Surname		Centre Number	Candidate Number
Other Names			0

GCSE – NEW

wjec cbac

C400U10-1

S18-C400U10-1

eduqas
Part of WJEC

BIOLOGY – Component 1
Concepts in Biology

FOUNDATION TIER

TUESDAY, 15 MAY 2018 – AFTERNOON

2 hours 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	12	
2.	13	
3.	14	
4.	10	
5.	11	
6.	14	
7.	8	
8.	8	
9.	16	
10.	14	
Total	120	

ADDITIONAL MATERIALS

In addition to this examination paper,
you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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.
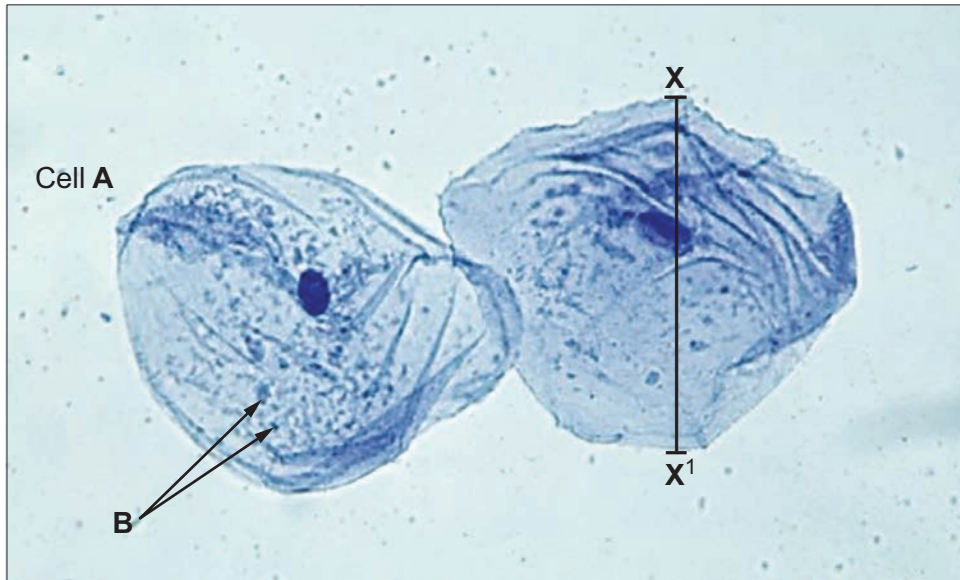
INFORMATION FOR CANDIDATES

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

The assessment of the quality of extended response (QER) will take place in question **8**(a).

2

Answer **all** *questions.*

1. The photograph shows two animal cells as seen under a light microscope.

Cell **A**

X

X¹

B

(a) (i) The drawing below represents cell **A**.

      I.   **On the drawing**, label the cytoplasm and cell membrane. [2]

      II.   **Add the nucleus** to the drawing and label it. [1]
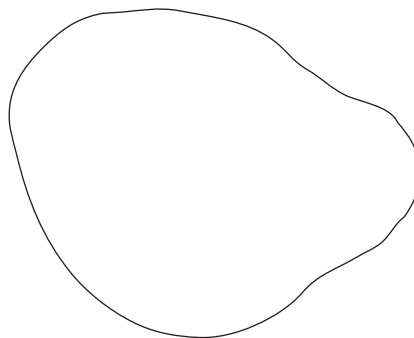
(ii) The structures labelled **B** carry out respiration. State the name of these structures. [1]

....

(iii) Explain how it is possible to tell, from the photograph, that these cells are not plant cells. [3]

....

....

....

(iv) The actual length of the cell along line **X – X₁** is 0.02 mm.

Calculate the magnification of the photograph using the following formula, showing your working. [2]

$$\text{Magnification} = \frac{\text{length of line } \mathbf{X} - \mathbf{X_1} \text{ on photograph of cell}}{\text{actual length of cell along line } \mathbf{X} - \mathbf{X_1}}$$

Magnification = × ....

(b) The cells in the photograph have been stained for observation under the microscope.

Describe the method by which you would stain and prepare the cells for observation under the microscope. State the purpose of the staining. [3]

....

....

....

....

12

2. *(a)* DNA is found in the nucleus of eukaryotic cells.

(i) Describe **one** way in which the DNA of prokaryotic cells is different from that of eukaryotic cells. [1]

....

....
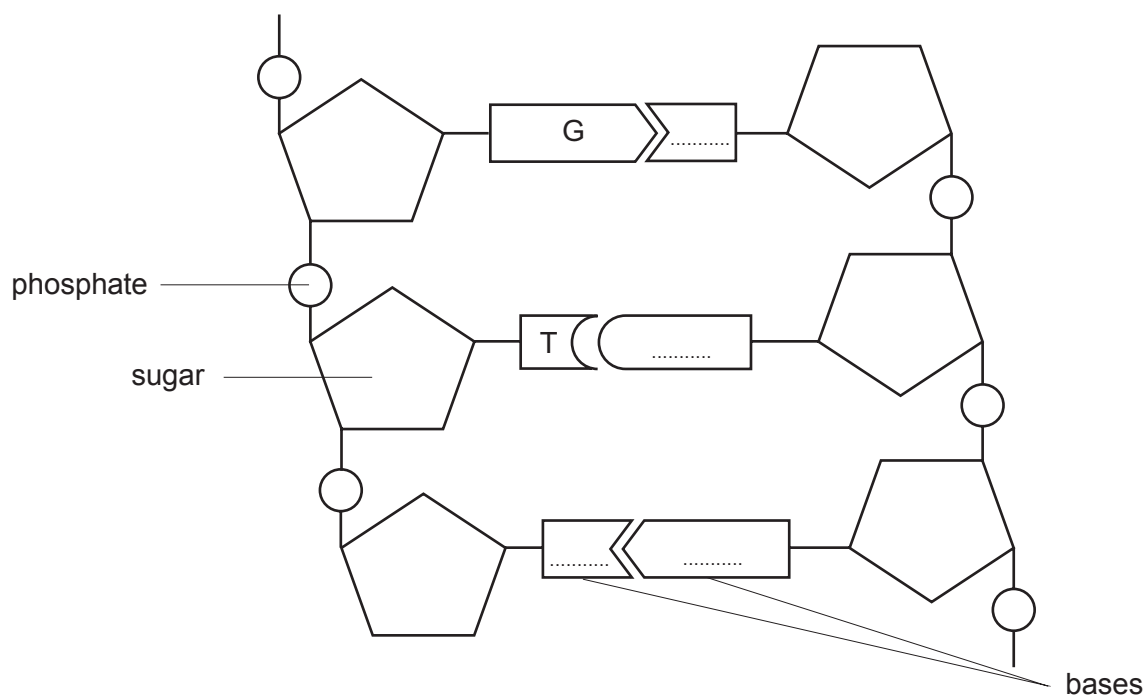
(ii) The diagram below shows part of a DNA molecule.

On the diagram,

    I.   **complete** the letter names for the bases [2]

    II.   **draw** a circle around one nucleotide [1]

(b) DNA profiling can be used to study how closely species are related.

One method is called DNA barcoding and is based on the sequence of bases in a gene. Scientists in Norway used this technique to study four species of birds. The willow warbler, (*Phylloscopus trochilus*) was the reference species. The three other species were compared against this species.

The willow warbler, *Phylloscopus trochilus*

The barcodes obtained for the birds are shown in the table below.

DNA Bar number	Barcode for reference species	Barcodes for other species		
	willow warbler (*Phylloscopus trochilus*)	chiff-chaff (*Phylloscopus collybita*)	arctic warbler (*Phylloscopus borealis*)	yellow warbler (*Setophaga petechia*)
1	—	—		—
2	—	—	—	—
3	—	—	—	—
4	—	—		—
5			—	
6	—	—		
7	—	—		
8	—	—	—	
9			—	—
10	—	—		—

(i) From the DNA barcodes, explain which **one** of the three species is most closely related to the willow warbler and which is the least closely related. [3]

....

....

....

(ii) Before beginning their work, one of the scientists said:

'It is not always possible to tell how closely species are related to one another from the common names they have been given.'

From these results, state the evidence that supports this statement. [1]

....

(c) The feather colour of the Java sparrow is controlled by a gene which has two alleles. The dominant allele **G** gives a phenotype of grey feathers, as shown in the photograph. The recessive allele **g** gives brown feathers.

Java sparrow *(Lonchura oryzivora)*

A commercial breeder of Java sparrows crossed two birds with the grey phenotype on five occasions and the following offspring were produced.

Cross number	Numbers of offspring	
	Grey	Brown
1	4	2
2	6	1
3	5	3
4	6	2
5	6	1
Total	....	....

(i) Calculate the totals for each phenotype and then the overall ratio of grey to brown phenotypes in the offspring, showing your working. [1]

Ratio = grey .... : brown ....

(ii) State the genotypes of the two parent birds which the breeder crossed. [1]

Parent 1 ....   Parent 2 ....

(iii) Complete the Punnett square below to show a cross between these two parent birds.

Give the gametes produced by the parents and show the possible genotypes of the offspring. [2]

Gametes		

(iv) If a breeder crossed a homozygous grey bird with a homozygous brown bird, state the probability that offspring with the brown phenotype would be produced. **Circle** your answer. [1]

0%   **25%**   **50%**   **75%**   **100%**

13

C400U101
07

Examiner only

3. *(a)* Complete the word equation for photosynthesis. [1]

.... + ... ⟶ .... + oxygen

(b) The diagram below shows part of a food chain in a pond.
The figures show energy in kJ per m^2 per year.

energy in sunlight
1880000

photosynthesis
in water plants
45000

energy not available to
herbivores

....

food available
for herbivores
23000
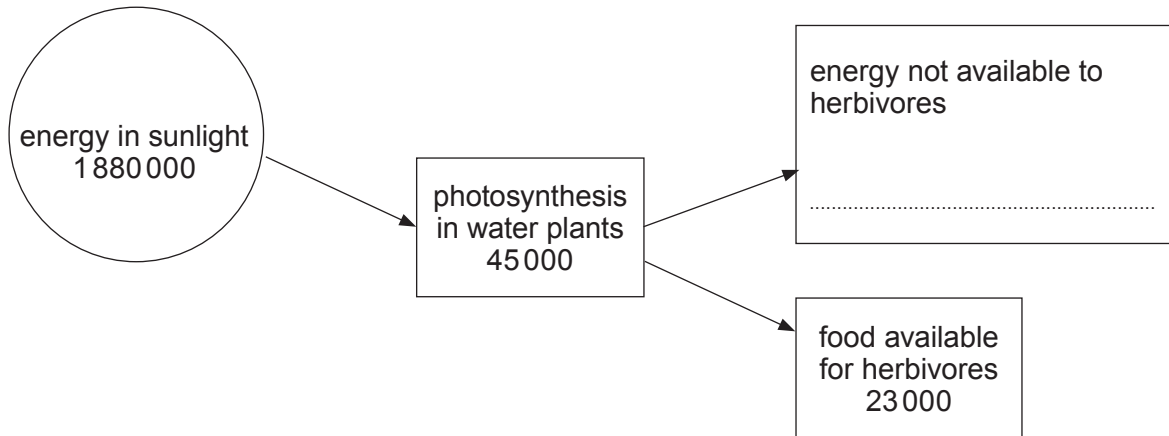
From the diagram:

(i) I. Calculate the percentage of the energy from the sunlight which is used in photosynthesis. Give your answer to the nearest whole number. [2]

percentage of energy from sunlight used in photosynthesis = ... %

II. State why this percentage is so small. [1]

....

....

(ii) **Complete the diagram** by calculating the energy which is **not** available to the herbivores and **state the process** which results in this loss of energy from the food chain. [1]

....

(c) Some students in a college in Yorkshire investigated photosynthesis in the water plant *Cabomba caroliniana* at different light intensities. The plant grows in many parts of North America but is not native to the UK and was obtained from a shop selling products for ornamental fish tanks.
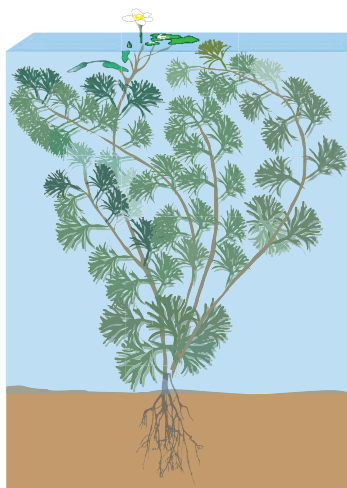
Cabomba caroliniana

The apparatus the students used is shown in the diagram below. They set it up in a darkened room with one tube at 20 °C and one at 30 °C.

thermometer

waterbath (beaker of water)

bubbles of oxygen

Cabomba caroliniana

test tube with water and sodium hydrogen carbonate
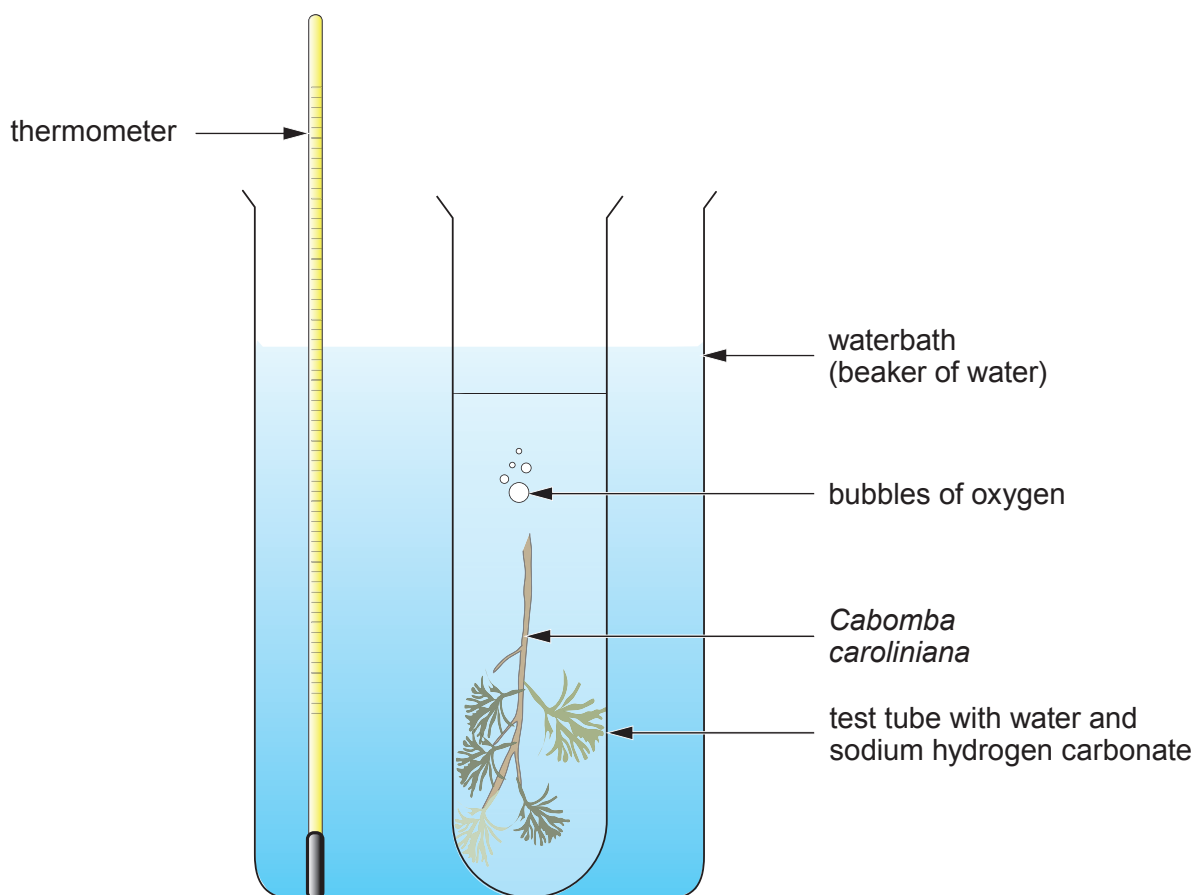
The students used pieces of plant stems which were 6 cm in length. They altered the light intensity by changing the distance between the lamp and the test tube, measuring the intensity at each distance using a light meter. The students monitored the temperature of the waterbath by reading the thermometer.

The rate of photosynthesis was recorded by counting the number of bubbles produced in one minute for each light intensity.

The results of the investigation are shown in the graph.
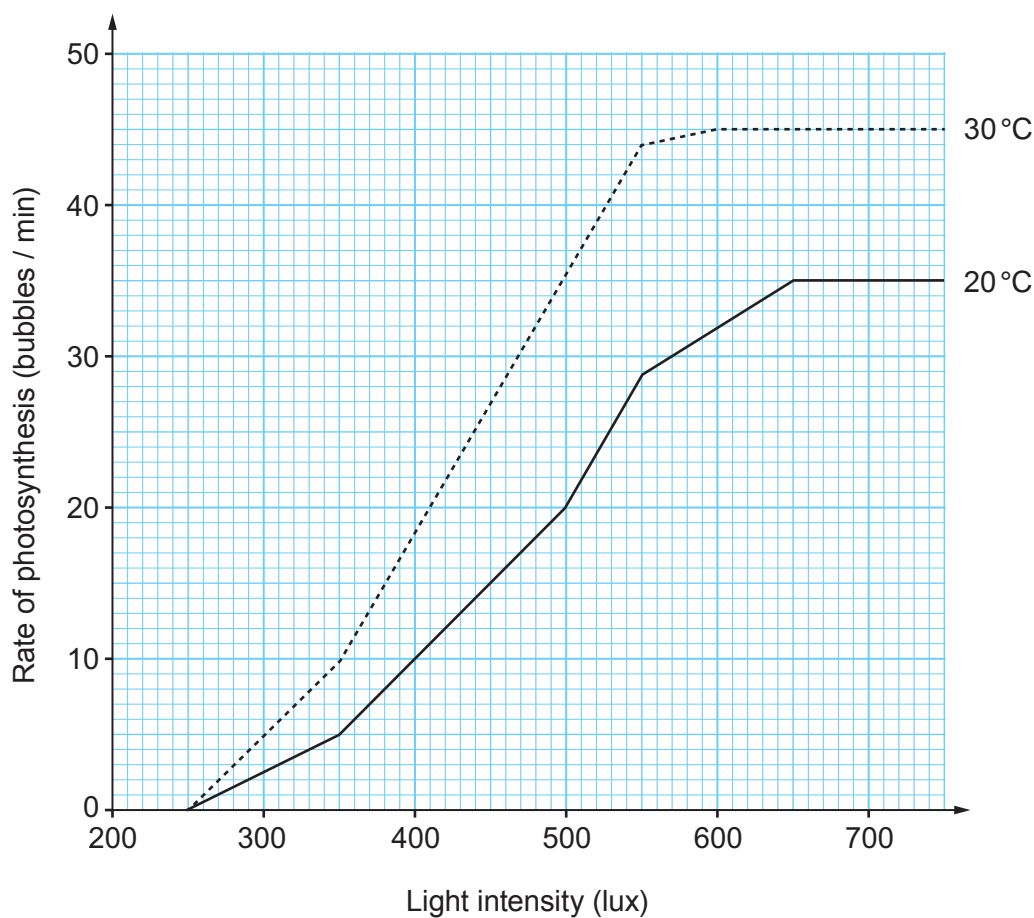
Use the graph to answer the questions.

(i)   State what you can conclude about the effect of increasing light intensity on the rate of photosynthesis in *Cabomba caroliniana* at 20 °C.   [2]

....

....

....

(C400U10-1)

(ii)   I.   Calculate the difference between the rate of photosynthesis at 20 °C and
              30 °C at a light intensity of 550 lux.   [2]

                       Difference = ... bubbles per minute.

        II.   Explain the reason for this difference.   [2]

        ....

        ....

        ....

(iii)   During the investigation the students found that the temperatures of both the
        waterbaths varied by a few degrees and had to be adjusted by adding hot or cold
        water.
        State **one** way in which the apparatus could be improved to reduce this source of
        error.   [1]

        ....

        ....

(iv)   When the students were clearing up after their investigation one of the students
        offered to collect up all the *Cabomba caroliniana* and dispose of it by putting it
        into the college pond. Explain why, for environmental reasons, this should not be
        done.   [2]

        ....

        ....

(C400U10-1)   **Turn over.**

14

C400U101
11

12

4. This question is about cell division.

(a) The function of meiosis is to produce sex cells (gametes) for sexual reproduction.

(i) State **one** function of mitosis. [1]

....

(ii) State the number of daughter cells produced when a cell divides by: [1]

I. mitosis ....

II. meiosis ....

(b) The images below show the mosquito (*Anopheles sp.*) and the chromosomes from one of its body cells.

Anopheles sp.
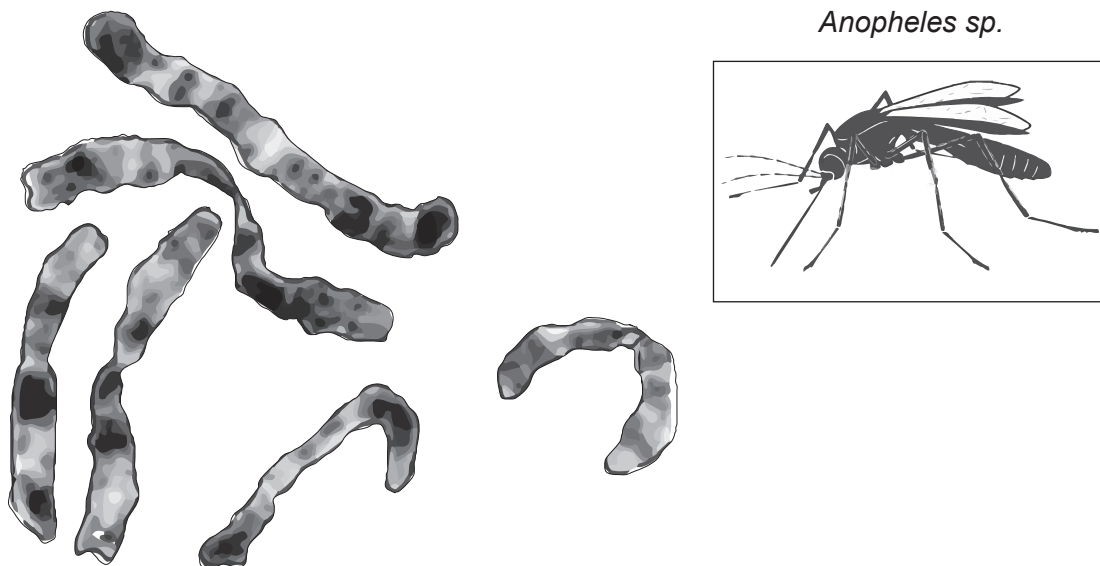
(i) **Complete the table** below. [2]

Type of mosquito cell	Number of chromosomes
body cell	
sex cell (gamete)	
fertilised egg cell	

(ii) The mosquito is a dangerous pest in many countries. Scientists working for the World Health Organization (WHO) have produced an insecticide spray which acts by preventing meiosis in mosquitoes.

State the name of a communicable disease spread by mosquitoes and explain how the use of this insecticide by the WHO would help to prevent the spread of this disease. [3]

....

....

....

....

(c) Human stem cells can be obtained from embryos and adults and can be used in medical treatment. Stem cells undergo rapid mitosis.

Scientists have developed a method of treating tooth decay by using adult stem cells, as shown in the diagram below.
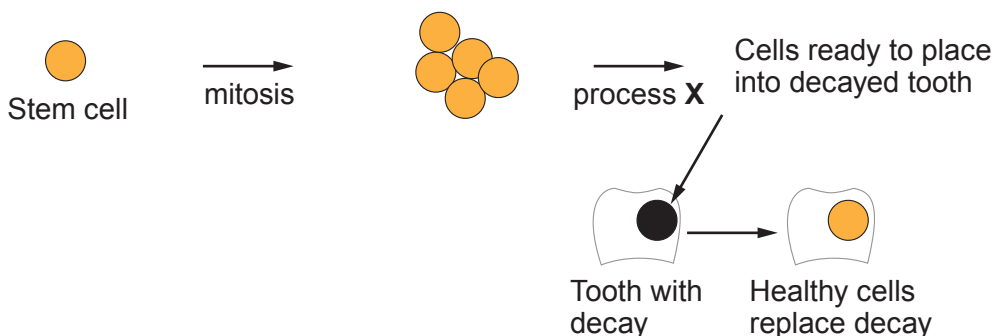
(i) Describe what occurs during process **X** in the diagram. [1]

....

....

(ii) The adult stem cells used in this treatment can be the patient's own cells. Give **one** advantage of this compared with using stem cells from a donor. [1]

....

....

(iii) Some people accept the use of adult stem cells in medical treatments but object to the use of embryonic stem cells. State a reason for this. [1]

....

....

(C400U10-1) **Turn over.**

10

5. The diagram shows a section through the human heart.

(a) (i) **On the diagram, label** blood vessels **A** and **B**. [1]

blood vessel **A**

....

blood vessel **B**

....

tricuspid valve

left atrium
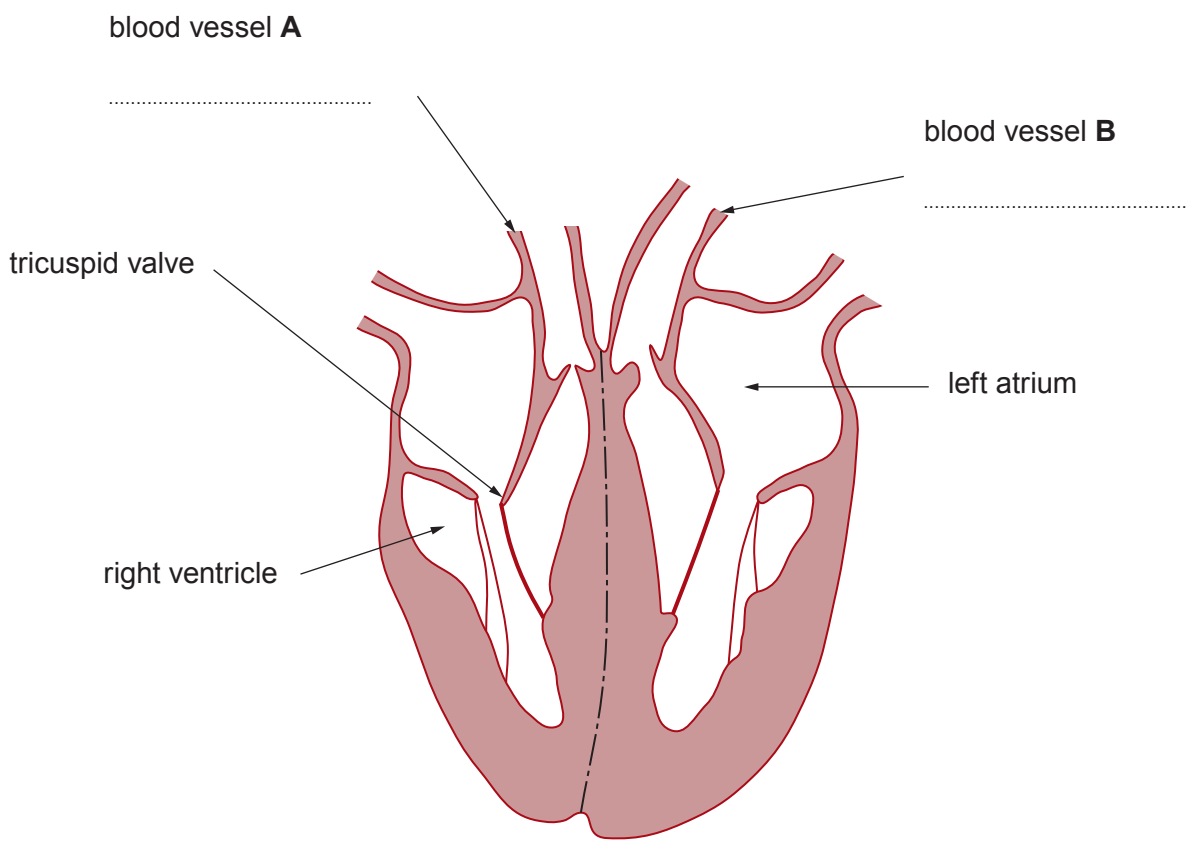
right ventricle

(ii) State the type of tissue which makes up the walls of the heart. Explain the importance of the difference in the thickness of the walls of the right and left ventricle. [3]

....

....

....

....

(iii) Explain why the concentration of oxygen in the blood would be lower than normal if the tricuspid valve was not functioning effectively. [2]

....

....

....

Examiner only

(b) The image below shows the coronary arteries which supply blood to the tissue of the heart wall.

Coronary arteries
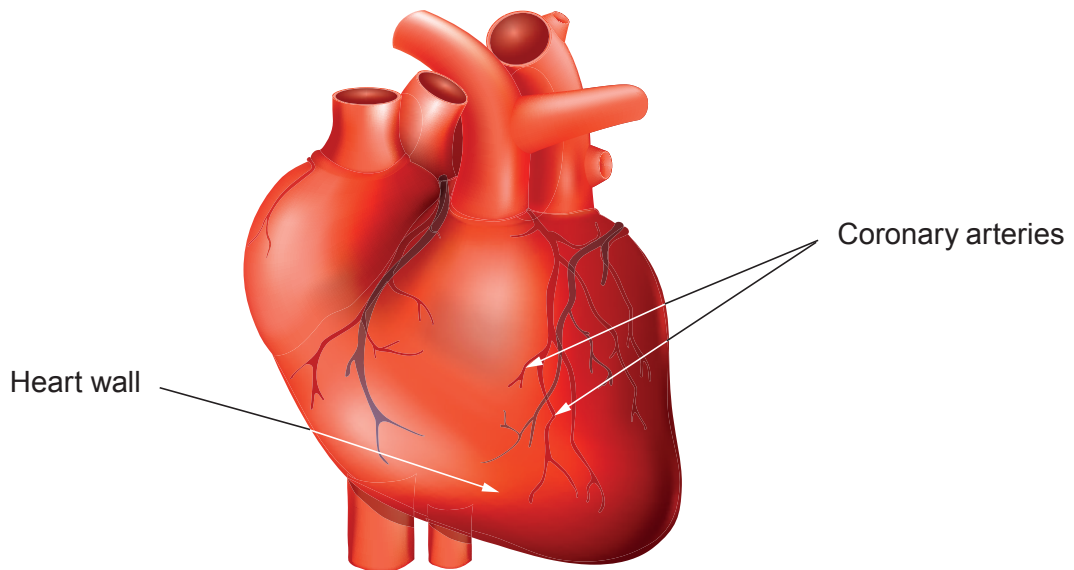
Heart wall

In coronary heart disease (CHD) the coronary arteries can become blocked so that blood does not reach part of the heart wall.

(i) If the coronary arteries are blocked the tissues of the heart wall do not receive oxygen for respiration. State **one** *other* substance also needed for respiration, which will not reach the heart wall. [1]

....

(ii) Smoking causes platelets in the blood to become over-active.
Describe how smoking could lead to the coronary arteries becoming blocked. [1]

....

....

C400U101
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Examiner
only

(iii) The diagram shows a blocked coronary artery at the start of a procedure called angioplasty.

Artery wall

Balloon

Balloon
inserted
into artery

Material blocking
coronary artery
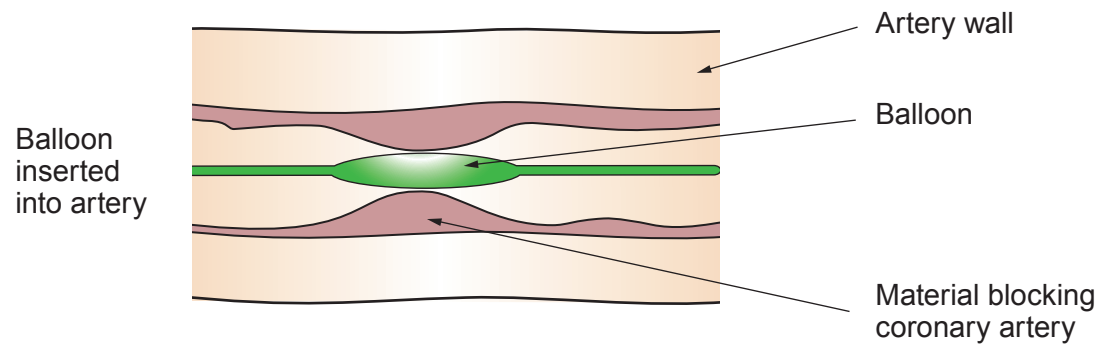
Describe this procedure and how it would enable blood to reach the tissues of the heart wall. [3]

....

....

....

....

11

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(C400U10-1)

Turn over.

6. A group of students investigated osmosis in potatoes.

They cut six cylinders of potatoes using a set of cork borers and recorded the mass of each cylinder.
They placed each of the cylinders in sugar solution in one of a range of concentrations.

Set of cork borers

cylinders of potato

boiling tube

cylinder of potato

$20\,cm^3$ of sugar solution
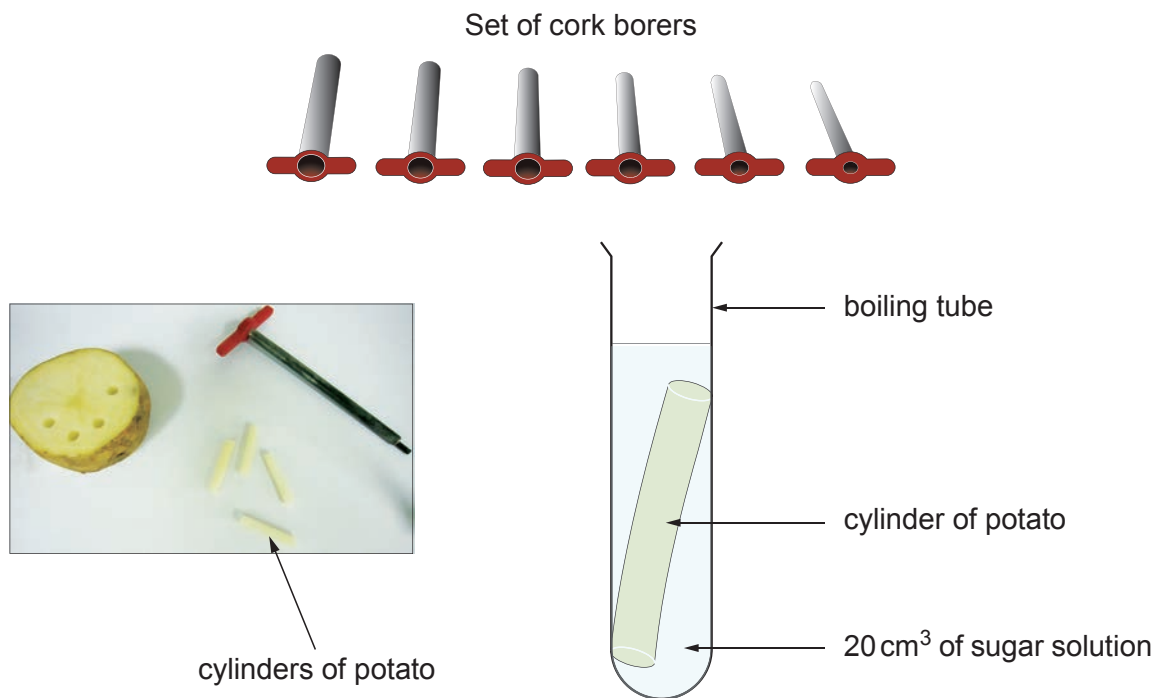
After 30 minutes they removed the cylinders from the solutions and again recorded the mass of each. They calculated the percentage change in mass for each cylinder.

The results are shown below.

Concentration of sugar solution (mol/dm^3)	Change in mass after 30 minutes (%)
0.0	+28
0.1	+16
0.4	−8
0.6	....
0.8	−28
1.0	−30

(C400U10-1)

(a) (i) The cylinder placed in the solution of 0.6 mol/dm³ had an initial mass of 2.20 g and a mass of 1.70 g after 30 minutes. **Complete the table** opposite by calculating the percentage change in mass for this cylinder. [2]

Space for working

(ii) Draw a line graph of the results on the grid below by: [4]

I. adding a scale for the concentration of sugar

II. plotting the points

III. using a ruler to join your plots.

Change in mass after 30 minutes (%)

Concentration of sugar solution (mol/dm³)
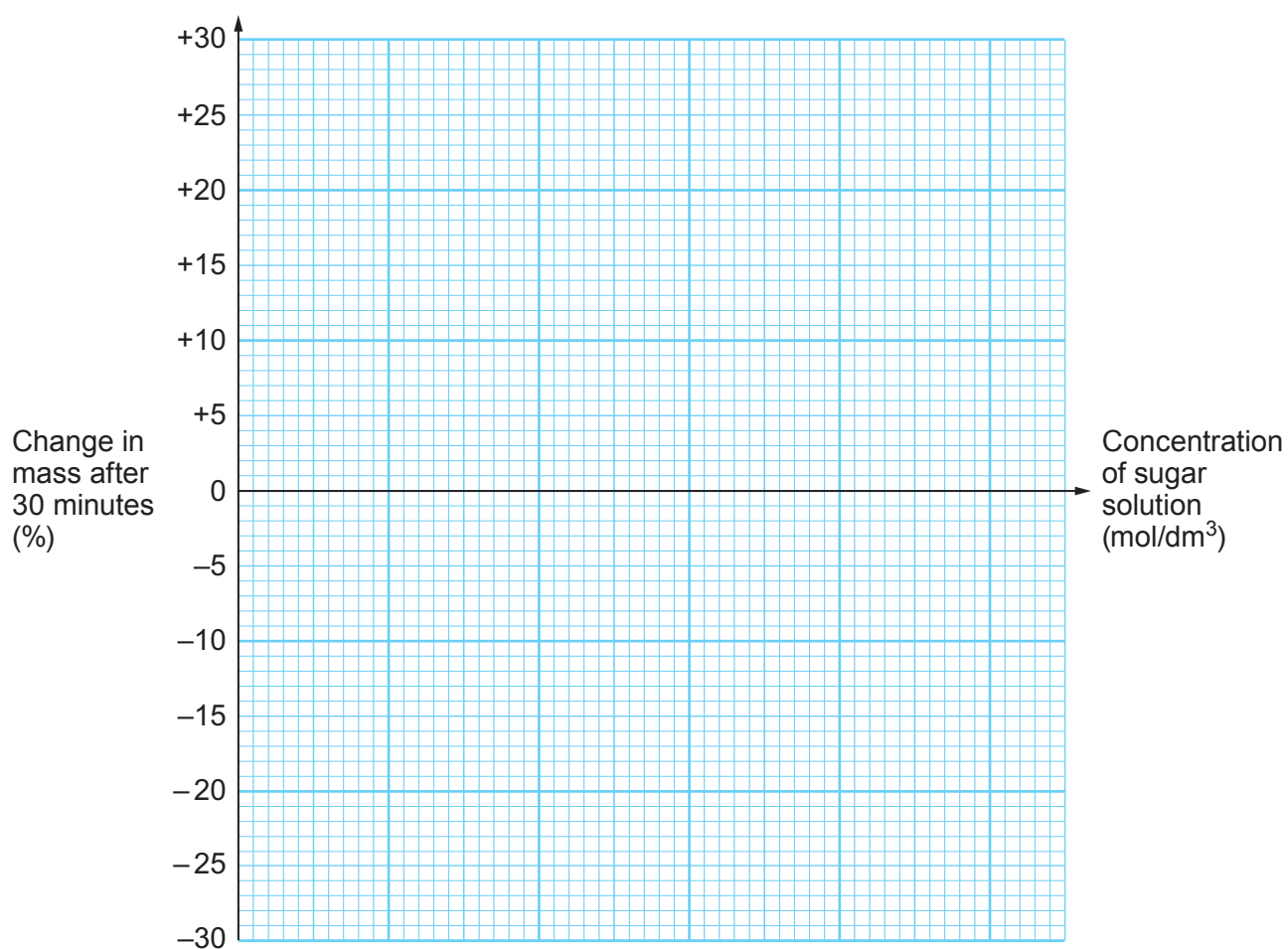
(iii) From your graph:

    I.   Describe how increasing the concentration of the solution from $0.4\,mol/dm^3$ to $1.0\,mol/dm^3$ affects the mass of the potato cylinders.   [1]

....

....

    II.   Estimate the concentration of sugar solution which is **equal to** the concentration of the solution in the potato cells. Explain your answer.   [2]

....

....

(b)   (i)   State how the experimental method could be improved so that the point where the two concentrations are equal could be estimated more accurately.   [2]

....

....

   (ii)   The students tried to ensure that their investigation was a fair test.
State **two** variables which they should have controlled during the investigation.   [2]

....

....

   (iii)   State what the students could do to increase the confidence they have in their results.   [1]

....

....

14

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Examiner only

7.

Campylobacter bacteria and food poisoning

The photograph above shows *Campylobacter* bacteria, of which there are many different strains. These bacteria cause food poisoning.

Campylobacter infections have been effectively treated by fluoroquinolone antibiotics. Fluoroquinolone has also been used in treating many less serious infections. Unfortunately, by 2015 a study showed that at least half of the strains had become resistant.

The UK Food Standards Agency (FSA) has identified the source of many infections as chickens which are sold in supermarkets and which carry *Campylobacter*. In some instances, antibiotics have been routinely given to farm animals.

Scientists are having difficulty in obtaining new antibiotics from fungi, to replace those antibiotics where resistance is a problem. They are trying other methods to develop new drugs to treat people but this is a long process.

In the kitchen, infection can be prevented by thorough cooking, good hygiene and keeping cooked and uncooked meats separately. Many people say that they rinse uncooked chicken in warm water before cooking but the FSA has warned against this.

(a) (i) State **two** pieces of evidence, from the information, which could support the hypothesis that overuse of antibiotics has led to the development of resistance in bacteria. [2]

....

....

(ii) State **one** way in which scientists are trying to produce new antibiotics and why it takes a long time for them to become available. [2]

....

....

(iii)   Explain why uncooked chicken: [3]

    I.   should be stored separately from other food;

....

....

    II.   should be cooked at a high temperature;

....

....

    III.   should not be rinsed in warm water.

....

....

(b)   Describe **one** way in which bacteria are beneficial to other organisms in the environment.   [1]

....

8

8. A species of rye grass (*Lolium rigidum*) is a problem weed in crop fields. For many years farmers controlled this weed with glyphosate herbicides. In 1986, however, a few rye grass plants were found to be resistant to the herbicide. By 2011 this resistant type of rye grass had become very common and farmers could no longer rely on glyphosate herbicides to destroy the weed.

Rye grass (*Lolium rigidum*)

(a) Explain how natural selection led to the development and spread of resistance to glyphosate in *Lolium rigidum*. [6 QER]

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Examiner only

(b)   Resistance to herbicides now occurs in many species of weeds across the world. Suggest why there is a lack of effective herbicides in developing countries and why the lack of effective herbicides in these countries causes particular problems.   [2]

....

....

....

8

26

9. The diagram below shows some of the glands in the body which produce hormones.

pituitary

A ....

B ....

adrenal

ovary
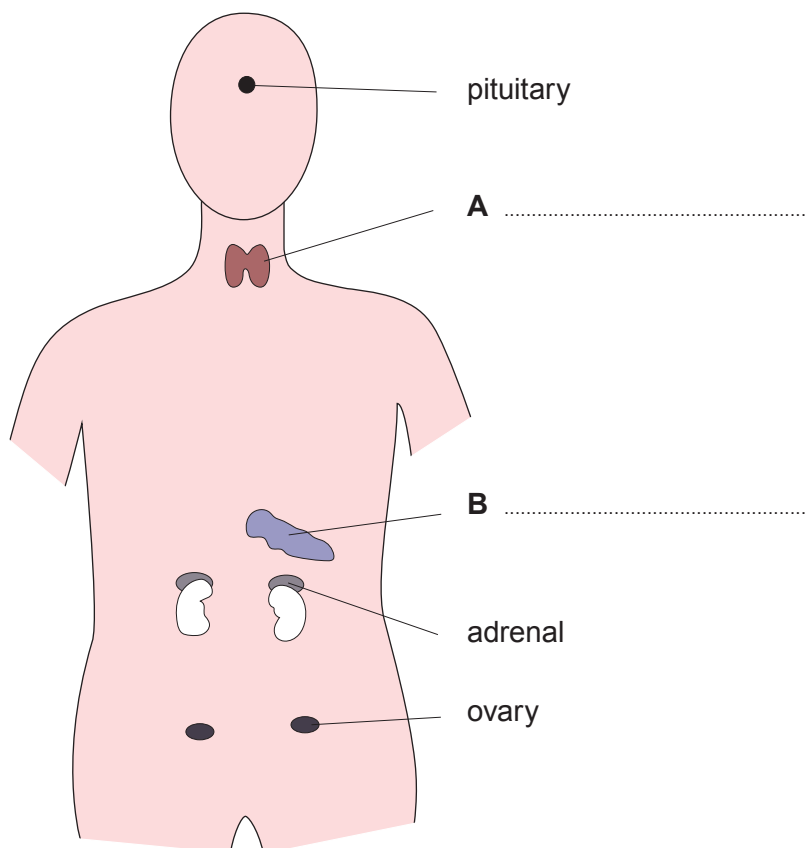
(a) (i) Label glands **A** and **B**. [2]

(ii) Describe how hormones reach the organs of the body where they act. [1]

....

(iii) If internal conditions in the body change, hormones enable the balance to be restored. State the scientific term for this process. [1]

....

(b) The hormone insulin helps control the concentration of glucose in the blood.

The sketch graphs below show the results of an investigation into the control of blood glucose concentration in two people. They both drank $100\,cm^3$ of glucose solution and the concentrations of glucose and insulin in the blood were monitored. The concentration of glycogen in the liver was also recorded.
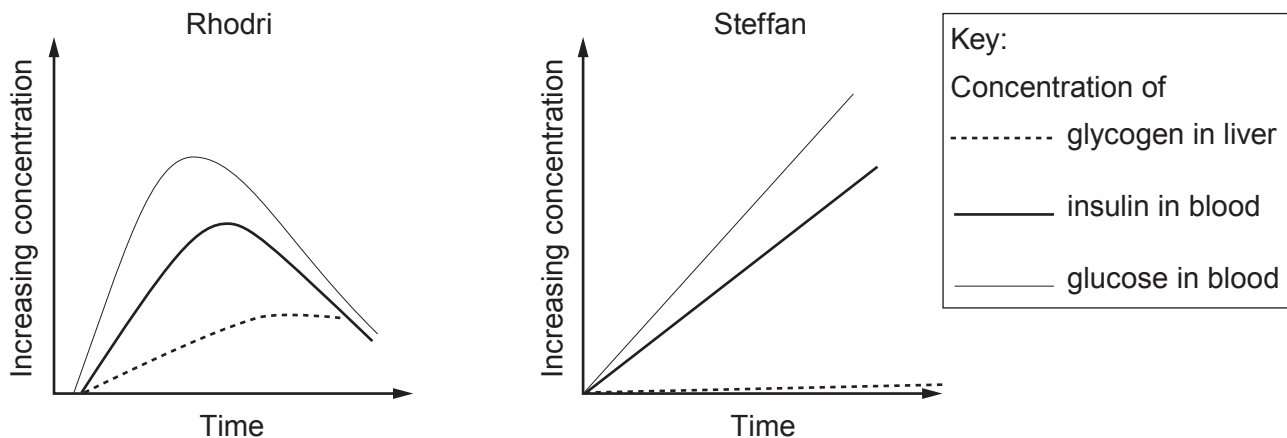
Steffan has a medical condition. State the name of this medical condition, give **two** pieces of evidence from the graphs which support your answer and suggest how this condition could be treated. [4]

....

....

....

....

....

....

(C400U10-1)

Turn over.

28

(c) The development of an egg cell in the human ovary is shown in the diagram below.

Egg cell in follicle → Egg cell and follicle grow → Egg cell released from follicle (ovulation) ready for fertilisation
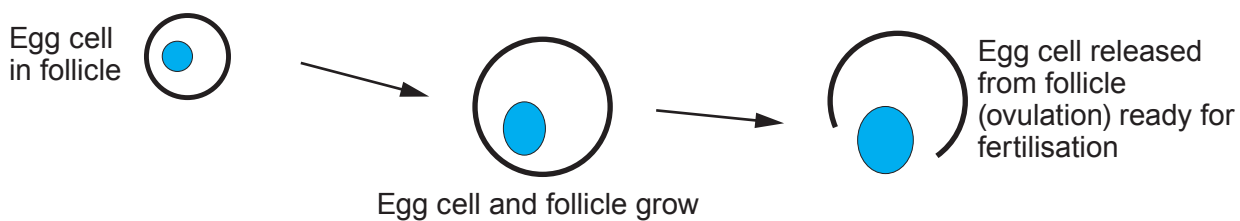
Hormones control this process and can be used in contraceptives.

The graph shows the result of an investigation of a hormonal contraceptive which prevents ovulation, so that fertilisation cannot occur. It was administered in three ways as follows:

Group 1: as a pill taken daily,

Group 2: as an injection given once which lasts a few weeks,

Group 3: as an implant into the body which lasts three years.
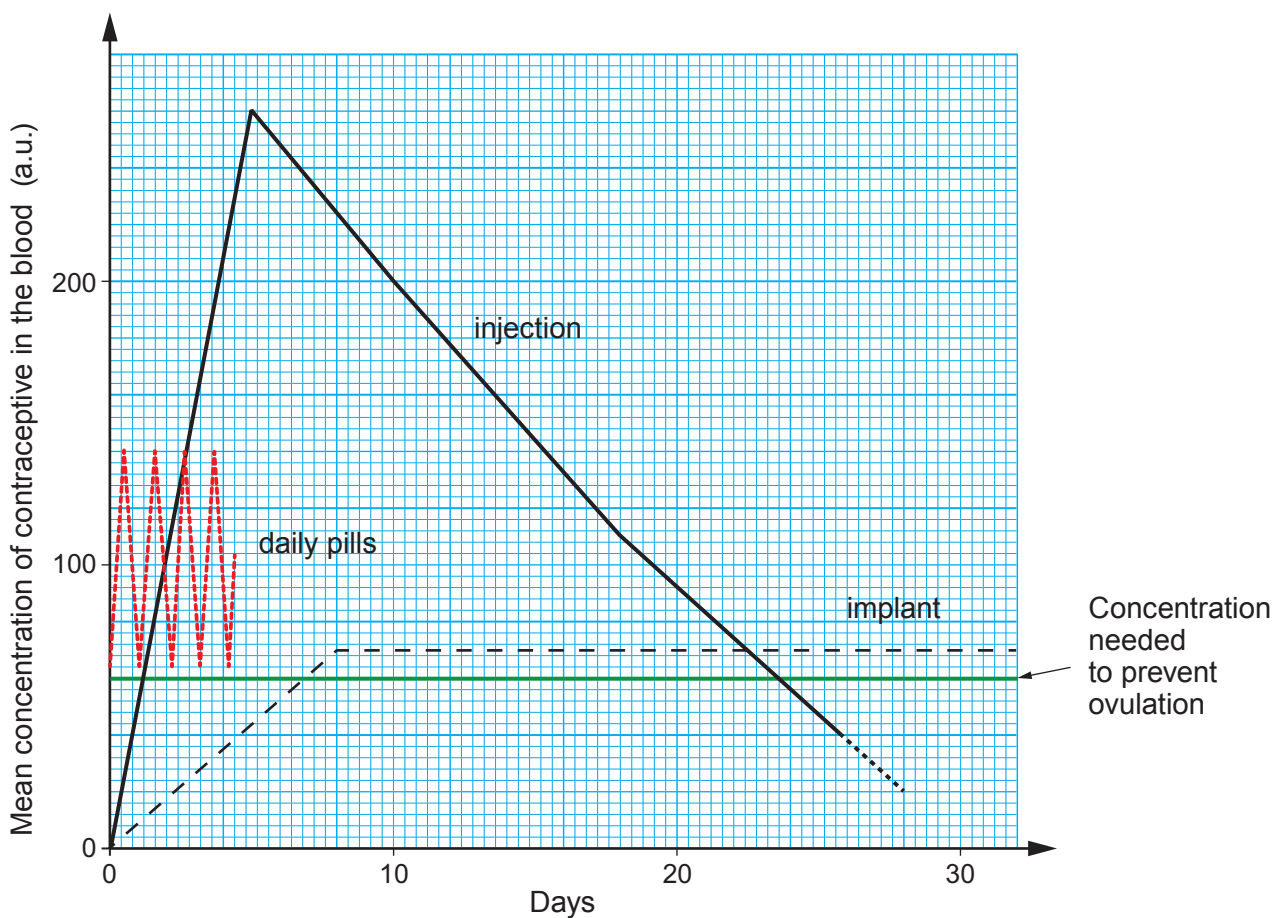
From this graph:

(i) State the minimum concentration of contraceptive in the blood needed to prevent ovulation. [1]

.... a.u.

(ii) Calculate:

I. the difference between the highest and lowest mean concentration of contraceptive in the blood for the group taking daily pills. [1]

difference = ... a.u.

II. the percentage increase from day 2 to day 5 in mean concentration for the group having an injection. [2]

percentage increase = ... %

(iii) Suggest how many days after receiving the injection it would **need** to be repeated. Give a reason for your answer. [1]

Answer .... days

Reason ....

....

(iv) Describe **two** advantages and **one** disadvantage of an implant over the other hormonal methods of contraception. [3]

....

....

....

....

16

10. Students investigated the abundance of plantain (*Plantago sp.*) and bugleweed (*Ajuga sp.*) in two fields (**A** and **B**). **A** measured $250\,m^2$ and **B** measured $375\,m^2$.
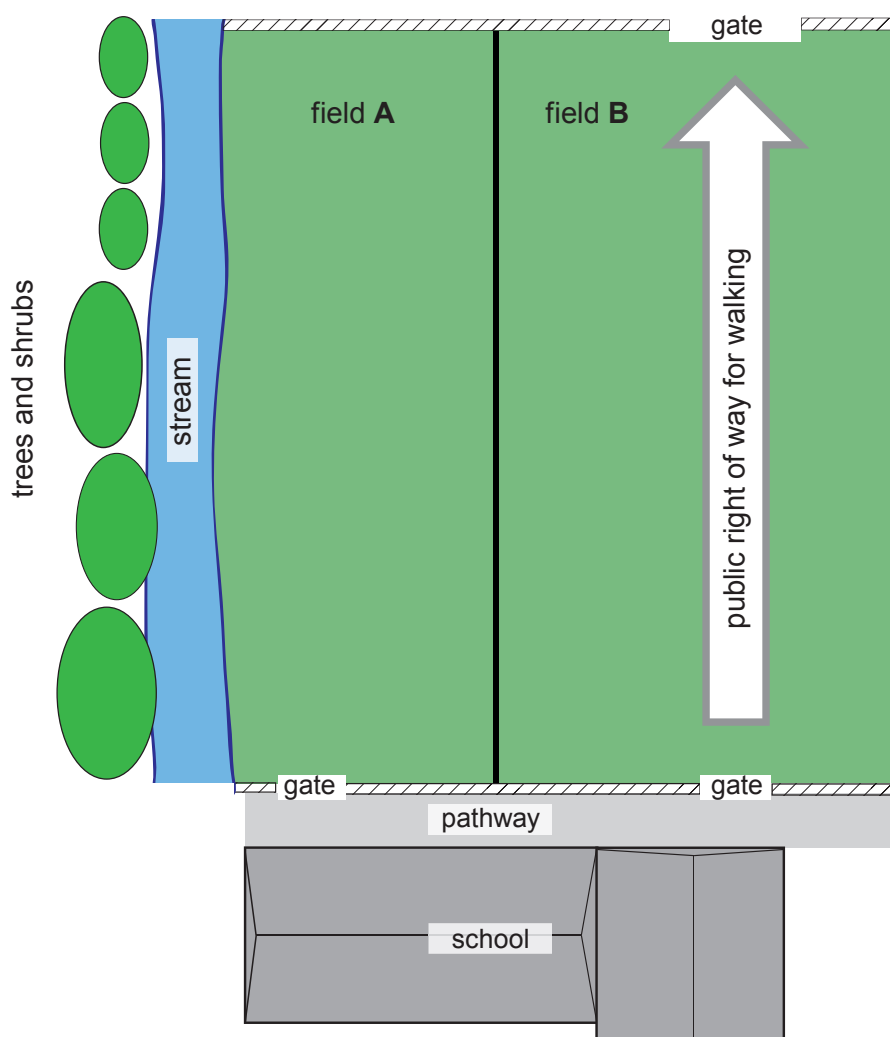

plantain
(*Plantago sp.*)

bugleweed
(*Ajuga sp.*)

Trampling by walkers occurred in field **B** as a public right of way passed through, as shown below.

The students used six quadrats of 1 m², which they placed randomly in the fields to investigate the abundance of plantain and bugleweed.

Results of the investigation

	Plantain		Bugleweed	
	Field **A**	Field **B**	Field **A**	Field **B**
Total number of plants counted in six quadrats	34	41	38	5
Mean number of plants per m² quadrat	....	....	6.3	0.8
Estimated total number of plants in field	....	....	1575	300

(a) (i) **Complete the results table** by calculating: [2]

I. the mean numbers of plantain per m²;

II. the estimated total numbers of plantain in the fields.

Space for working

(ii) From the results, state what can be concluded about the effects of trampling on the plant species. Explain your answer. [2]

....

....

....

....

....

(iii) From the information in the diagram on page 30, suggest **two** variables, apart from trampling, which could have affected the results, giving **one** reason for each variable. [2]

....

....

....

....

(b) (i) Describe a technique the students could have used to place their quadrats at random and obtain their data. [3]

....

....

....

....

....

....

(ii) State why the students should have increased the number of quadrats used. [1]

....

....
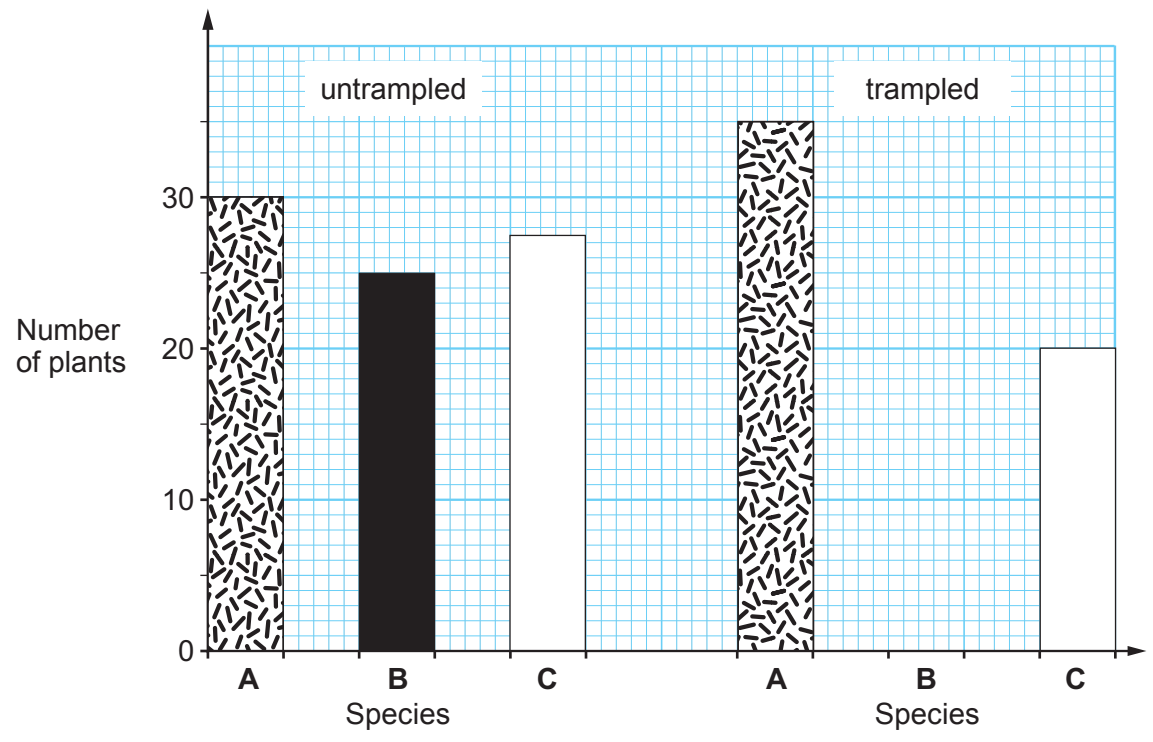
(c) The bar chart below shows the results of an investigation on the effects of trampling carried out by conservation scientists in an area of grassland. They studied three species of plants, **A**, **B** and **C**.

(i) From the information in the bar chart, state the evidence that biodiversity has been affected by trampling. [2]

....

....

....

....

(ii) State **two** reasons why it is important to protect the biodiversity of habitats. [2]

....

....

END OF PAPER

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