MARKS

6. (continued)

(a) (i) Identify the optimum pH for pepsin in this experiment. 1

pH 1.5

(ii) Calculate how many times more active the enzyme is at pH 2·5 than at pH 4·5. 2mm 8mm 1

Space for calculation

$\frac{8\text{ mm}}{2\text{ mm}}$

$= 4$

4. times

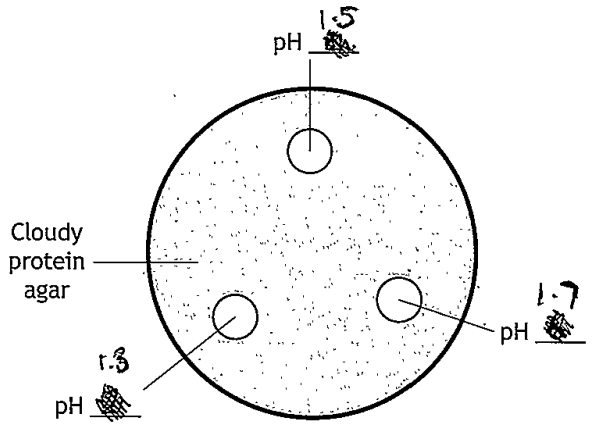
(b) State two variables which should be controlled to make this experiment valid. 2

1 Temperature

2 concentration of pepsin.

(c) As a follow-up to this investigation, students were asked to design an experiment using the same apparatus to identify a more exact optimum pH value.

Complete the diagram below to show the pH values the students could use. 1



MARKS

7. The process of mitosis begins with the chromosomes becoming visible.

Describe the sequence of events which follows on from this resulting in the production of two daughter cells. 4

~~chromatids replicate to become a chromosome~~

Step 2 – chromosomes line up at the equator and spindle fibres form.

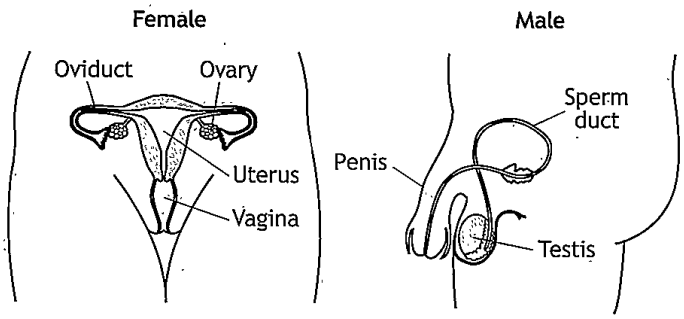
Step 3 – The spindle fibres pull the chromosomes apart – two sets of chromatids

Step 4 – The cell splits forming two daughter cells with the same amount and kind of chromatids.

Step 1 – chromatids replicate to produce a pair of themselves this is called a chromosome

MARKS

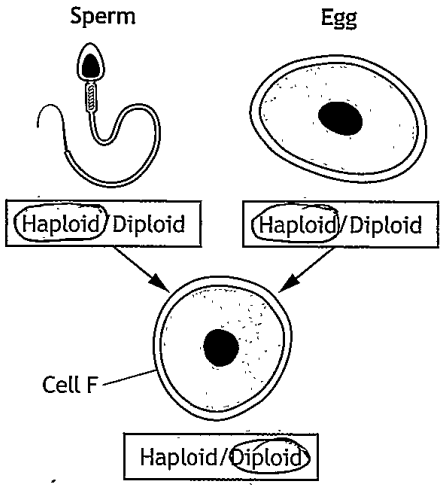
8. The diagrams show the human reproductive system in females and males.



(a) From the diagrams, identify one site of gamete production. 1

Ovary.

(b) The diagram represents the process of fertilisation.



(i) In the diagram, circle one term in each box to show the chromosome complement for each cell. 1

(ii) Name cell F which is produced when the sperm fertilises the egg. 1

Zygote.

MARKS

9.

Adapted from the Herald, Friday 4 March 2016

Coffee and Multiple Sclerosis

Multiple sclerosis (MS) is a condition which affects the central nervous system and can cause problems with vision and balance as well as numbness in the skin. Scotland has one of the highest incidences of MS in the world, with a mixture of genetic and environmental factors thought to be the cause.

Research suggests that drinking a lot of coffee every day could potentially cut the risk of developing MS.

Experts found that consuming more than 900 ml daily may offer up to 30% reduced risk.

Researchers compared the results of studies from two different countries.

One study in Sweden involved 1,620 adults with MS and a comparison group of 2,788 people without MS. A second study in the USA involved 1,159 people with MS and 1,172 people without MS.

The results showed the risk of MS was consistently higher among people who drank fewer cups of coffee every day in both studies, even after taking into account other factors of influence.

(a) Identify the factors thought to be the cause of the high incidence of MS in Scotland. 1

The enviroment.

(b) In the table below, present the information from the passage, to give details of the two studies and the people involved. 2

(An additional table, if required, can be found on *page 28*.)

Country	Sweden	USA
people without (MS)	2,788 people.	1,172 people
people with (MS)	1,620 Adults	1,159 people

MARKS

9. **(continued)**

(c) As part of the research described in the passage, groups of people with MS were compared to those without MS.

Give the term used to describe a comparison group in scientific research. 1

A control.

(d) Decide whether this research would be described as reliable or not and tick the appropriate box.

Give a reason for your choice. 1

Reliable ☑ Not reliable ☒

Reason. The study was completed many times with many people of different genetics.

(e) The researcher took 'other factors of influence' into consideration.

Suggest one of these factors. 1

The secuence of bases in their DNA - Genetics.

MARKS

10. The following statements are about blood vessels.

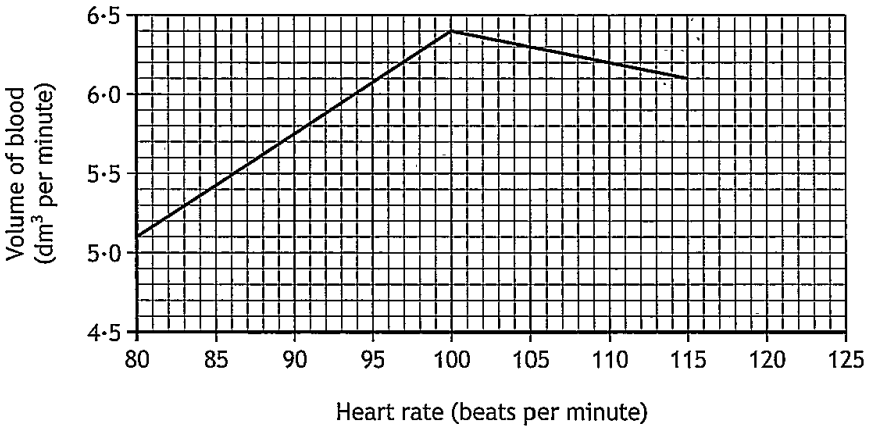
1. Contain valves.
2. Have a narrow central channel.
3. Carry blood under low pressure.
4. Form networks at organs and tissues.
5. Carry blood from the heart to organs.

(a) Choose either arteries or veins and select two statements from the list above which describe that type of blood vessel. 2

Blood vessel veins

Statements 1 and 3

(b) The graph shows the effect of changes in heart rate on the volume of blood pumped by the left ventricle.



(i) Describe the relationship between heart rate and volume of blood pumped by the left ventricle. 2

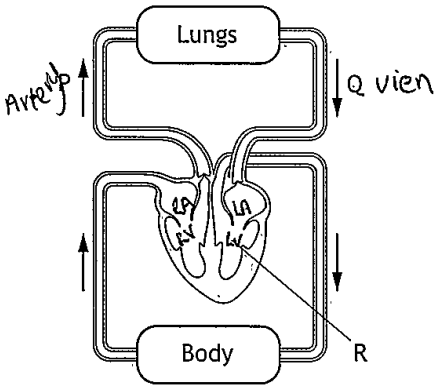
The higher the heart rate the more blood pumped but when the heart rate gets to high the volume decrease

(ii) Predict the volume of blood pumped by the left ventricle at 120 beats per minute. 1

6.0 dm³ per minute

10. (continued) MARKS

(c) The diagram represents part of the circulatory system in humans.



(i) Describe the difference in oxygen concentration in the blood travelling through blood vessels P and Q. 1

- P = less oxygen going from heart to lungs.
- Q = more oxygen going from lungs to heart.

(ii) Name the heart chamber labelled R. 1

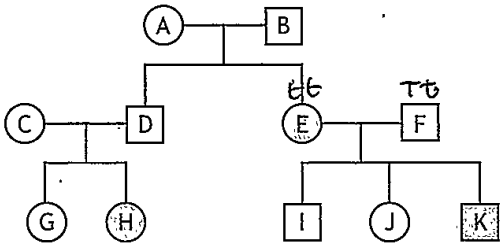
Left ventricle.

MARKS

11. (a) Tongue-rolling is an inherited characteristic controlled by different forms of a gene. T (roller) represents the dominant form of the gene, and t (non-roller) represents the recessive form.

The family tree diagram shows a pattern of inheritance of the characteristic.

Male tongue-roller
Male non tongue-roller
Female tongue-roller
Female non tongue-roller



(i) Use letters from the diagram to identify all the individuals in the F_2 generation. 1

G, H, I, J, K.

(ii) Give the genotypes of individuals E and F. 2

E tt F Tt

(iii) Complete the Punnett square to show the gametes and expected genotypes of the offspring of E and F. 2

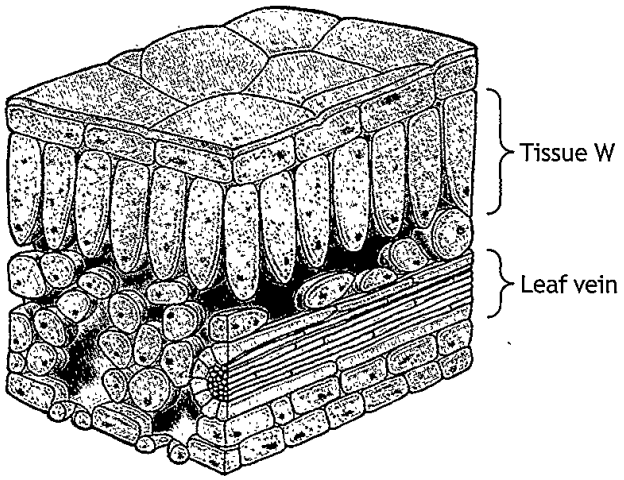
		Genotype of gametes from F	
		T	t
Genotype of gametes from E	t	Tt	tt
	t	Tt	tt

(b) State the type of variation shown by tongue-rolling. 1

discontinuous.

MARKS

12. The diagram represents a section through a leaf.



(a) (i) Name tissue W. 1

spongy mesophyll.

(ii) The cells in tissue W have a greater number of chloroplasts than other leaf cells.

Suggest the advantage of these cells being located near the upper surface of the leaf. 1

more sunlight which means more photosynthesis

(b) The leaf vein consists of xylem and phloem tissues.

Choose either xylem or phloem, by ticking one box, and describe one structural feature of that tissue. 1

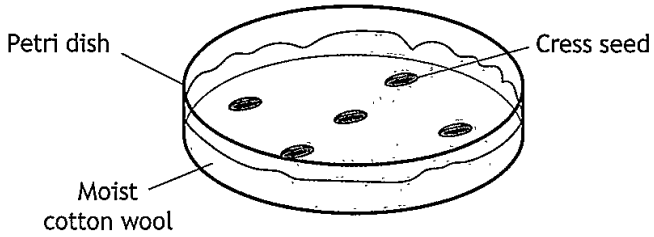
Xylem [✓] Phloem [ ]

Feature of tissue To transport water from the roots to the leaves.

MARKS

13. To investigate the effect of competition on the growth of cress seeds, five Petri dishes, labelled A–E, were set up and left for six days. Each dish contained a layer of moist cotton wool with different numbers of cress seeds sown evenly across its surface.

Dish A is shown in the diagram.



The results are shown in the table.

Dish	*Number of seeds sown*	*Number of seedlings surviving after six days*	*Percentage of seedlings surviving after six days*
A	5	5	100
B	10	10	100
C	20	19	95
D	40	34	85
E	80	60	75

(a) (i) Complete the table by calculating the number of seedlings surviving in Dish C. 1

Space for calculation

0.95
x 20
19

19 seedlings are surviving after 6 days.

(ii) Describe the relationship between the number of seeds sown and the percentage of seedlings surviving after six days. 1

The lower the amount of seeds sown the higher the percentage of surviving seeds.

MARKS

13. (a) (continued)

(iii) Explain why the type of competition shown in this investigation is described as being intraspecific. 1

Because all of the seeds are the same type/species which means they are fighting their own kind.

(b) The diagram represents positions of organisms in a food chain.

Tick one of the boxes to show the position cress would occupy in the food chain. 1

(c) Name one resource, other than water, for which plants may be in competition. 1

sunlight. to carryout photosynthesis - Green plants.

MARKS

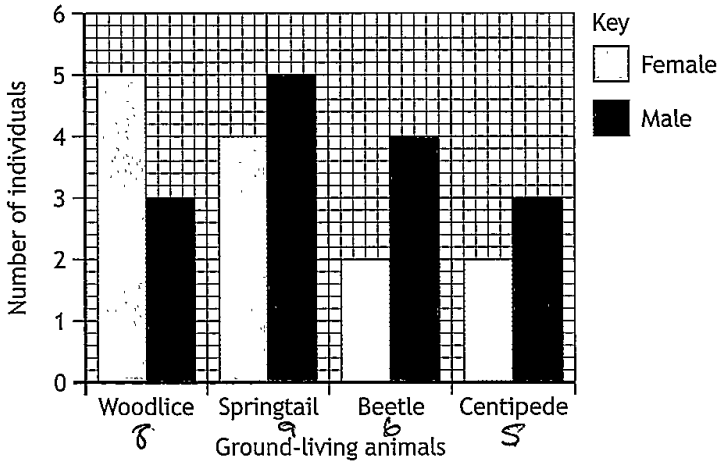
14. Sampling techniques can be used to estimate the abundance of plants and animals.

(a) In an investigation into ground-living animals in a woodland, a group of students collected and counted the animals they found.

(i) Name a sampling technique which could be used to collect the ground-living animals. 1

A pitfall trap.

(ii) The students sorted the animals into male and female, counted them and recorded the results in a bar graph.



1 Identify the animal which had the greatest overall abundance. 1

Springtail

2 The students concluded that males were always more abundant than females.

Identify the animal for which this is **not** true. 1

woodlice.

(iii) It was decided that the samples were not fully representative of the area.

Suggest how the investigation could be improved. 1

put ethanol in the bottom of the pitfall trap to make sure that they are not eating each other. when they are getting trapped.

MARKS

14. (continued)

(b) The distribution of organisms may be affected by abiotic factors.

The table shows the results of a study into the effect of soil moisture levels on the distribution of three species of plant.

		Number of plants		
Sample site	*Soil moisture* (units)	*Species E*	*Species F*	*Species G*
1	20·2	11	15	12
2	23·4	13	14	11
3	22·1	12	16	10
4	24·5	15	17	15
5	26·6	18	13	12
6	28·4	19	15	14

(i) State which species has its distribution most affected by the soil moisture levels. 1

Species G

(ii) Calculate the average number of plants per sample site for species F. 1

Space for calculation

15 + 14 + 16 + 17 + 13 + 15
= 90

90 ÷ 6
= 15

15 plants

MARKS

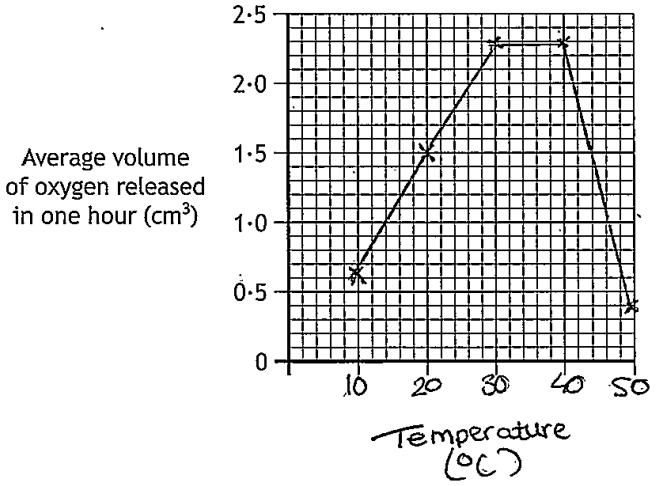
15. A student set up an investigation into the effect of temperature on the rate of photosynthesis in a green plant, by measuring the volume of oxygen released in one hour.

The results are shown in the table.

Temperature (°C)	*Volume of oxygen released in one hour* (cm^3)		
	Experiment 1	*Experiment 2*	*Average*
10	0·7	0·5	0·6
20	1·6	1·4	1·5
30	2·7	1·9	2·3
40	2·0	2·6	2·3
50	0·3	0·5	0·4

(a) On the grid, plot a line graph to show the effect of temperature on the average volume of oxygen released in one hour. 2

(An additional grid, if required, can be found on *page 28*.)



(b) Predict the average volume of oxygen released in one hour if the experiment was carried out at a temperature of 60 °C. 1

0.2 cm^3

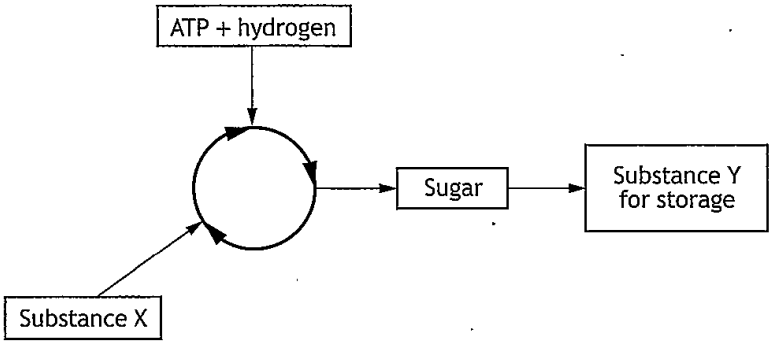
MARKS

15. (continued)

(c) State one factor, other than temperature, which can limit the rate of photosynthesis. **1**

Light intensity.

(d) The diagram represents the second stage of photosynthesis.



Name substances X and Y. **2**

X carbon dioxide

Y starch

MARKS

16. A gardener treated the soil in the area where he planted vegetables with a chemical to increase the yield.

(a) (i) The chemical added to the soil by the gardener contained nitrates.

Give the general name for this type of chemical. 1

Fertilisers

(ii) Describe the use that plants make of nitrates. 1

They use them to make food + grow.

(iii) When the vegetables were picked and weighed, the total yield was 42 kilograms. The previous year the total yield was 35 kilograms.

Calculate the percentage increase in yield. 1

Space for calculation

$\frac{42}{35} \times 100$

$= 120$ percentage increase in yield.

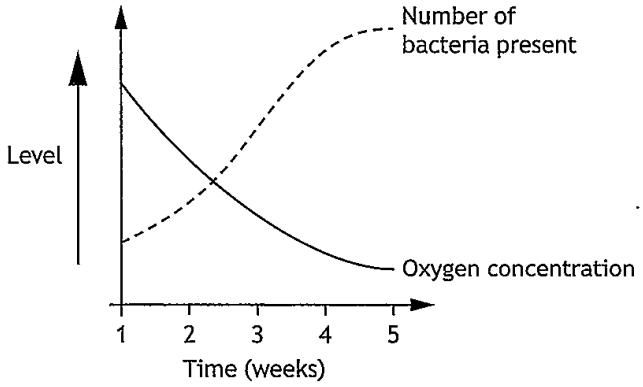
120 %

MARKS

16. (continued)

(b) Later in the year the gardener noticed that the algae in his pond had increased and now covered the surface of the water. He sampled the pond water over 5 weeks and measured its oxygen concentration and number of bacteria present.

The results are shown in the graph.



(i) What name is given to the increased growth of algae in the pond? 1

An algal bloom.

(ii) Explain why the increased growth of algae resulted in an increase in the number of bacteria. 1

Because when the algae dies the bacteria then feed of the algae. Which causes the bacteria numbers to increase.

(iii) Using the information in the graph, explain why the increase in number of bacteria resulted in the population of goldfish in the pond decreasing. 1

Because the bacteria started to use up all of the oxygen which the gold fish needed to survive.