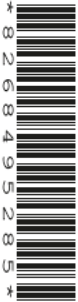


**Friday 06 November 2020 – Morning**

**GCSE (9–1) Biology B  
(Twenty First Century Science)**

**J257/01** Breadth in biology (Foundation Tier)

**Time allowed: 1 hour 45 minutes**



**You must have:**

- a ruler (cm/mm)

**You can use:**

- an HB pencil
- a scientific or graph calculator



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

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Candidate number

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First name(s)

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Last name

---

**INSTRUCTIONS**

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

**INFORMATION**

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [ ].
- This document has **28** pages.

**ADVICE**

- Read each question carefully before you start your answer.

**2**  
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Answer **all** the questions.

1 The human body has many specialised cells. Each specialised cell has a certain function.

(a) Draw lines to connect each **specialised cell** with its **function**.

Specialised cell	Function
Red blood cell	Conduction of impulses
Nerve cell	Transport of oxygen
White blood cell	Protection against disease

[2]

(b) When do cells in embryos start to become specialised?

Tick (✓) **one** box.

When the egg is fertilised

Before the eight-cell stage

After the eight-cell stage

[1]

(c) Cells contain many organelles.

Complete the sentences about organelles and their functions.

Use words from the list.

You can use each word once, more than once, or not at all.

**chloroplast      mitochondrion      nucleus      plasmid**

Aerobic respiration takes place in the .....

Photosynthesis takes place in the .....

[2]

2 Some people can roll their tongues, others cannot.

Tongue rolling is inherited.

- The allele for tongue rolling is represented by **R**
- The allele for non-tongue rolling is represented by **r**.

(a) Jack's genotype is **RR**.

(i) Which **two** words can be used to describe Jack's genotype?

Put a **ring** around the **two** correct answers.

**dominant**      **heterozygous**      **homozygous**      **recessive**

[2]

(ii) Jack's friend is unable to roll their tongue.

What will their genotype be?

Tick (✓) **one** box.

**RR**

**Rr**

**rr**

[1]

(iii) A male with the genotype **Rr** and a female with the genotype **Rr** have a baby.

Complete the Punnett square to show how the male and female can have a baby that can roll its tongue.

State the probability of the baby being able to roll its tongue.


Probability ..... [3]

(b) What word is used to describe the physical features observed as a result of genes?

Put a **ring** around the correct answer.

**allele**      **environment**      **phenotype**

[1]

(c) (i) Which statement defines the term **genome**?

Tick (✓) **one** box.

The chromosomes inherited from the mother

The DNA found in the sperm cell

The entire genetic material of an organism

[1]

(ii) Where is DNA stored in an animal cell?

Tick (✓) **one** box.

Chloroplast

Cytoplasm

Nucleus

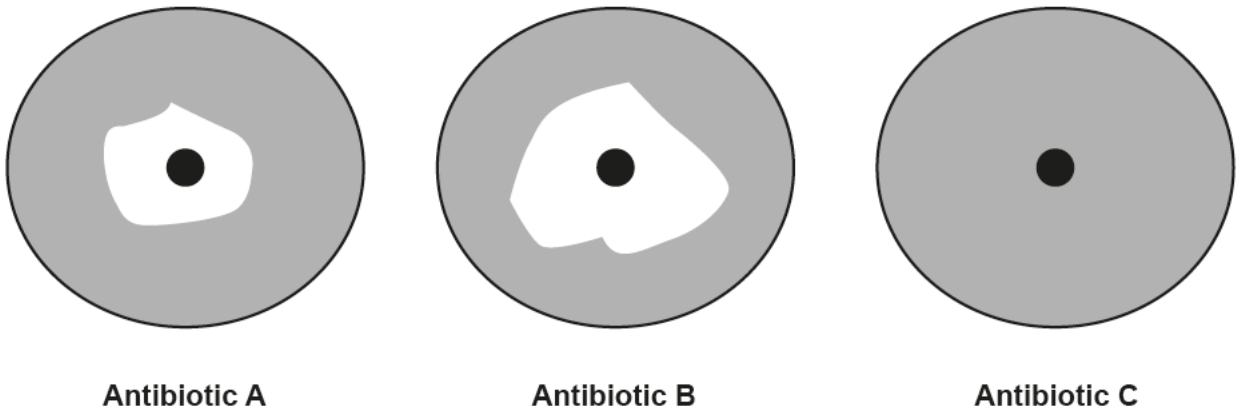
[1]

3 Many diseases are caused by bacteria. Antibiotics are used to kill bacteria.

A scientist grows bacteria on three agar plates. He then tests the effectiveness of three different antibiotics, **A**, **B** and **C**.

The results are shown in **Fig. 3.1**.

- The black circle in the centre of each plate is the antibiotic.
- The grey areas are where bacteria have grown.
- The white areas are the zones of inhibition, where the bacteria have been killed.



**Fig. 3.1**

(a) The scientist concludes that **Antibiotic B** is the most effective.

Explain how the scientist reached this conclusion.

.....

.....

..... [1]

- (b) The bacteria are resistant to one antibiotic.

Which antibiotic are the bacteria resistant to?

Tick (✓) **one** box.

**Antibiotic A**

**Antibiotic B**

**Antibiotic C**

Explain your answer.

.....

.....

..... [2]

- (c) The statements **A**, **B**, **C** and **D** explain how bacteria become resistant to antibiotics but they are in the wrong order.

- A** The bacterium reproduces.
- B** The bacterium survives.
- C** The bacteria passes on its resistance.
- D** There is a mutation in the DNA of the bacteria.

Put the statements in the correct order by writing a letter in each box.

--	--	--	--

[3]

- (d) The theory of evolution by natural selection was developed by which two scientists?

Tick (✓) **one** box.

Darwin and Wallace

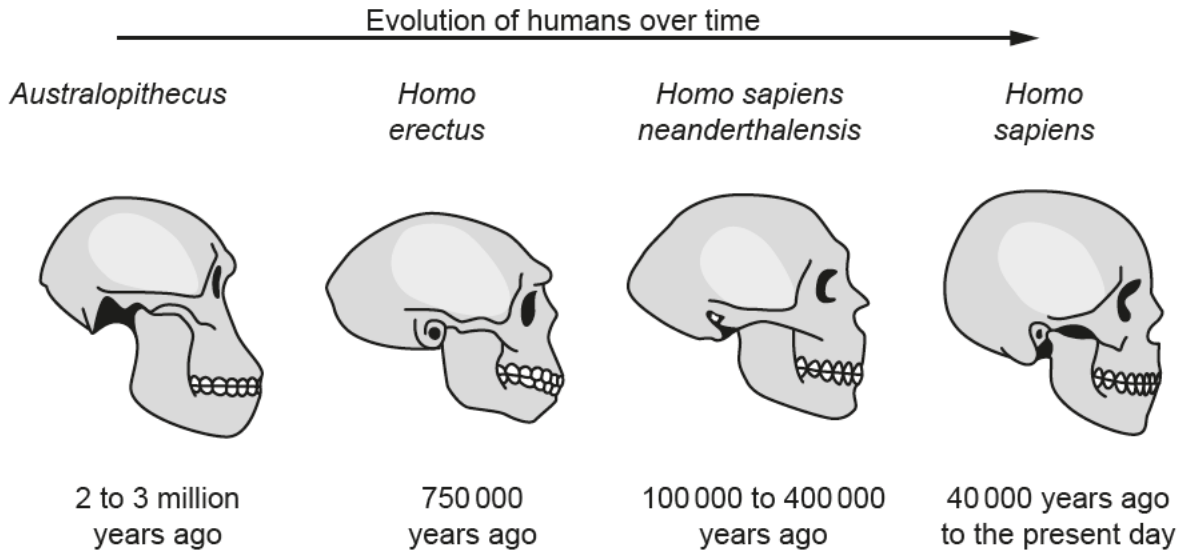
Mendel and Darwin

Wallace and Mendel




[1]

(e) Fig. 3.2 shows the evolution of humans using fossils.



**Fig. 3.2**

Describe how the fossils in **Fig. 3.2** provide evidence for evolution.

.....

.....

.....

.....

.....

.....

.....

.....

[3]



4 (a) Plants respond to their environment.

Select the word from the list below that describes each statement.

**auxin      gravitropism      photosynthesis      phototropism      respiration**

- (i) Plant shoots grow towards the light. .... [1]
- (ii) Plant roots grow in the direction of gravity. .... [1]
- (iii) A hormone involved in plant growth responses. .... [1]

(b) Pathogens can cause disease in plants.

Which **two** statements describe **plant** defences against pathogens?

Tick (✓) **two** boxes.

They have a cell wall.

They have platelets.

They have white blood cells.

They produce antibodies.

They produce antimicrobial substances.

[2]

(c) (i) Some plants grow in waterlogged soil.

What type of respiration will take place in root cells growing in waterlogged soil?

..... [1]

(ii) Which **two** statements, when taken together, explain why plants that grow in waterlogged soil may obtain fewer nutrients from the soil?

Tick (✓) **two** boxes.

Active transport uses ATP.

Active transport requires a concentration gradient.

Active transport needs water.

Less ATP is made in aerobic respiration.

Less ATP is made in anaerobic respiration.

[2]

5 Fig. 5.1 shows the life cycle of a male chicken.

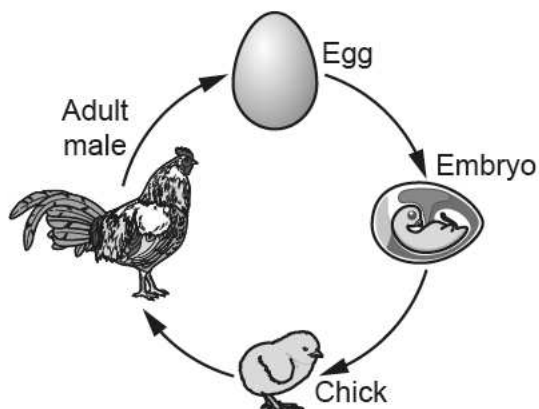


Fig. 5.1

(a) An adult male chicken has 78 chromosomes in a body cell.

The adult male chicken makes sperm cells.

How many chromosomes will there be in one sperm cell?

.....

[1]

(b) As a chick grows, the number of cells that make up its body increases.

What is the name given to the type of cell division involved in growth?

Tick (✓) **one** box.

Meiosis

Mitosis

Replication

[1]

(c) Chickens reproduce sexually.

Give **one** biological advantage of sexual reproduction.

..... [1]

(d) A chicken's sex is determined by genes located on the sex chromosomes.

Chickens have two different sex chromosomes, Z and W.

Male chickens are ZZ and female chickens are ZW.

Describe how sex determination in chickens is different to that of humans.

.....

.....

.....

..... [2]

6 Insulin controls the blood sugar level in the human body.

(a) Complete the sentences to describe how insulin controls blood sugar levels.

Use words from the list.

You can use each word once, more than once, or not at all.

**high      kidney      less      low      more      pancreas**

When blood sugar levels are ....., insulin is released from the .....

The insulin causes cells to take up ..... sugar.

[3]

(b) Insulin is an example of a hormone released by the endocrine system in the human body.

For each statement decide if it is a **true** or **false** description of hormonal control.

Tick (✓) **one** box in each row.

Statement about hormonal control	True	False
Effects can be long-lasting.		
Hormones are transported by the blood.		
Target cells have specific receptors.		
Hormones are usually fast-acting.		
Hormones are secreted by glands.		

[2]

(c) People with Type 1 diabetes cannot make enough insulin.

Scientists think stem cells could be used to enable the pancreas to produce insulin again.

What **two** properties do stem cells have that make this possible?

1 .....

.....

2 .....

.....

[2]

13  
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7 Bowel cancer is one of the most common types of cancer diagnosed in the UK.

Fig. 7.1 shows the average number of deaths due to bowel cancer depending on age in the UK.

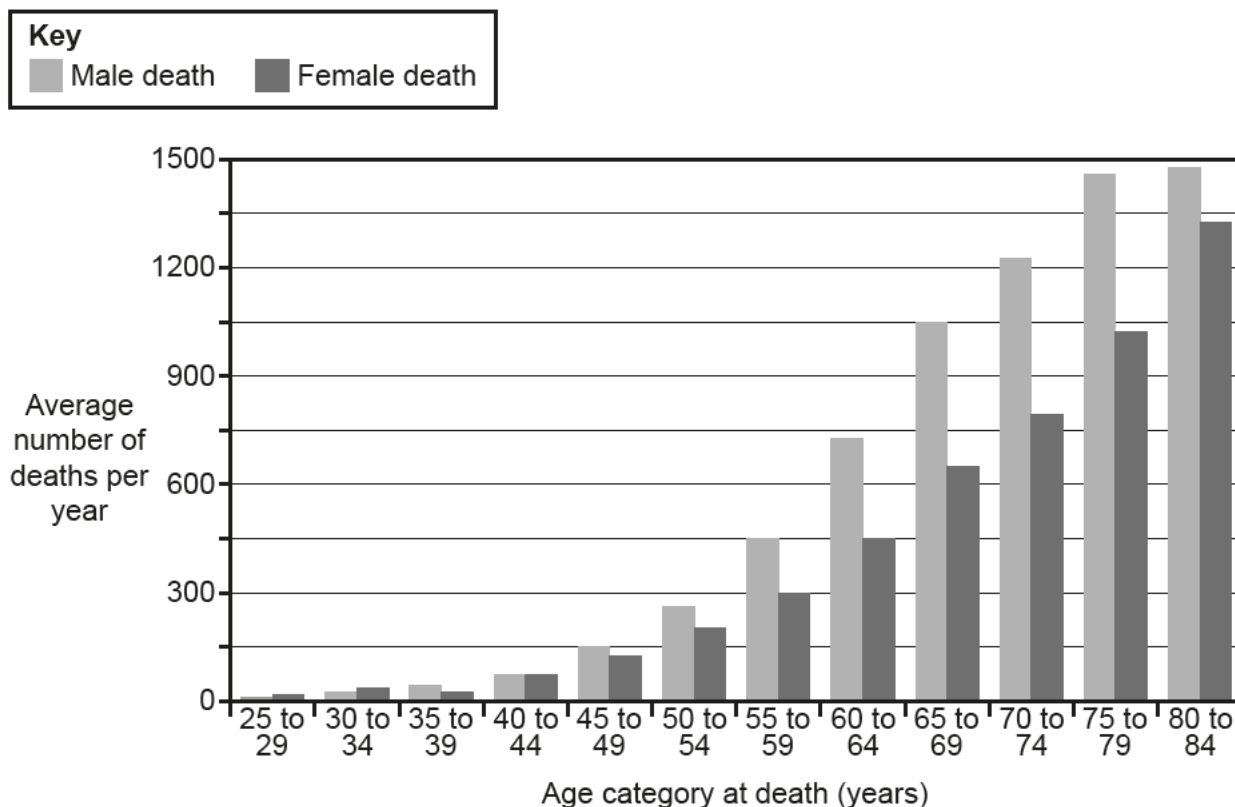


Fig. 7.1

(a) (i) How many male and female deaths occur for the age category 55–59?

Male = .....

Female = ..... [1]

(ii) Which conclusion can be drawn from the data in Fig. 7.1?

Tick (✓) **one** box.

Men are generally at greater risk of dying from bowel cancer than women.

The male risk is always double that of the female.

Men and women are at the same risk of bowel cancer.

More women in the age category 45–49 die of bowel cancer than men.

[1]

(b) **Table 7.1** shows some data on the causes of bowel cancer in the UK.

Cause of bowel cancer	Percentage of cases in UK (%)
processed meat	13
being overweight	11
drinking excess alcohol	6
smoking	7
ionising radiation	2
lack of physical activity	5
eating too little fibre	28

**Table 7.1**

Kareem is a 59-year-old male. He describes his diet as high in processed meat and low in fibre. He drinks a small amount of alcohol each week and does not smoke. He is overweight but is not obese.

Explain to Kareem which parts of his lifestyle put him at the greatest risk of bowel cancer.

Use the information in **Table 7.1** to support your answer.

.....

.....

..... [2]

(c) Cancer is a non-communicable disease.

Explain the difference between cancer and a communicable disease such as HIV/AIDS.

.....

.....

..... [2]

- 8 Whooping cough is a communicable disease caused by bacteria.

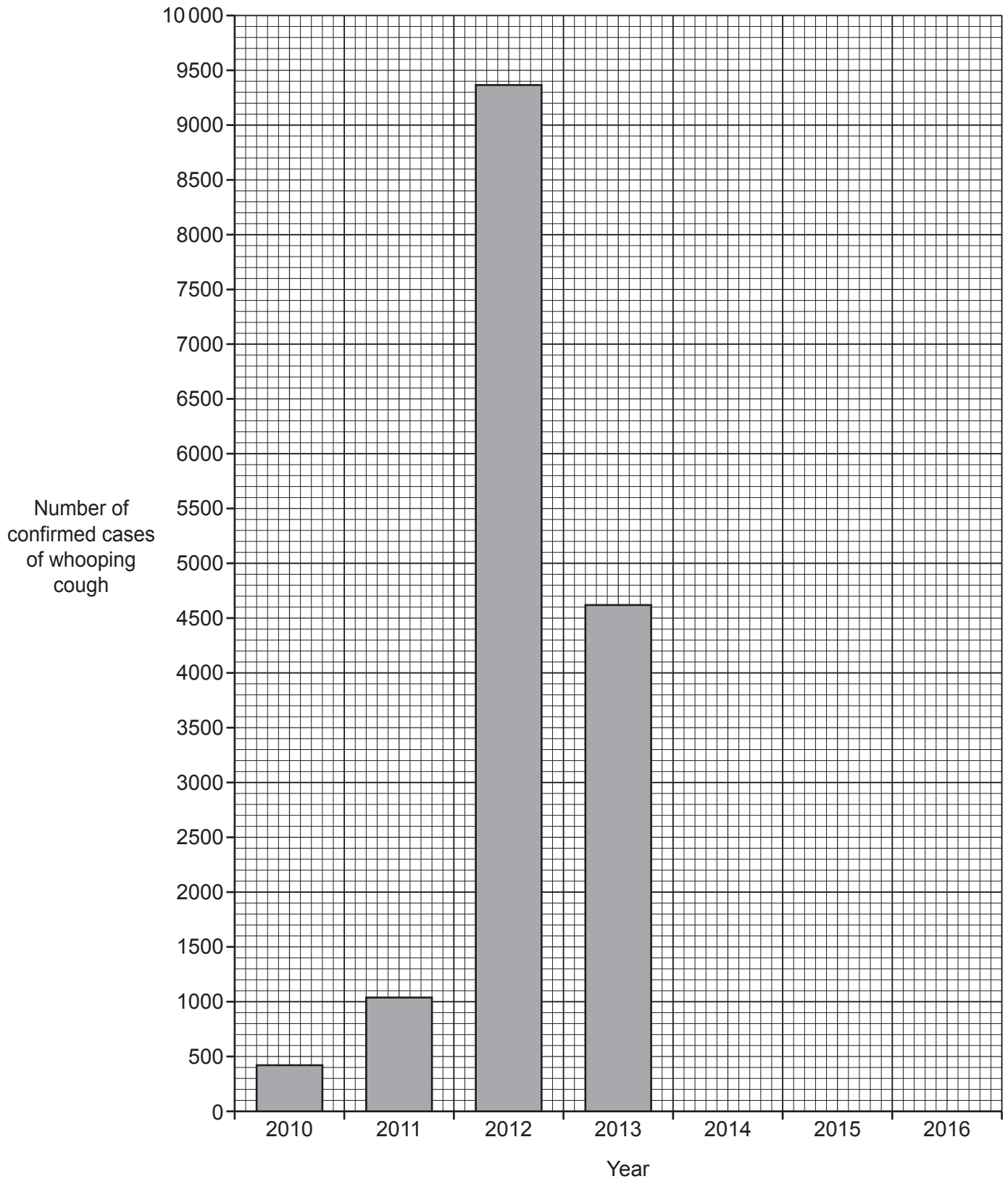
**Table 8.1** shows the number of confirmed cases of whooping cough in England from 2010 to 2016.

<b>Year</b>	<b>Number of confirmed cases of whooping cough</b>
2010	421
2011	1040
2012	9367
2013	4621
2014	3387
2015	4191
2016	5945

**Table 8.1**



(a) (i) Complete the graph by plotting the data in **Table 8.1** for **2014**, **2015** and **2016**.



[2]

Table 8.1 is repeated.

Year	Number of confirmed cases of whooping cough
2010	421
2011	1040
2012	9367
2013	4621
2014	3387
2015	4191
2016	5945

**Table 8.1**

(ii) Which **two** statements about the data are correct?

Tick (✓) **two** boxes.

The number of cases roughly doubled between 2010 and 2011.

The number of cases confirmed was lowest in 2014.

The number of cases in 2016 was roughly half that of 2015.

The number of cases peaked in 2012.

The number of cases in 2016 was lower than the number of cases in 2014.

[2]

(iii) In which year is it most likely that the vaccination rate for whooping cough dropped?

Tick (✓) **one** box.

2012

2013

2014

[1]

(b) Which statement explains how vaccines work?

Tick (✓) **one** box.

The vaccination stimulates the production of platelets.

The vaccination makes the heart beat faster.

The vaccination makes the body make more red blood cells.

The vaccination causes the white blood cells to make antibodies.

[1]

(c) Whooping cough is a communicable disease caused by bacteria. It is common in children who are not vaccinated.

Explain how this disease could spread and suggest how the spread could be prevented.

.....

.....

.....

.....

.....



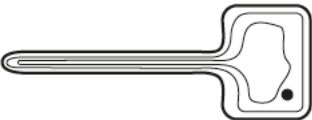
.....

.....

..... [3]

9 Sarah is learning about plants.

(a) Draw a line to connect each **diagram** to the **name of the structure** and its **role in the plant**.

Diagram	Name of the structure	Role in the plant
	Xylem	Absorbs water and mineral ions
	Phloem	Transports sugars
	Root hair cell	Transports water and mineral ions

[5]

(b) Sarah's teacher tells her she can observe these structures using a light microscope.

Complete the sentences to describe how to use a light microscope.

Use words from the list.

You can use each word once, more than once, or not at all.

- coverslip    eyepiece lens    focussing knob    light**  
**objective lens    stage    table**

Place the slide with the specimen to be observed on the .....

Select the ..... to be used.

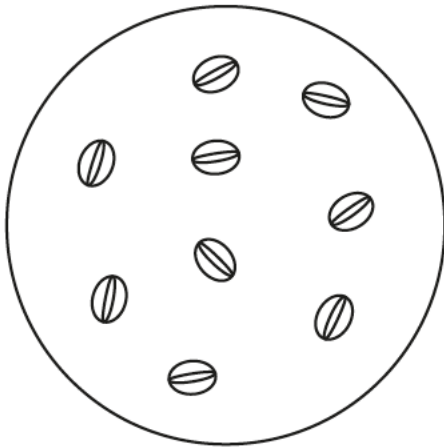
As you look down the microscope column, turn the ..... to bring the specimen into focus.

[3]

(c) Sarah wants to estimate how many stomata there are on the underside of a leaf.

Sarah uses a light microscope to do this.

The diagram shows the field of view from her microscope.



(i) Count how many stomata can be seen in the field of view.

Number of stomata = ..... [1]

(ii) The area covered by the field of view is approximately  $1 \text{ mm}^2$ .

The total area of the underside of the leaf is  $60 \text{ mm}^2$ .

Estimate how many stomata there will be on the underside of this leaf.

Use your answer to part (c)(i).

Estimated number of stomata = ..... [1]

(iii) Sarah does not think that her sample was representative of the whole leaf.

Suggest how Sarah could improve her method.

.....  
 ..... [2]

(iv) If the sample taken was not representative of the leaf, what impact would this have on Sarah's estimate?

.....  
 ..... [1]

22  
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10 Fig. 10.1 shows three different circulatory systems.

© B Furst, 'The Heart: Pressure Propulsion Pump or Organ of Impedence?', Fig. 8, Journal of Cardiothoracic and Vascular Anesthesia', Vol. 367(6), February 2015. Item removed due to third party copyright restrictions.

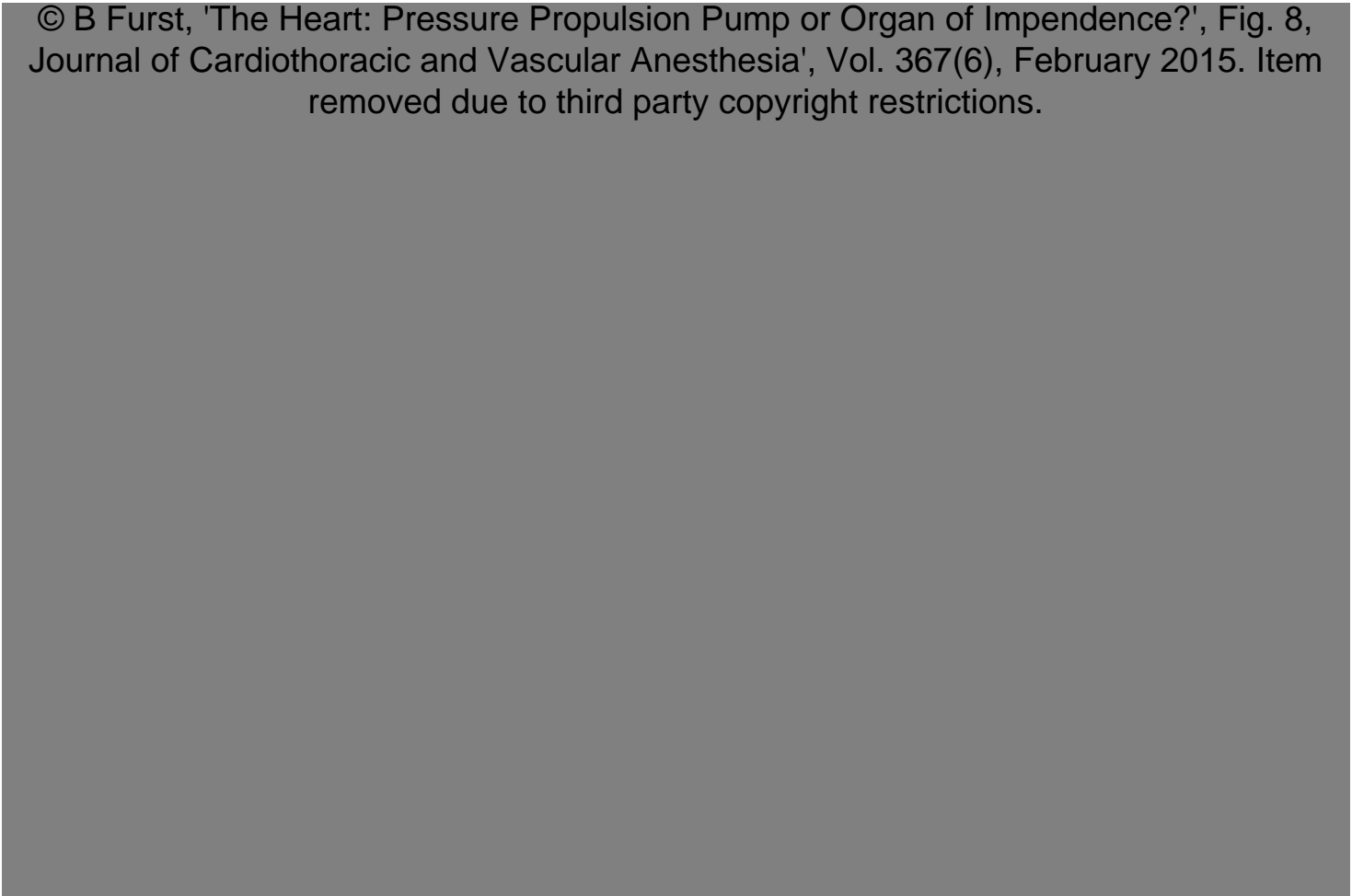


Fig. 10.1

(a) Which diagram best represents the **human** circulatory system?

Tick (✓) **one** box.

A

B

C

Give a reason for your answer.

.....  
.....  
.....  
..... [2]

(b) The human heart has many features that means it is adapted to its function.

For each statement decide which structure's function is described.

Tick (✓) **one** box in each row.

Function	Structure		
	Heart valves	Cardiac muscle	Heart chambers
Contracts to force blood from atria to ventricles			
Contracts to force blood out of the ventricles through vessels			
Prevents backflow of blood during contractions			
Blood temporarily stored in these small spaces to allow blood to be pumped at a high pressure			

[4]

(c) Some babies are born with a heart defect known as a 'hole in the heart'. This is where there is a hole between two of the heart's chambers.

Fig. 10.2 shows a normal heart. Fig. 10.3 shows a heart of a baby with a 'hole in the heart'.

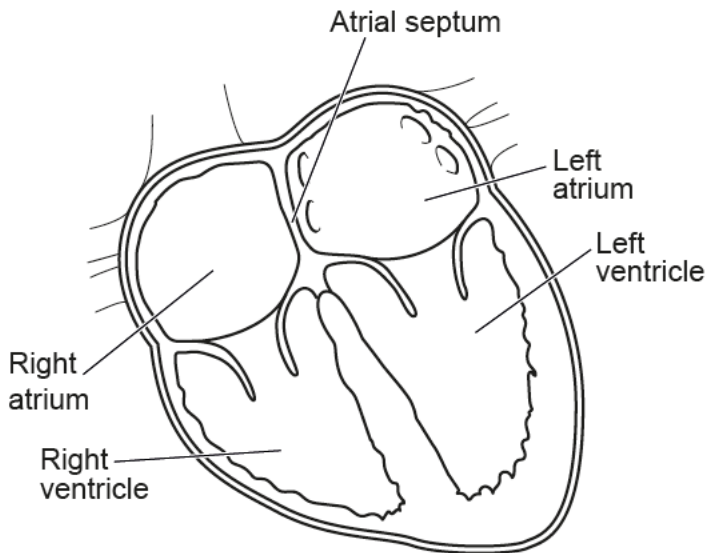


Fig. 10.2

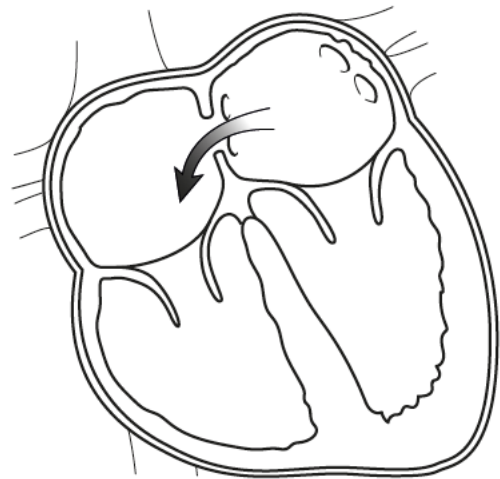


Fig. 10.3

Suggest how the defect in Fig. 10.3 could affect the baby.

.....

.....

..... [1]



(d) The human circulatory system has three types of blood vessel.

Draw lines to connect the **blood vessel** to the correct description of its **structure** and the explanation of how its structure allows it to carry out its **function**.

Blood vessel	Structure	Function
Arteries	Very thin walls, one cell thick	To withstand the high blood pressure of blood leaving the heart
Capillaries	Very thick walls containing elastic tissue and muscle	They can be squashed to move blood along; backflow of blood is prevented
Veins	Thin walls containing elastic tissue, also contains valves	Allows diffusion of substances into and out of the vessel quickly and easily

[3]

11 In the past, humpback whales have been hunted for meat, oil and blubber (fat).

This hunting (known as whaling) caused their numbers to decrease and humpback whales to be classed as an endangered species.

Whaling was banned in 1986.

The data in the table shows how the estimated number of humpback whales has changed over time.

	Estimated humpback whale population
Before whaling	125 000
Before the ban on whaling in 1986	Less than 5000
2015	24 500

(a) Explain why scientists can only estimate how many humpback whales there are.

.....  
..... [1]

(b) In 2015, humpback whales were removed from the endangered species list.

Do you agree with this decision?

Justify your answer using data from the table.

.....  
..... [1]

(c) Current estimates of population size suggest that the number of humpback whales may not be increasing.

Suggest **two** possible reasons for this.

1 .....

.....

2 .....

.....

[2]

(d) In 2018, Japan announced that it will start to hunt whales again.

Use the data in the table to explain why scientists are concerned.

.....  
..... [1]

(e) Whales migrate each year to breeding grounds.

On average, the distance travelled is 5000km and they travel at an average speed of 1.6 km per hour.

Calculate how many **days** it will take the whales to reach the breeding grounds.

Use the equation:  $\text{time} = \text{distance} \div \text{speed}$

Give your answer to **2** significant figures.

Time in days = ..... [3]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large rectangular area with a vertical solid line on the left side and horizontal dotted lines across the rest of the page, providing space for writing answers.



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