Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

AS
BIOLOGY

Paper 2

Tuesday 6 June 2017 Afternoon Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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Answer **all** questions in the spaces provided.

0 1 . 1 Glycogen and cellulose are both carbohydrates.
Describe **two** differences between the structure of a cellulose molecule and a glycogen molecule.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 2 Starch is a carbohydrate often stored in plant cells.
Describe and explain **two** features of starch that make it a good storage molecule.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 3 Tick (✓) the box that identifies the test which would be used to show the presence of starch.

[1 mark]

Acid hydrolysis test ☐

Benedict's test ☐

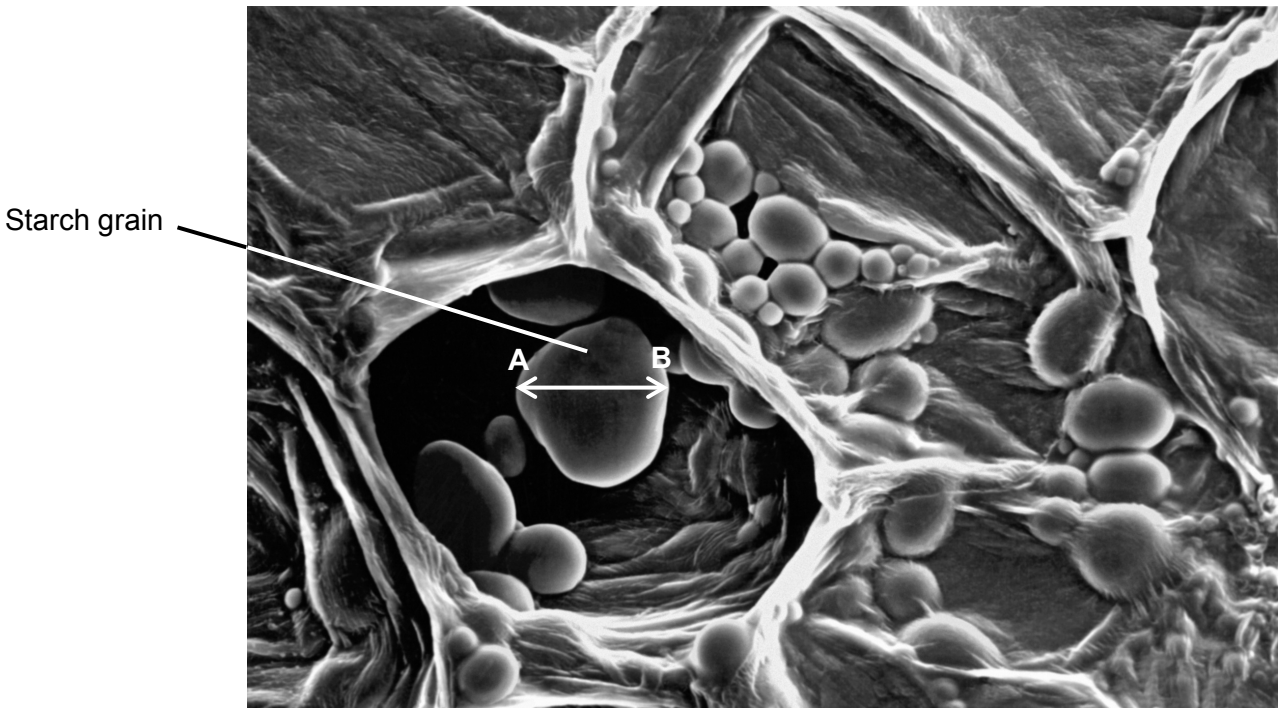
Emulsion test ☐

Iodine/potassium iodide test ☐

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0 1 . 4 **Figure 1** shows a section through a plant tissue at a magnification of ×500.

Figure 1



Calculate the actual diameter of the starch grain between points **A** and **B**.

[2 marks]

Answer = _____ µm

0 1 . 5 What type of microscope was used to obtain the image shown in **Figure 1**?
Give **one** piece of evidence to support your answer.

[2 marks]

Type of microscope _____

Evidence _____

_____

9

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0 2 The cells of beetroot contain a red pigment. A student investigated the effect of temperature on the loss of red pigment from beetroot. He put discs cut from beetroot into tubes containing water. He maintained each tube at a different temperature. After 25 minutes, he measured the percentage of light passing through the water in each tube.

0 2 . 1 The student put the same volume of water in each tube.

Explain why it was important that he controlled this experimental variable.

[2 marks]

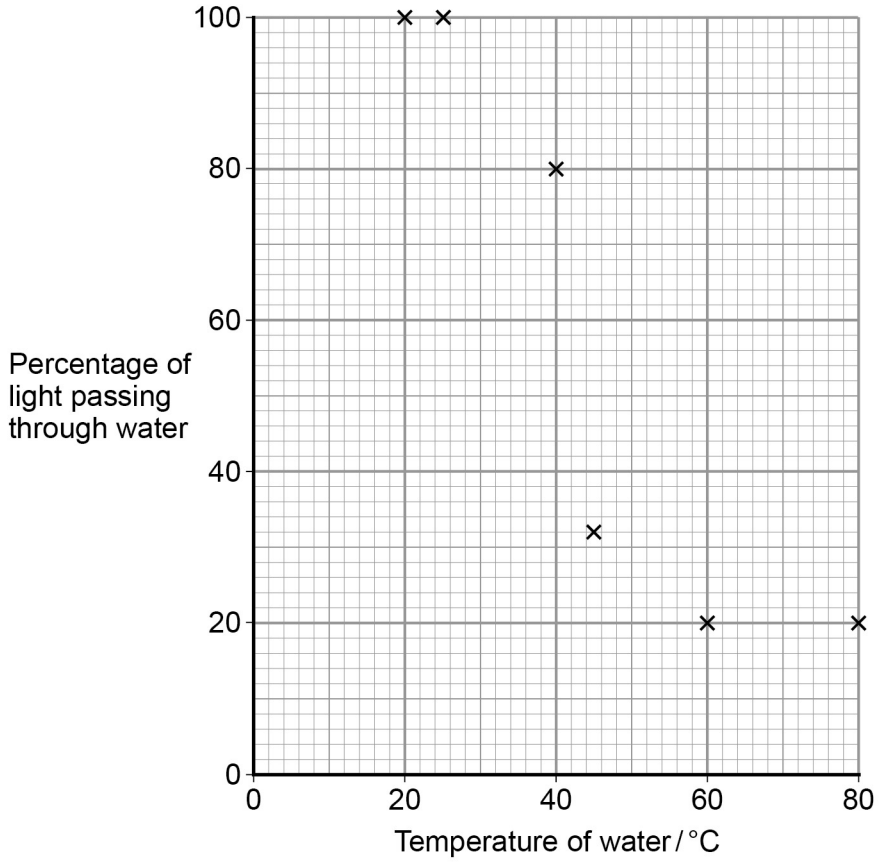
0 2 . 2 Describe a method the student could have used to monitor the temperature of the water in each tube.

[1 mark]

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Figure 2 shows the student's results.

Figure 2



0 2 . 3 Draw a suitable curve on **Figure 2**.

[1 mark]

0 2 . 4 The decrease in the percentage of light passing through the water between 25 °C and 60 °C is caused by the release of the red pigment from cells of the beetroot.

Suggest how the increase in temperature of the water caused the release of the red pigment.

[2 marks]

_____

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_____

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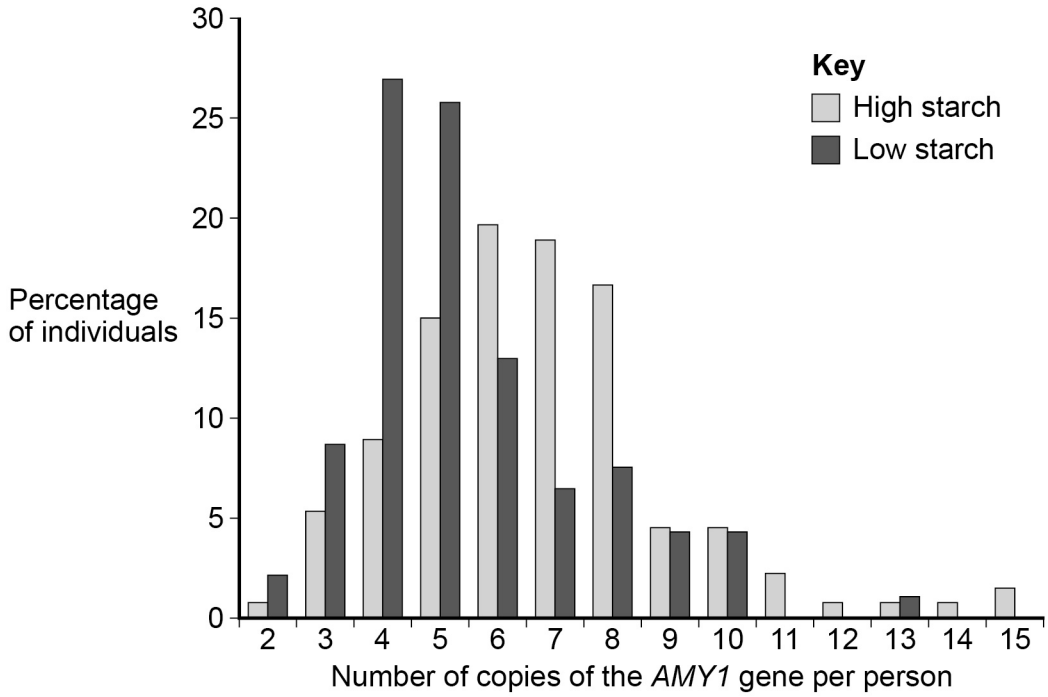
6

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0 3 . 1 Most human cells contain two copies of each gene. However, there might be up to 15 copies of the gene for amylase (*AMY1*). Scientists investigated the number of copies of the *AMY1* gene in individual people in two populations. One population had a high-starch diet and the other population had a low-starch diet.

Figure 3 shows their results.

Figure 3



Describe what their results show.

[3 marks]

Do not write outside the box

[Extra space]

0 3 . 2 Multiple copies of the *AMY1* gene is an adaptation to a high-starch diet.

Use your knowledge of protein synthesis and enzyme action to explain the advantage of this adaptation.

[3 marks]

[Extra space]

Question 3 continues on the next page

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0 3 . 3 Multiple copies of the *AMY1* gene is an adaptation to a high-starch diet.

Suggest how this evolved through natural selection.

[3 marks]

[Extra space]

9

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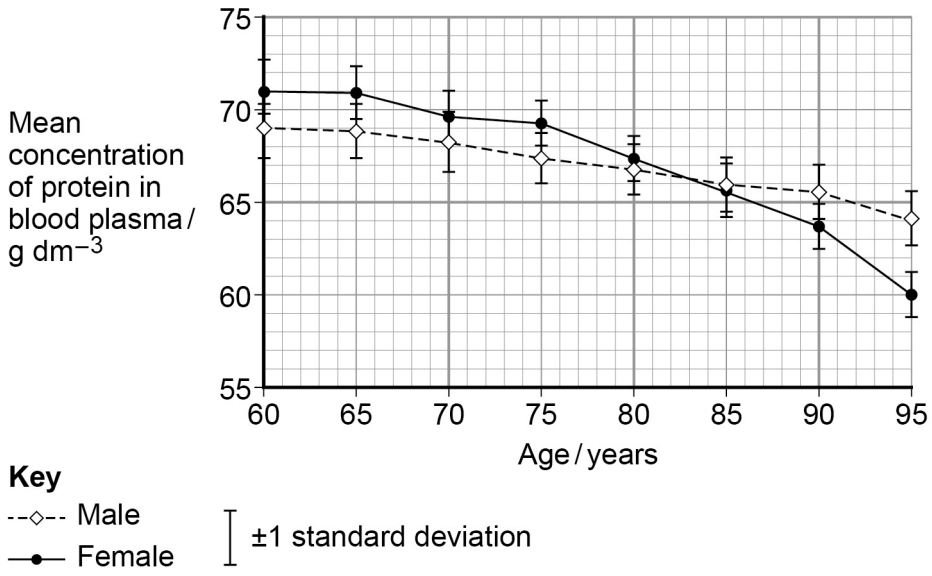
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ANSWER IN THE SPACES PROVIDED

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0 4 Scientists investigated how the concentration of protein in blood plasma changes in people between the ages of 60 and 95.

Figure 4 shows the scientists' results. The bars show ±1 standard deviation.

Figure 4



0 4 . 1 What is the difference between males and females in the fall in mean concentration of protein in blood plasma between 60 and 95 years?

[1 mark]

Answer = _____ g dm^{-3}

Do not write outside the box

0 4 . 2 Use **Figure 4** to calculate the rate of change of the mean concentration of protein in the blood plasma of males between the ages of 60 and 95.

Show your working.

[2 marks]

Answer = _____ g dm^{-3} $year^{-1}$

0 4 . 3 What can you conclude from **Figure 4** about the effect of ageing on the mean concentration of protein in the blood plasma in males and females?

[2 marks]

_____

_____

_____

_____

_____

_____

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 The scientists measured the absorption of each sample of blood plasma using a colorimeter. They used a calibration curve to find the concentration of protein in samples of blood plasma.

Describe how the scientists could obtain data to produce a calibration curve and how they would use the calibration curve to find the concentration of protein in a sample of blood plasma.

[3 marks]

[Extra space]

0 4 . 5 Older people are more likely to suffer from infectious diseases.

Suggest how this may be linked to the decrease in the mean concentration of protein in the blood as people get older.

[1 mark]

9

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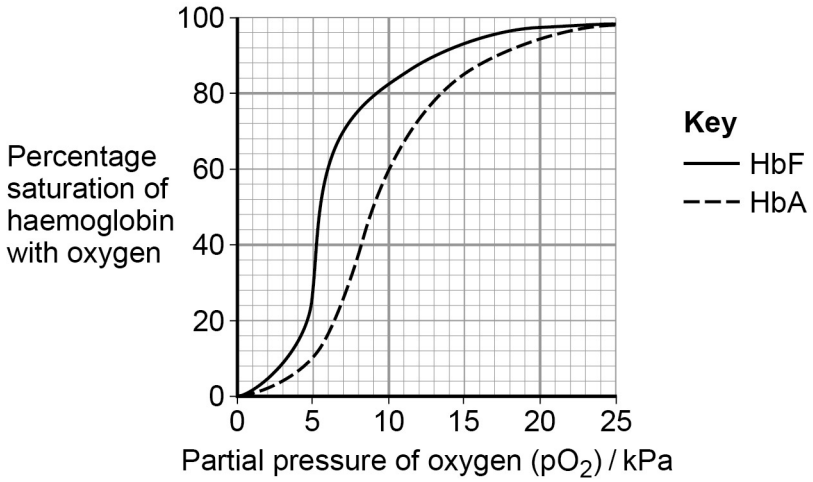
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0 5 **Figure 5** shows the oxyhaemoglobin dissociation curves for fetal haemoglobin (HbF) and adult haemoglobin (HbA).

Figure 5



0 5 . 1 Explain how changes in the shape of haemoglobin result in the S-shaped (sigmoid) oxyhaemoglobin dissociation curve for HbA.

[2 marks]

0 5 . 2 At birth 98% of the haemoglobin is HbF. By the age of 6 months, the HbF has usually completely disappeared from the baby's blood and been replaced by HbA.

Use **Figure 5** to explain why this change is an advantage for the baby.

[2 marks]

Do not write outside the box

Sickle cell disease (SCD) is caused by production of faulty HbA. This results in a reduced ability to transport oxygen to tissues. Scientists investigated the use of a substance called hydroxyurea to treat babies with SCD. Hydroxyurea changes the concentration of HbF in the blood.

The scientists carried out an investigation with 122 babies who had SCD.
Each baby was given hydroxyurea for 41 months. The scientists then found the mean change in the concentration of HbF in the babies' blood.

Their results are shown in **Table 1**.

Table 1

Mean concentration of HbF in the babies' blood / arbitrary units	
Before treatment with hydroxyurea (±1 standard deviation)	**After treatment with hydroxyurea (±1 standard deviation)**
7.6 (±4.5)	19.1 (±6.5)

0 5 . 3 The scientists concluded that treatment with hydroxyurea would increase the concentration of oxygen in the blood of babies with SCD.

Suggest how **Figure 5** and **Table 1** support this conclusion.

[3 marks]

[Extra space]

7

Turn over ►

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0 6 Stomata are found mainly on the underside of leaves of dicotyledonous plants.
A student painted a layer of nail varnish on the lower epidermis of a leaf.
She peeled off the dry layer of nail varnish and placed it on a microscope slide.
The student was able to see the impressions of the stomata on the varnish using an optical microscope.
She then determined the mean diameter of the stomata.

0 6 . 1 Describe how the student could use an eyepiece graticule to determine the mean diameter of stomata.

[3 marks]

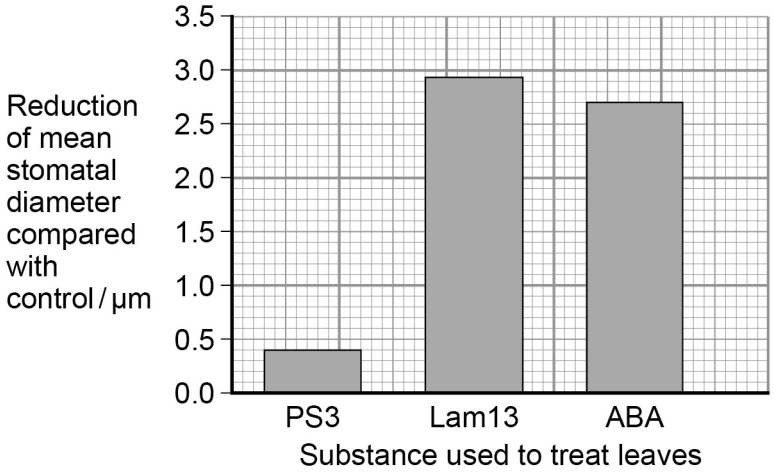
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A scientist investigated the effect of treating the leaves of one species of plant with three different substances. These substances **reduce** the stomatal diameter. He compared the mean diameter of stomata after treating the leaves with these substances with the mean stomatal diameter on control leaves treated with distilled water.

The scientist's results are shown in **Figure 6**.
The mean stomatal diameter of the control leaves was 7.5 µm.

Figure 6



0 6 . 2 Calculate the ratio of mean stomatal diameter of leaves treated with PS3 to those treated with ABA.

[2 marks]

Answer = _____ : 1

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 ABA is a substance that some plant species produce when little water is available.

Explain why producing ABA may help these species survive in dry conditions.

[2 marks]

0 6 . 4 Many species of plants can be infected by powdery mildew which is spread by microscopic spores in the air.

Suggest how treatment with Lam13 might protect plants against powdery mildew infection.

[1 mark]

8

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0 7 . 1 NMO is a disease that leads to damage to nerve cells in the spinal cord. A person with NMO produces anti-AQP4 antibody that attacks only these nerve cells.

Explain why the anti-AQP4 antibody only damages these cells.

[4 marks]

Question 7 continues on the next page

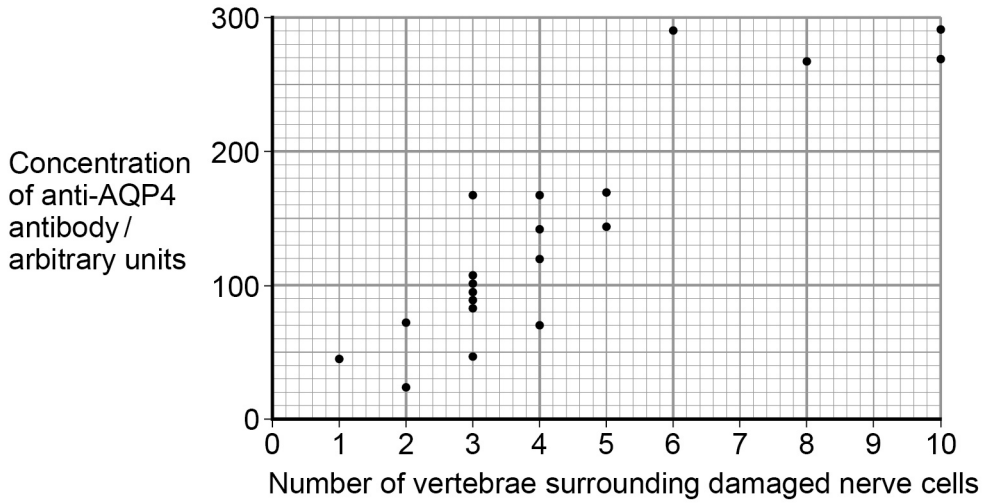
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0 7 . 2 Scientists measured the concentration of anti-AQP4 antibody in the blood of people with NMO.

The spinal cord is surrounded by small bones called vertebrae. For each person, the scientists also determined the number of vertebrae surrounding damaged nerve cells.

Their results are shown in **Figure 7**.

Figure 7



A scientist suggested that the concentration of anti-AQP4 antibody in a person's blood could be used to predict the number of vertebrae surrounding damaged nerve cells they are likely to have.

Use **Figure 7** to suggest reasons why this suggestion might **not** be valid.

[3 marks]

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0 7 . 3 A new treatment for NMO involves using a monoclonal antibody. The structure of the variable region of this monoclonal antibody is identical to the variable region of an anti-AQP4 antibody, but the rest of its structure is different.

Use this information and your knowledge of antigen-antibody complexes to suggest how this monoclonal antibody prevents anti-AQP4 damaging nerve cells.

[2 marks]

9

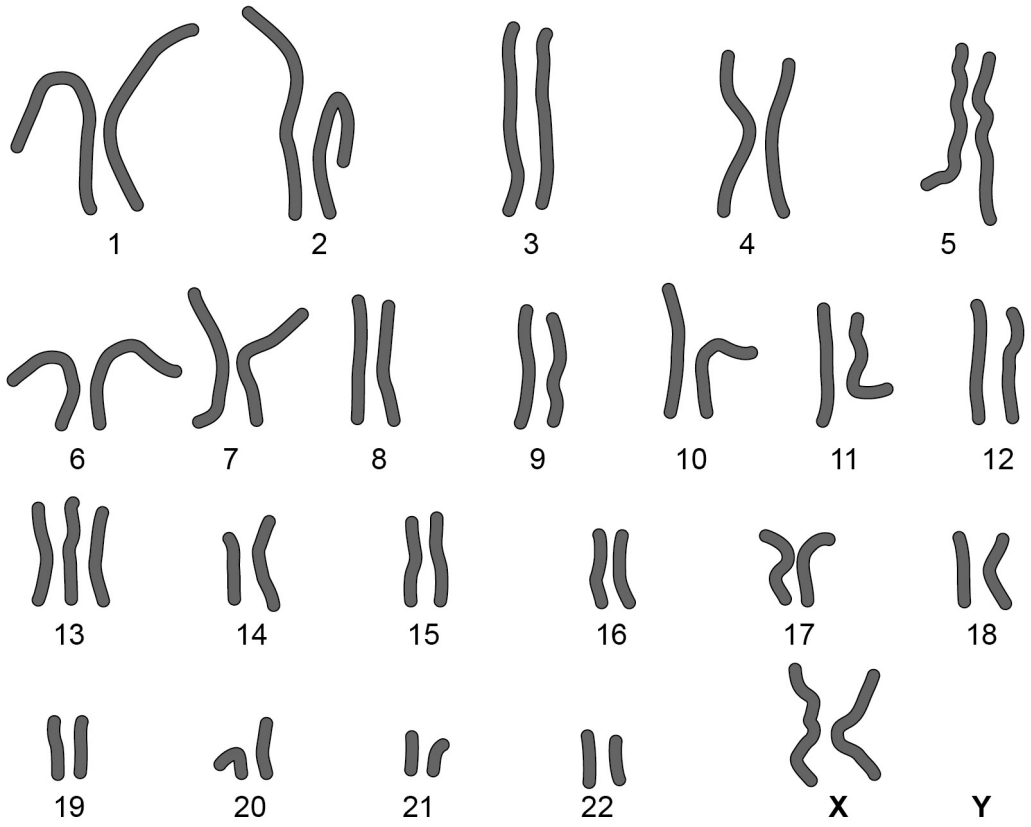
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0 8 Patau syndrome is a condition caused by a mutation affecting chromosome number. All the cells of the body will have this mutation.

Figure 8 shows the chromosomes from one of the cells of a female who has Patau syndrome.

Figure 8



0 8 . 1 What is the effect of Patau syndrome on the chromosomes of this female?

[1 mark]

Do not write outside the box

0 8 . 2 Describe how the change in chromosome number in Patau syndrome was produced.

[2 marks]

0 8 . 3 Explain why all the cells of the body will have this mutation.

[2 marks]

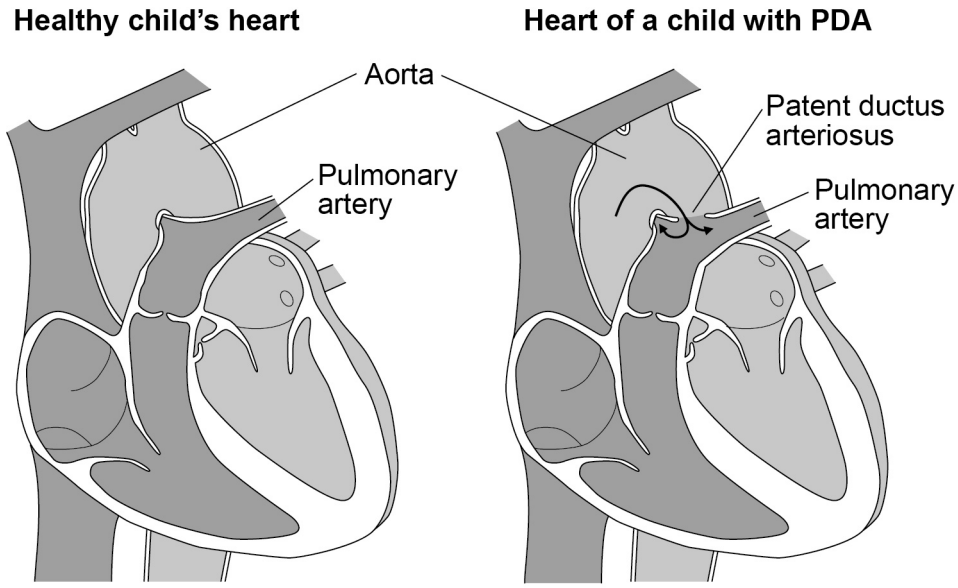
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Most children born with Patau syndrome die in the first 12 months, often due to defects of circulation of blood.

One of these defects is patent ductus arteriosus (PDA). This can result in some of the blood flowing between the aorta and the pulmonary artery.
Figure 9 shows a healthy child's heart and the heart of a child with PDA.

Figure 9



0 8 . 4 Suggest how the flow of some of the blood between the aorta and pulmonary artery could cause children to die in the first 12 months.

[3 marks]

[Extra space]

8

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0 9 . 1 Describe the cohesion-tension theory of water transport in the xylem.

[5 marks]

[Extra space]

Do not write outside the box

0 9 . 2 Describe how mRNA is produced in a plant cell.

[5 marks]

[Extra space]

10

END OF QUESTIONS

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