

**GCSE (9–1) Combined Science B
(Twenty First Century Science)
J260/01 Biology (Foundation Tier)
Sample Question Paper**

F

Date – Morning/Afternoon

Version 2.2

Time allowed: 1 hour 45 minutes

You may use:

- a scientific or graphical calculator



First name

Last name

Centre
number

Candidate
number

INSTRUCTIONS

- Use black ink. HB pencil may be used for graphs and diagrams only.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION

- The total mark for this paper is **95**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in the question marked with an asterisk (*).
- This document consists of **32** pages.

Answer **all** the questions.

1 (a) Scientists use key terms to explain genetics.

Use words from the list to complete the sentences about genetics.

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

alleles chromosomes genes genome nucleotides

The molecule which carries the genetic information is DNA.

DNA is a polymer made up of

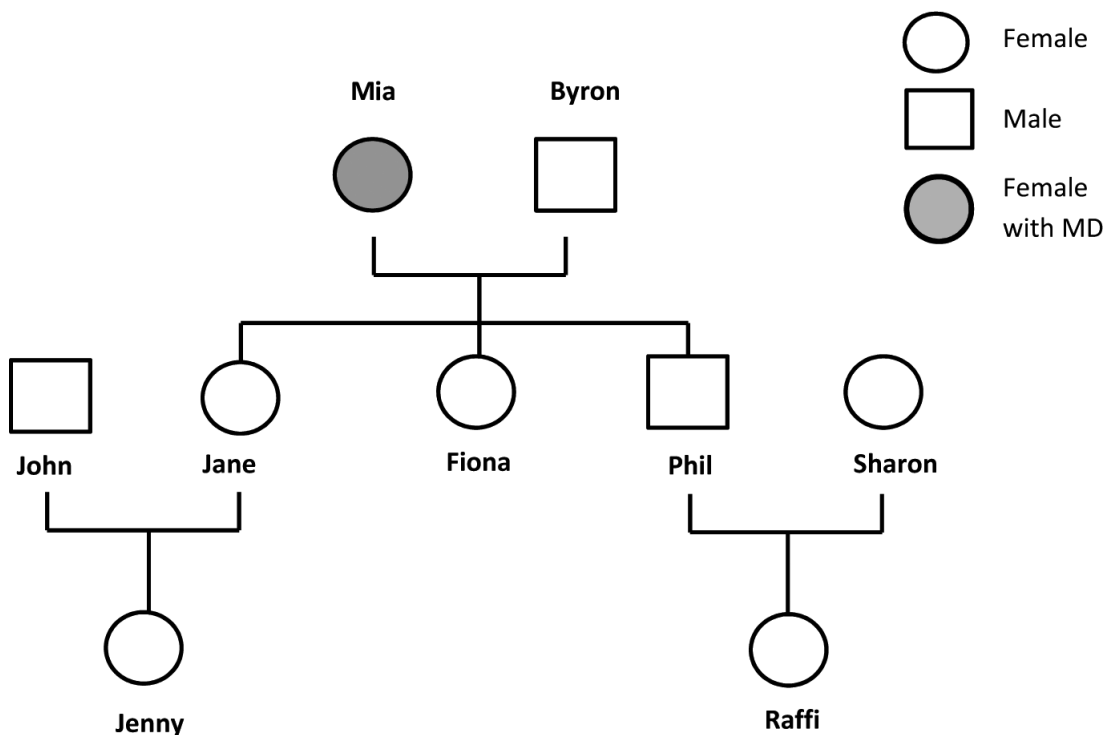
Sections of DNA which code for a particular protein are called [2]

(b) Mitochondria are sub-cellular structures inside nearly every cell of the body. They have a small amount of their own DNA.

Mitochondria are inherited **only** from the mother. Mitochondria are inherited in the cytoplasm of the egg.

Some faulty mitochondria cause Mitochondrial Disease (MD). Symptoms can be brain damage, muscle wasting, heart failure and blindness.

Look at the family tree. Mia has Mitochondrial Disease (MD).



Name the **four other** people in Mia's family tree who will definitely have Mitochondrial Disease.

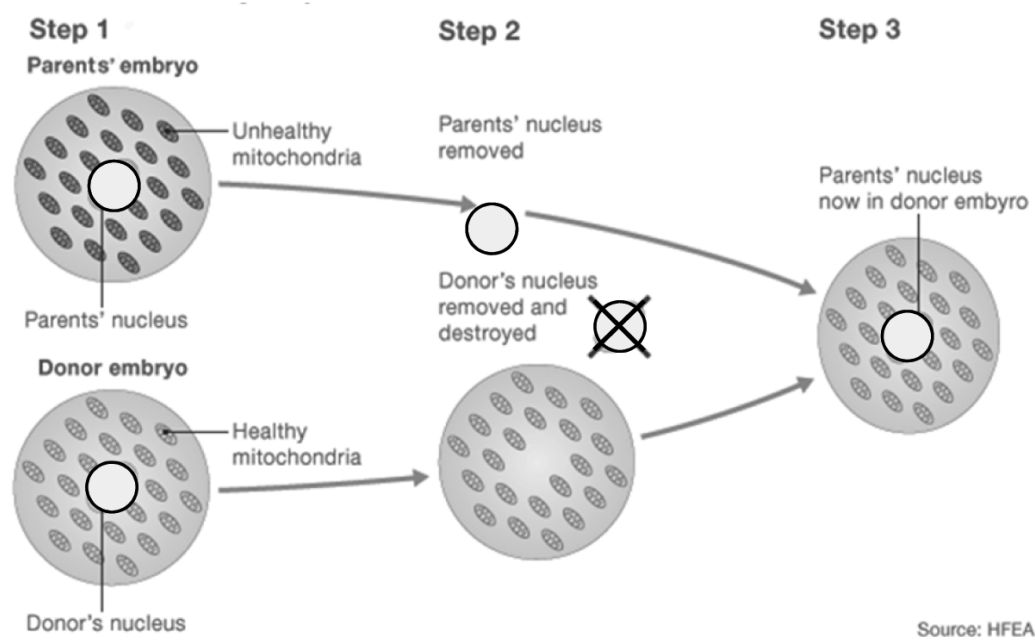
1..... 2..... 3..... 4..... [2]

3

- (c) (i) In February 2015 the UK became the first country in the world to approve laws to allow the creation of babies with genetic material from three people.

The new laws were passed to help develop treatments for Mitochondrial Disease.

The diagram shows one way in which passing on Mitochondrial Disease might be prevented.



Explain why the embryo at the end of the process can be described as having three parents.

.....

.....

..... [2]

- (ii) State **two** possible benefits of this new technique.

Include practical and ethical considerations.

1

.....

2

..... [2]

4

- 2 (a) Communicable diseases in plants and animals can be caused by microorganisms called pathogens.

Put a tick (✓) in the box next to the type of organism that does **not** cause infectious disease.

Type of organism

Bacteria ☐

Fungi ☐

Insects ☐

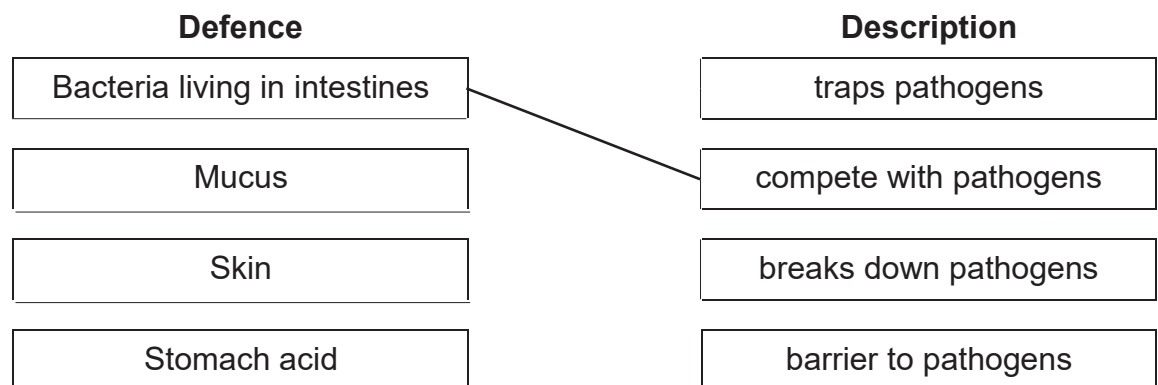
Protists ☐

[1]

- (b) Our bodies have defences that make it difficult for pathogens to enter.

Use **lines** to link each **defence** to its correct **description**.

One line has been drawn for you.



[2]

5

- (c) In 2014, there was an outbreak of Ebola in Africa. It was estimated that just over 50% of individuals infected with Ebola died during this outbreak.

Read the article below about Ebola.

Ebola pathogen
(a virus)



Ebola is a serious infectious disease of humans.

The early symptoms are fever, muscle pain, tiredness, headache and sore throat, then vomiting, diarrhoea and bleeding. Symptoms appear about 21 days after infection.

The Ebola pathogen has been found in the blood, vomit, faeces, urine and other bodily fluids of people with symptoms of the disease.

The Ebola pathogen is only found in these bodily fluids after the infected person has symptoms.

- (i) Use information in the article to identify **three** signs that might show someone that they have Ebola.

1

2

3 [1]

6

- (ii) Use the information in the article to describe how the Ebola pathogen spreads from person to person.

.....

.....

.....

..... [3]

- (iii) Ebola is a rare infection.

Describe how a **common** human infection that you have studied is spread from person to person.

.....

.....

..... [2]

- (d) Some infectious diseases can be prevented by a vaccination

Put a tick (✓) in the box next to the **correct** description of how vaccination does this.

A vaccination

... causes the production of antibodies before infection.

☐

... causes the production of antigens before infection.

☐

... stops the pathogen getting into the body.

☐

... stops the pathogen reproducing inside the body.

☐

[1]

7

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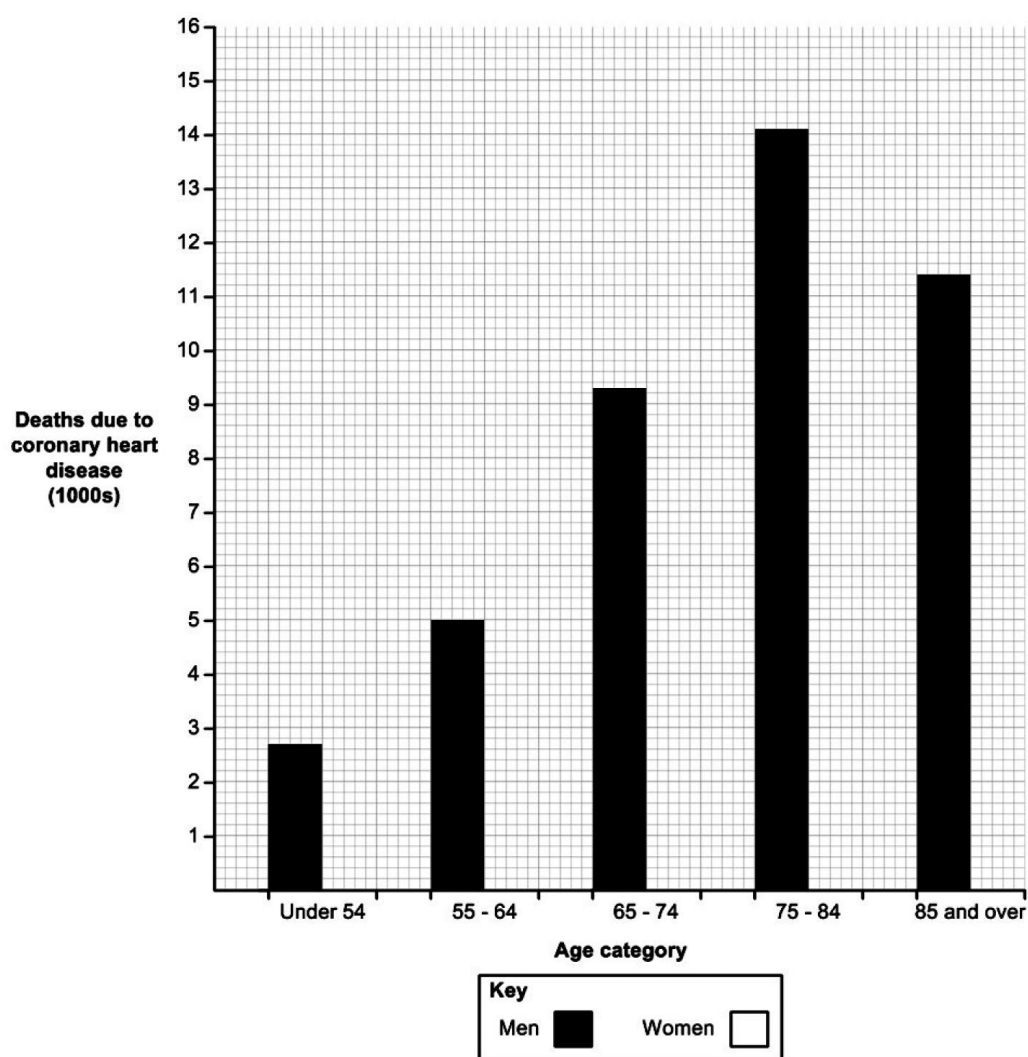
- 3 (a) Here are some data about deaths caused by coronary heart disease, a type of cardiovascular disease, collected by the British Heart Foundation in England.

The figures are rounded to the nearest hundred.

Age category	Deaths in 2012	
	Men	Women
Under 54	2 700	700
55 – 64	5 000	1 400
65 – 74	9 300	3 800
75 – 84	14 100	9 500
85 and over	11 400	15 500

Complete the graph below by adding the data for women.

[3]



- (b) The risk of coronary heart disease and other types of cardiovascular condition, such as a heart attack, is also affected by factors other than age and gender.

Describe how **two** lifestyle factors can increase or decrease the risk of having a heart attack.

.....

.....

.....

.....

.....

..... [4]

- (c) The heart forms part of the circulatory system.

What role does the heart play in this system?

..... [1]

1

- (d) Water moves through a plant in the xylem.
Which sentence best explains how the xylem is adapted to its function?

Put one tick (✓) in the correct box.

Cells are joined end to end and contain cytoplasm.

☐

Cells are joined end to end with no connecting cell walls.

☐

Companion cells containing mitochondria to produce energy.

☐

Perforated plates allow movement between cells.

☐**[1]**

- (e) The skin contains stem cells. Stem cells are unspecialised cells.

How does this make them useful to scientists?

.....

.....

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

11
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TURN OVER FOR THE NEXT QUESTION

4 (a) Organisms that can photosynthesise are called producers.

Photosynthesis produces glucose.

Describe a test that can be used to show that a solution contains glucose.

.....

.....

.....

..... **[3]**

(b) Yeast, a single celled microorganism, can use glucose for respiration.

Yeast can respire in conditions with oxygen and without oxygen. Yeast can be grown in a container called a fermenter.

Two fermenters, **A** and **B**, are set up with a solution containing yeast.

- In fermenter, **A**, air containing oxygen is bubbled through the solution.
- In second fermenter, **B**, the lid is shut and no air can get in or out.

Samples are taken and yeast cells are counted.

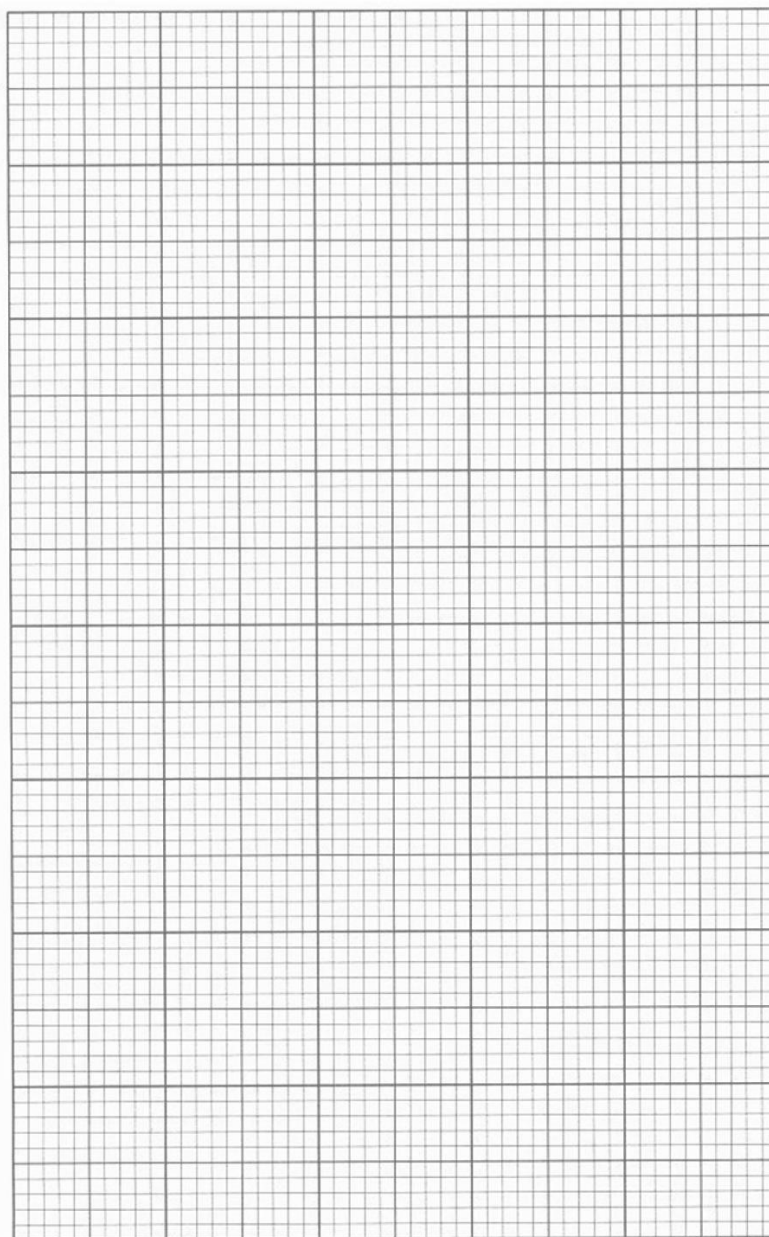
The results are shown in Table 4.1

Time when yeast samples were taken (hours)	Number of yeast cells (in 1 mm ³)	
	A	B
0	50	50
1	100	100
2	200	150
3	400	175
4	800	200

Fig 4.1

- (i) Plot the data given in the table (Fig 4.1) on the grid below.

Use the points to draw a curve through all the plots for **each** fermenter (**A** and **B**) and label each line appropriately.



[4]

- (ii) Describe the results shown in the table (Fig 4.1) and the graph.

.....

.....

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..... [2]

(c) Describe **two** differences between anaerobic and aerobic respiration.

1

.....

2

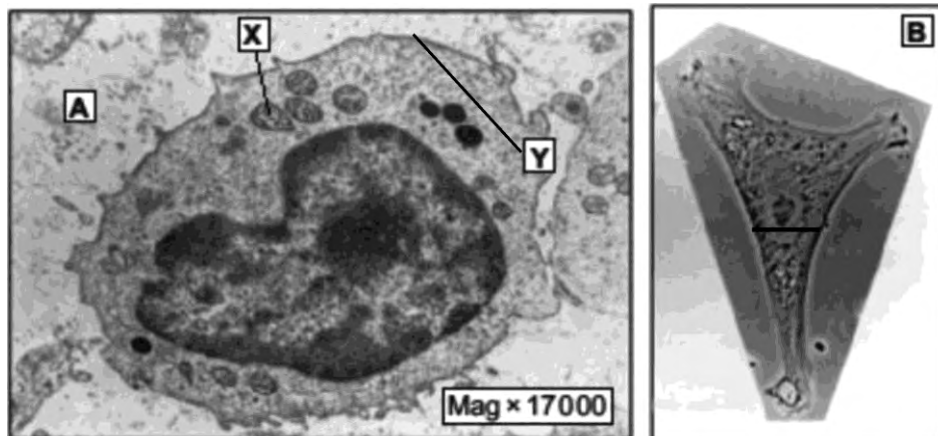
..... [2]

15

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TURN OVER FOR THE NEXT QUESTION

- 5 The photographs **A** and **B** both show a type of human white blood cell. One was taken using a light microscope and one using an electron microscope.



- (a) (i) A scientist measures the diameter of the white blood cell in photograph **B**.

The diameter is 8 mm.

The scientist knows that the actual diameter of the living cell is 0.01 mm.

Use this information and the equation below to calculate the magnification of photograph **B**.

$$\text{magnification} = \frac{\text{measured size}}{\text{actual size}}$$

Magnification = ... [1]

- (ii) Use your calculation of magnification in (i) and the information in the photographs to explain why photograph **A** is the one taken with an electron microscope.

.....

 [2]

- (b) (i) Name the structure labelled **Y** in photograph **A**.

..... [1]

- (ii) State the function of the structure labelled **X** in photograph **A**.

..... [1]

17

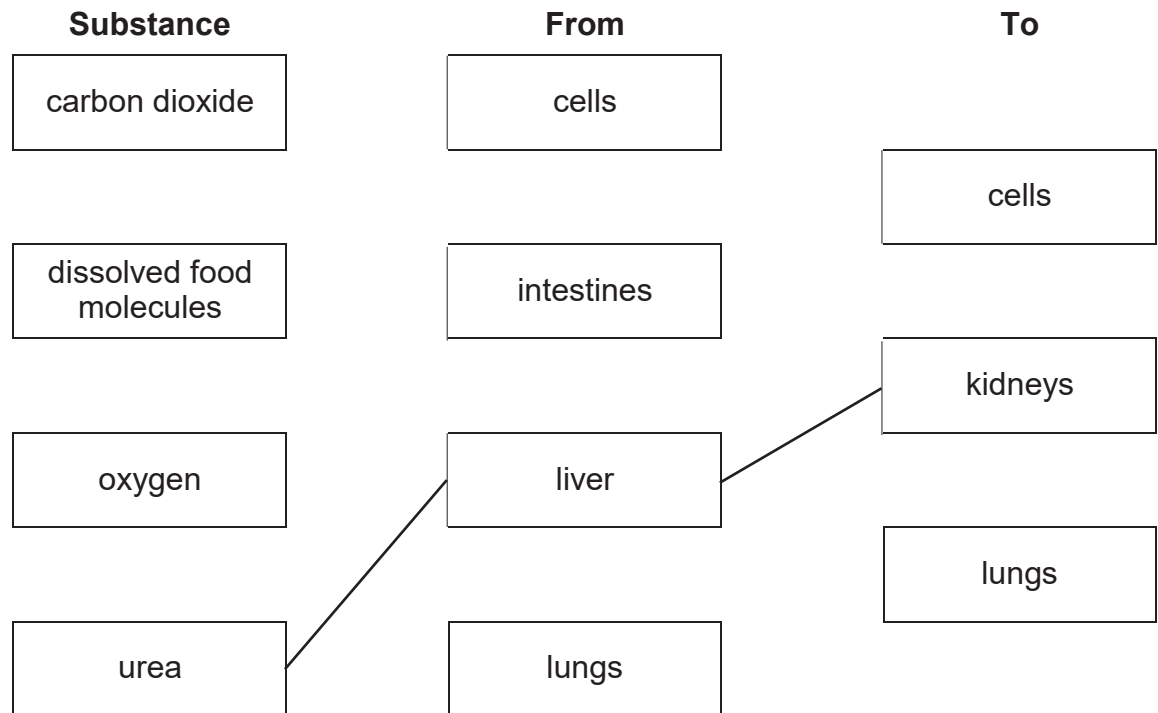
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- 6 (a) The human circulatory system transports substances from place to place within the body.

Use lines to complete the diagram showing where the listed **substances** are moved **from** and **to** in the human body.

Some boxes may have more than one line drawn to them.

Two lines have been drawn for you.



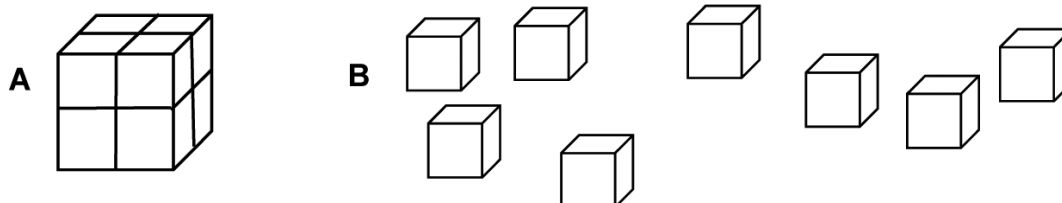
[3]

(b) A scientist knows that surface area is important at gas exchange surfaces.

She is modelling the shape of animals using 1 cm^3 blocks.

She makes two models. Each model contains eight 1 cm^3 blocks.

- **A** is a six sided cube.
- **B** has each block separate.



She works out the surface area of each model by counting the sides and starts to put the results in a table.

Model	Surface area (cm^2)	Volume (cm^3)	Surface area : volume ratio
A	24	8	 :
B	48	8	 :

Complete the table by calculating the surface area : volume ratios.

You can use the space below for working.

[2]

(c) As animals get bigger, they need special gas exchange surfaces like lungs.

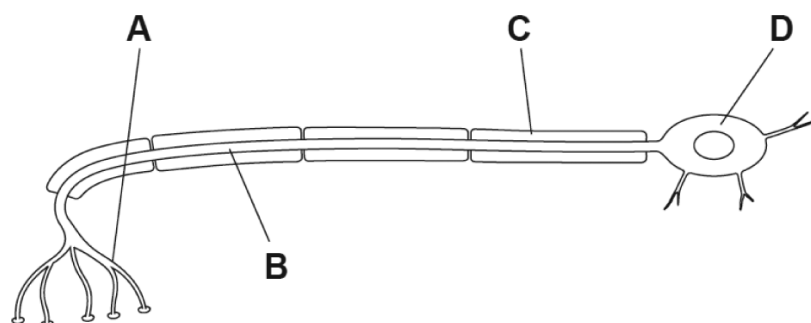
Using the scientist's findings about the surface area : volume ratios and your own knowledge, explain why bigger animals need special gas exchange surfaces.

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.....

..... [2]

- 7 (a) (i) The diagram below shows a motor neuron.



Which label, **A**, **B**, **C** or **D**, is pointing to the fatty sheath?

.....

[1]

- (ii) The nervous system consists of billions of neurons.

An electrical impulse can travel down a neuron at different speeds.

The table shows information about three neurons, **D**, **E** and **F**.

Neuron	Length (m)	Time taken for impulse to travel (s)	Speed (m/s)
D	1.3	0.027	48.15
E	1.3	0.014	
F	0.8	0.022	

Calculate the speed of the electrical impulse travelling down neuron **E** and neuron **F**.

Neuron **E** speed = ... m/s

Neuron **F** speed = ... m/s

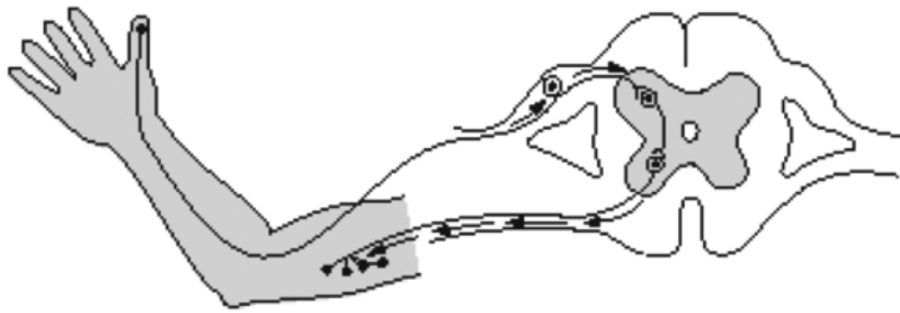
[2]

- (iii) What is the role of the fatty sheath?

.....

..... [1]

- (b) The diagram shows the reflex arc involved in pulling the hand away from a hot object.



- (i) What is the main feature of a reflex action, such as pulling the hand away from a hot object?

..... [1]

- (ii) Why are reflex actions important?

..... [1]

- 8 (a) Charles Darwin suggested that evolution happened partly because of natural selection.

An example of natural selection today is the evolution of antibiotic resistance in bacteria.

A number of steps occur to produce resistant bacteria.

The steps are listed below but in the wrong order.

- A** Number of resistant bacteria increases.
- B** Where the antibiotic is used the new variant is more likely to survive.
- C** An enzyme made by the new variant breaks down the antibiotic.
- D** A mutation causes a new variant.
- E** The new variant reproduces passing on the mutation.

Put the steps in the correct order.

Write the letters **A**, **B**, **C**, **D** and **E** in the boxes.

--	--	--	--	--

[3]

- (b) Humans have changed the characteristics of domesticated animals and crop plants by selective breeding.

Milk production per cow has increased since 1930. Some of this increase has been caused by selective breeding.

Explain how selective breeding has increased milk production per cow.

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.....

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.....

..... [4]

23

- 9 (a) Jack and Sarah have a daughter, Nina, who has just been diagnosed with Marfan syndrome. This is a genetic disease that affects the body's connective tissue. (Connective tissue holds organs in place.)

Nina's Dad also has Marfan syndrome.

Using the letters, **D** and **d** to represent the alleles for this disease, predict the probability that Jack and Sarah's next child will have Marfan syndrome.

Complete the Punnett square below.

		Sarah	
		d	d
Jack	D		
	d		

Probability = ...[2]

- (b) 1 in 5 000 people in the UK has Marfan syndrome.

The population of the UK in 2014 was 64.1 million.

Calculate the number of people with Marfan syndrome in the UK in 2014.

Show your working.

Number of people = ...[2]

- (c) Lung cancer affects far more people in the UK than Marfan syndrome.

In 2011, there were 43 463 new cases of lung cancer diagnosed.

Why is the incidence of lung cancer so high?

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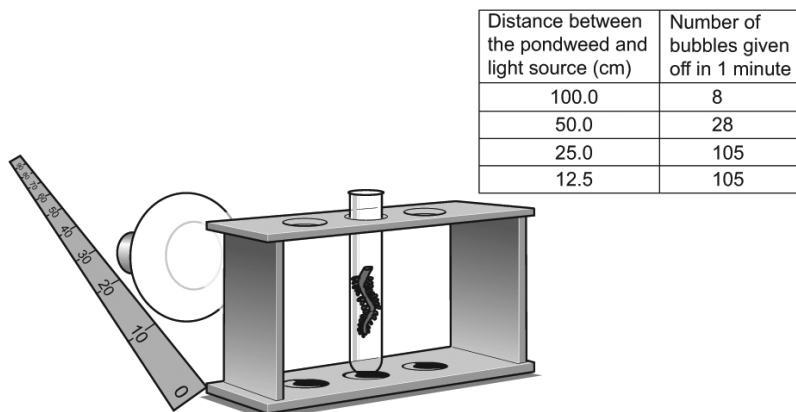
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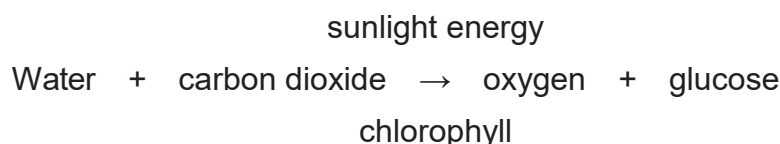
..... [2]

- 10 Two scientists are investigating the effect of light intensity on the rate of photosynthesis.

The diagram shows how they set up their investigation, and their results.



- (a) The word equation for photosynthesis is:



In which sub-cellular structure in a plant cell does photosynthesis occur?

..... [1]

- (b) Describe the pattern in the scientist's results.

.....

 [2]

- (c) (i) One scientist thinks that the result of 105 bubbles at 12.5 cm may be an error.

Describe how she could be more certain that 105 is the **true** value.

.....

 [2]

- (ii) How could similar apparatus be used to allow the scientists to investigate the effect of temperature on the rate of photosynthesis?

Other laboratory equipment is also available.

.....

 [2]

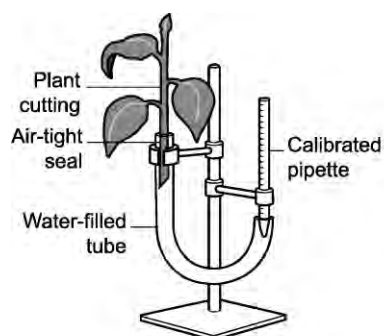
(d) The scientists also investigate the rate at which water is lost by leaves.

(i) What is the loss of water from leaves called?

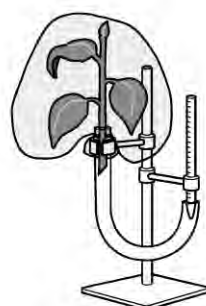
..... [1]

(ii) The scientists investigate the water uptake by a plant cutting using a potometer.

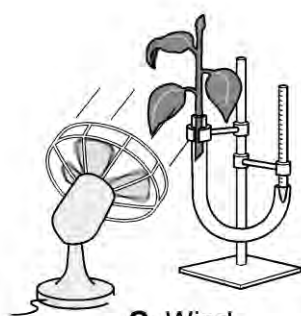
- They measure the water uptake in 30 minutes.
- They use four conditions: **A**, **B**, **C** and **D**, as shown below.



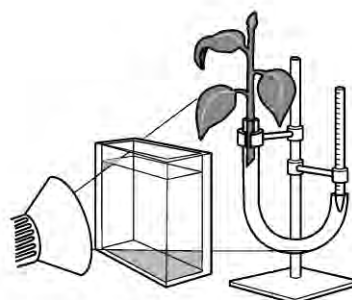
A. Normal room



B. Mist



C. Wind



D. Bright light

They take **three** readings for each condition and record their results in a table.

Condition	Water uptake in 30 minutes (cm ³)				Rate of water uptake (cm ³ /min)
	1	2	3	Mean	
A (Normal room)	4.18	4.01	3.98	4.06	0.32
B (Mist)	2.06	1.85	2.25	2.05	0.07
C (Wind)	9.34	9.85	9.20		
D (Bright light)	10.36	10.56	9.89	10.27	0.34

Complete the table by calculating the mean **and** the rate of water uptake for condition **C**.

[2]

- (iii) Condition D (bright light) causes plants to take up the most water.

Explain the results for **D**.

.....

.....

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..... [2]

- (iv) The volume of water taken up by the plants in this experiment may **not** be an accurate measurement of water lost from the plant.

Suggest why.

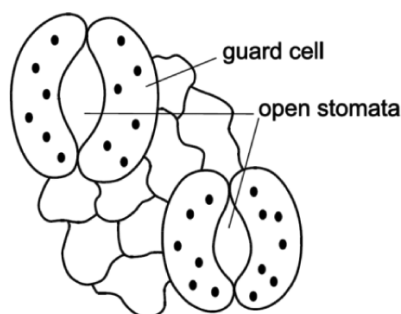
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..... [2]

- (e) Plants lose water from their leaves through tiny holes called stomata. These can be seen in the diagram below.



Plants can control water loss by closing their stomata.

Describe the consequences for photosynthesis for plants living in dry places if they need to close their stomata to save water.

.....

.....

.....

..... [2]

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Flowering plant	Number of plants in 1m ²	
	Field X	Field Y
Carrots	16	0
Daisy	0	6
Dandelion	4	9
Buttercup	0	5
Number of species		
Total number of plants		
Biodiversity index		

Table 11.1

Complete the last three rows in the table.

You will need to calculate the biodiversity index using the equation below:

$$\text{biodiversity index} = \frac{\text{number of species in the area}}{\text{total number of plants in the area}}$$

[1]

(c) It is important to try to maintain biodiversity.

Which of the following would help to prevent a decrease in biodiversity?

Put a tick (✓) in the box next to the correct answer.

Decreasing the genetic variation within species.

☐

Increasing the population of a common species.

☐

Storing seeds in seed banks.

☐

Using wood rather than oil for fuel.

☐
[1]

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Summary of updates

Date	Version	Details
December 2021	2.2	Updated copyright acknowledgements.

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