OCR
Oxford Cambridge and RSA

Accredited

GCSE (9–1) Combined Science B (Twenty First Century Science)

H

J260/05 Biology (Higher Tier)

Sample Question Paper

Date – Morning/Afternoon

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.

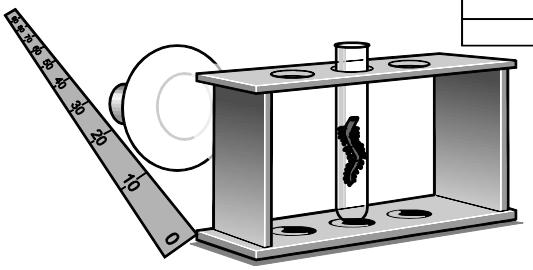
INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages.

Answer **all** the questions.

1 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.

Distance between the pondweed and light source (cm)	Number of bubbles given off in 1 minute
100.0	8
50.0	28
25.0	105
12.5	105



(a) The word equation for photosynthesis is:

$$\text{Water + carbon dioxide} \xrightarrow[\text{chlorophyll}]{\text{sunlight energy}} \text{oxygen + glucose}$$

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

…… **[1]**

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

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…… **[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.

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…… **[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.

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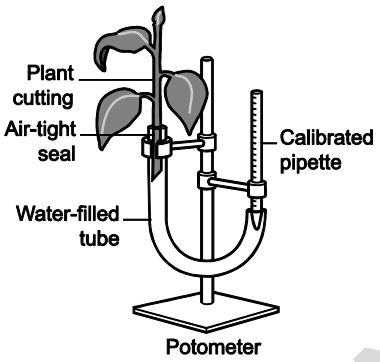
…… **[2]**

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

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

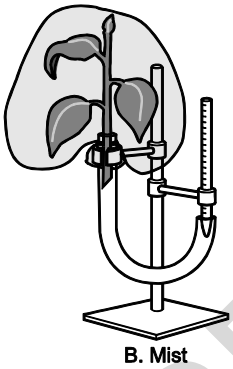
…… **[1]**

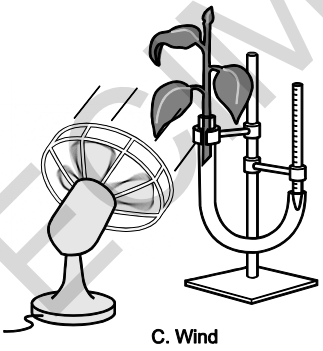
They use a potometer to measure the water uptake by the plant cutting in 30 minutes.

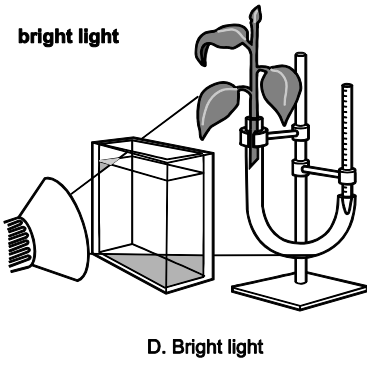


They use four conditions: **A** normal room, **B** mist, **C** wind and **D** bright light.

They do three readings for each condition.







They put their results in a table.

(ii)

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) **D bright light** causes plants to take up the most water.

Explain the results for **D bright light**.

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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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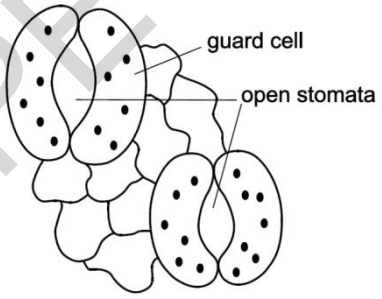
…… **[2]**

(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.

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…… **[2]**

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Turn over for the next question

2 **(a)** Kate is doing some fieldwork in an area where trees are growing around the edge of a field.

Kate wants to find out if the **type** of plant growing under a tree changes as you move away from the tree towards the middle of the field. She thinks light might affect the type of plant growing.

Kate uses a tape measure, quadrat, identification key and light meter in her fieldwork.

Explain how she will use this apparatus **and** describe how she will process her results.

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…… **[6]**

(b) Tom carries out a similar investigation but is interested in biodiversity and how humans can affect it.

Field **X** has been planted with carrots and Field **Y** is a grass meadow.

Tom counts flowering plants within quadrats in the two fields and is able to estimate the flowering plants per m^2 in each field.

His results are shown on the next page.

Flowering plant	Number of plants in 1 m^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		

Calculate the biodiversity index to complete the table.

Use 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.

Using wood rather than oil for fuel. ☐

Storing seeds in seed banks. ☐

Increasing the population of a common species. ☐

Decreasing the genetic variation within species. ☐

[1]

3 Scientists use key words to explain inheritance.

(a) Complete the sentences about genetics.

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 ……

An organisms' entire genetic material is called its ……

[3]

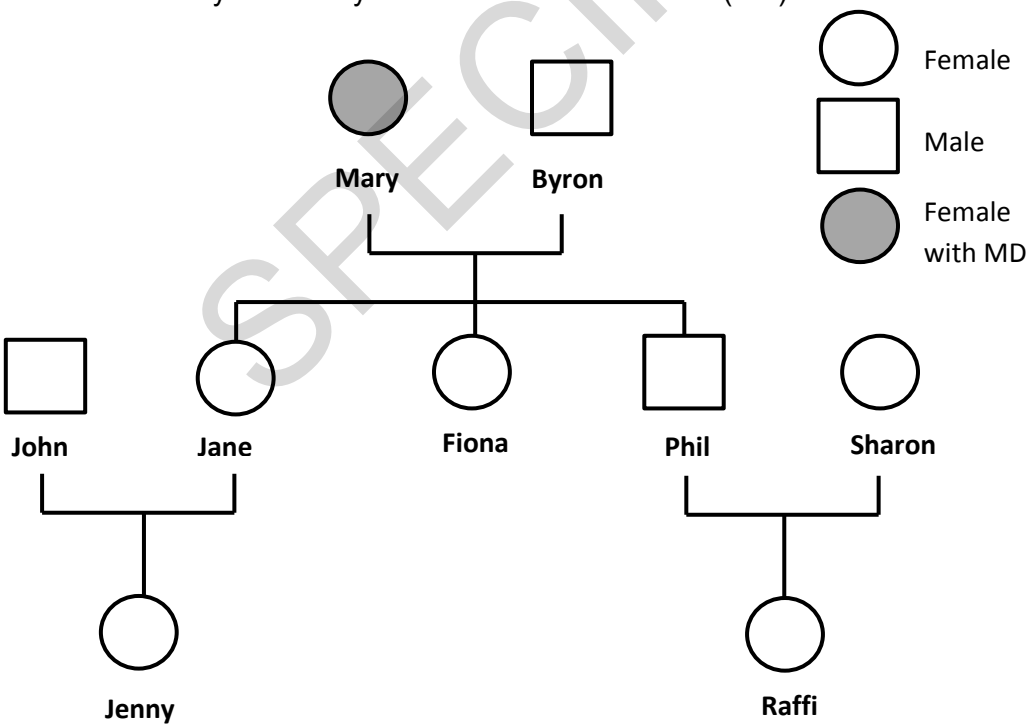
(b) Mitochondria are sub-cellular structures inside nearly every cell of the body.

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 cell.

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

Look at the family tree. Mary has mitochondrial disease (MD).



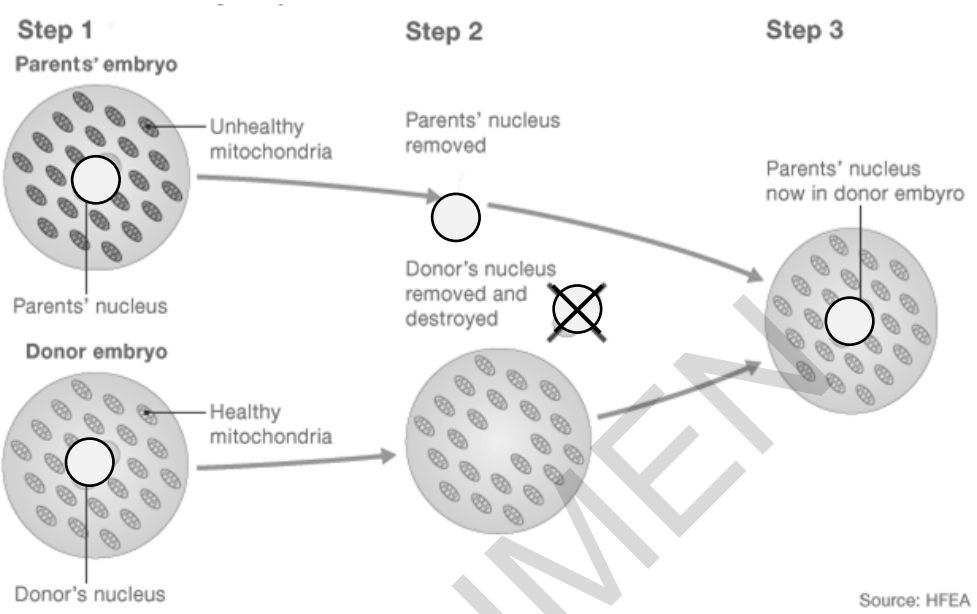
Name the four other people in Mary's family tree who will definitely have Mitochondrial Disease.

1…… **2**…… **3**…… **4**…… **[2]**

(c) 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.



Describe some of the possible benefits of using this gene technology.

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…… **[2]**

(d) **(i)** Enviropig is a genetically engineered type of pig.

Enviropig has been engineered to make the enzyme phytase in its salivary glands.

Phytase is naturally present in many plants.

Phytase enables Enviropig to digest plant phosphorus-containing compounds more efficiently.

Describe the main steps used to produce the genetically engineered Enviropig.

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…… **[3]**

(ii) Explain why the enzymes naturally present in pig saliva cannot digest plant phosphorus-containing compounds.

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…… **[2]**

4 Infectious diseases in plants and animals can be caused by some types of microorganisms, called pathogens.

(a) Our bodies have defences that make it difficult for pathogens to enter our bodies.

Use **straight lines** to link each **defence** to its correct **description,** one of the descriptions is incorrect.

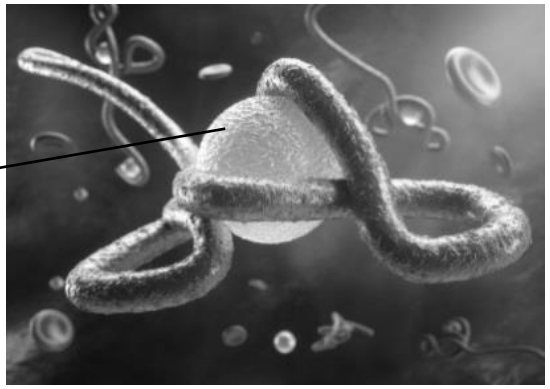
Defence	Description
	traps pathogens
Bacteria living in intestines	
	competes with pathogens
Mucus	
	breaks down pathogens
Skin	
	barrier to pathogens
Stomach acid	
	contains an enzyme that kills pathogens
Tears	
	recognises pathogen

[3]

(b) 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 information on Ebola.

Ebola pathogen (a virus)



Ebola is a serious communicable 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) Describe one way the spread of Ebola from individuals with symptoms could be reduced.

Use information from above in your explanation.

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…… **[1]**

(ii) If an individual survives Ebola they are unlikely to ever suffer from it again. They are immune.

Explain how individuals become immune to Ebola.

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…… **[4]**

(c) New medicines, including vaccinations, have to be tested before they are made widely available.

Preclinical and clinical tests are used to assess the safety and effectiveness of new medicines.

For each test, complete the table by putting a tick (✓), in **one** box next to the test to indicate if it assesses **safety**, **effectiveness** or **both**.

For each test, one example has been done for you.

Preclinical tests	Safety	Effectiveness	Both
Cultured human cells			✓
Whole animals			

Clinical tests	Safety	Effectiveness	Both
Healthy volunteers			
Humans with the disease			✓

[2]

(d) It usually takes years of preclinical testing before a new medicine or vaccine is tested on humans.

In 2014 a new vaccine for Ebola was tested only a few months after it was first made.

Use the information in the question about Ebola and ideas about risk to suggest why the 2014 Ebola vaccine was tested so quickly on humans.

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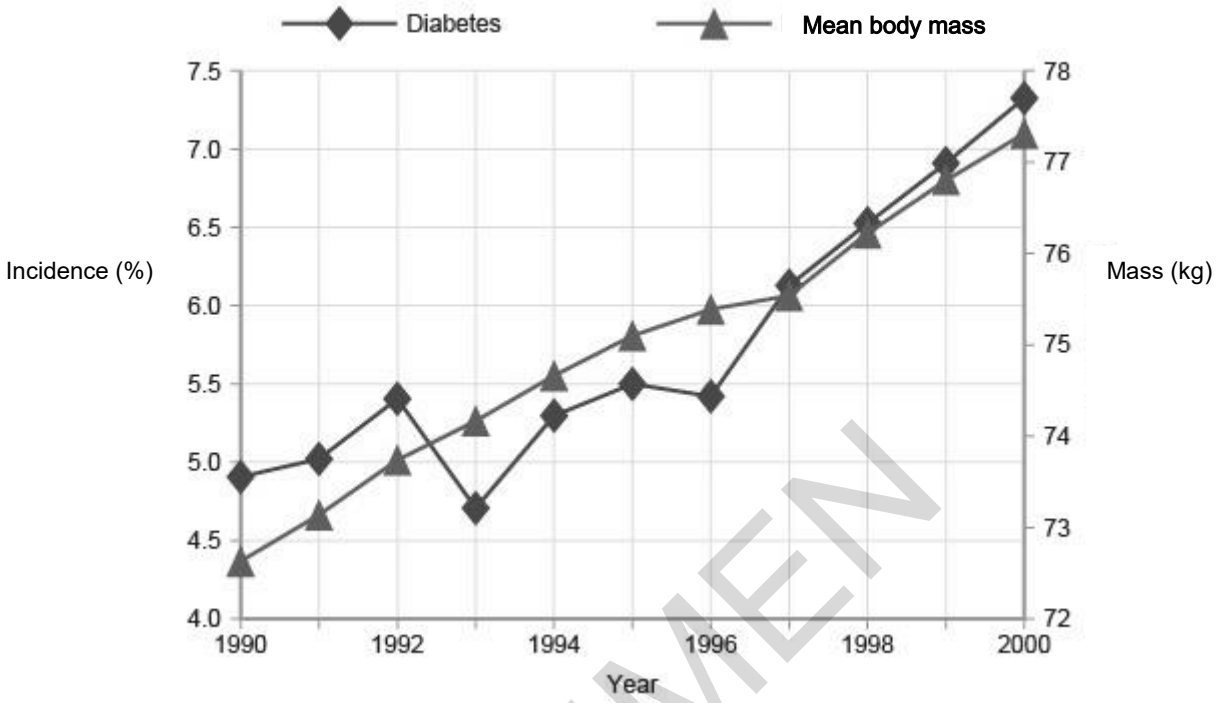
…… **[1]**

5 The graph below shows the changes in mean body mass and incidence of type 2 diabetes from 1990 to 2000.



(a) Use the graph to decide which of these statements is correct.

Put a tick (✓) in the box next to the **three** correct statements.

Statement	
The mean body mass increased in every year.	☐
The incidence of diabetes increased in every year.	☐
The biggest annual increase in diabetes was from 1996 – 1997.	☐
The percentage incidence of diabetes increased by more than 2.5% from 1990 to 2000.	☐
The mean body mass increased by less than 6 kg per person from 1990 to 2000.	☐

[3]

(b) The data in the graph suggests that as body mass increases, so does the incidence of diabetes.

What extra information is needed to show if this is a causal relationship?

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…… **[1]**

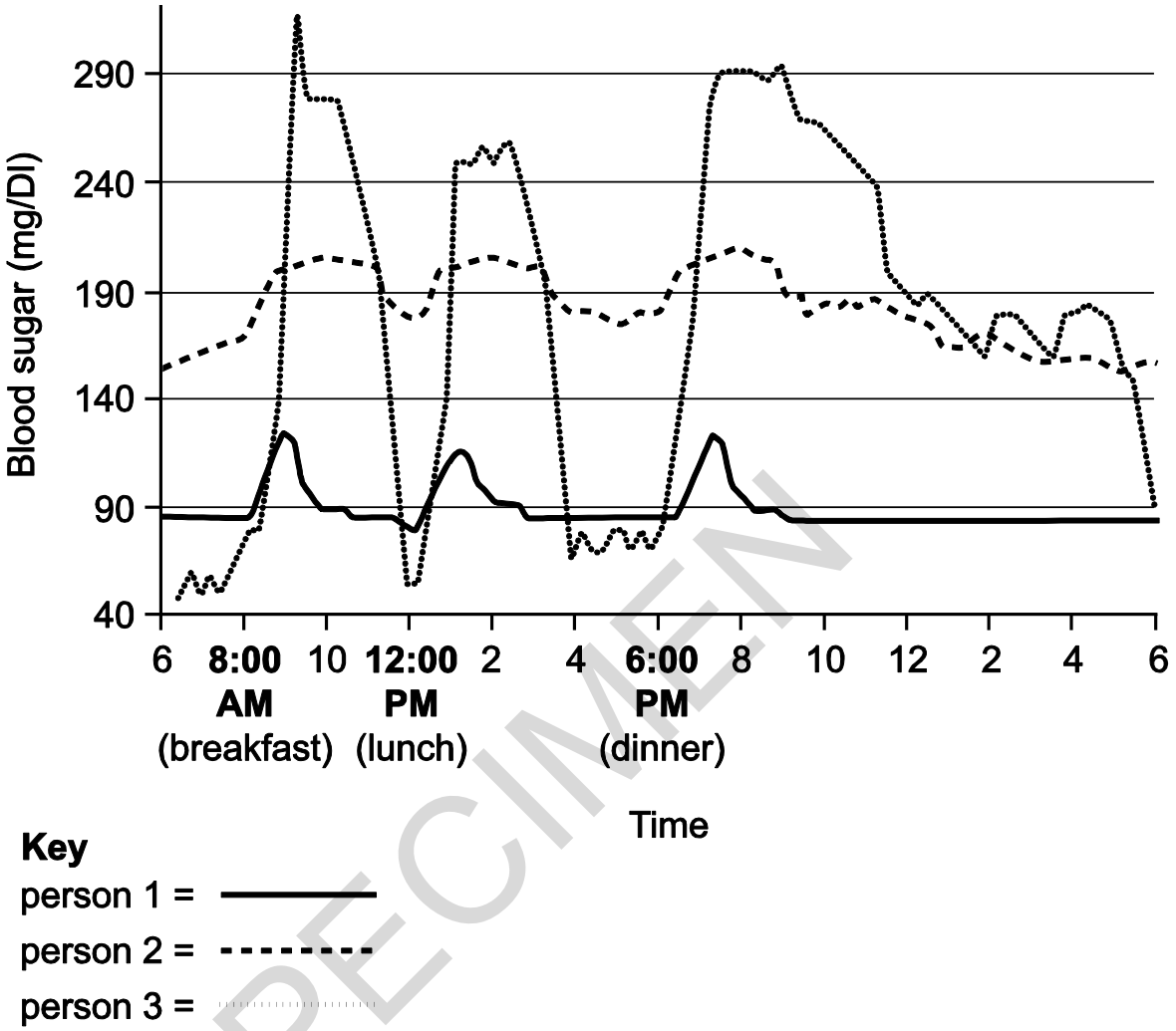
(c) In 2013 in the UK there were 3.2 million people living with a diagnosis of diabetes.

320 000 of these had type 1 diabetes.

Show that 90% of people with diabetes in 2013 had type 2 diabetes.

[2]

(d) The graph shows how the blood sugar level of three people varies over a day.



One of the three people, person **1**, **2** and **3**, has **type 1** diabetes, one has **type 2** diabetes and the third **doesn't have diabetes**.

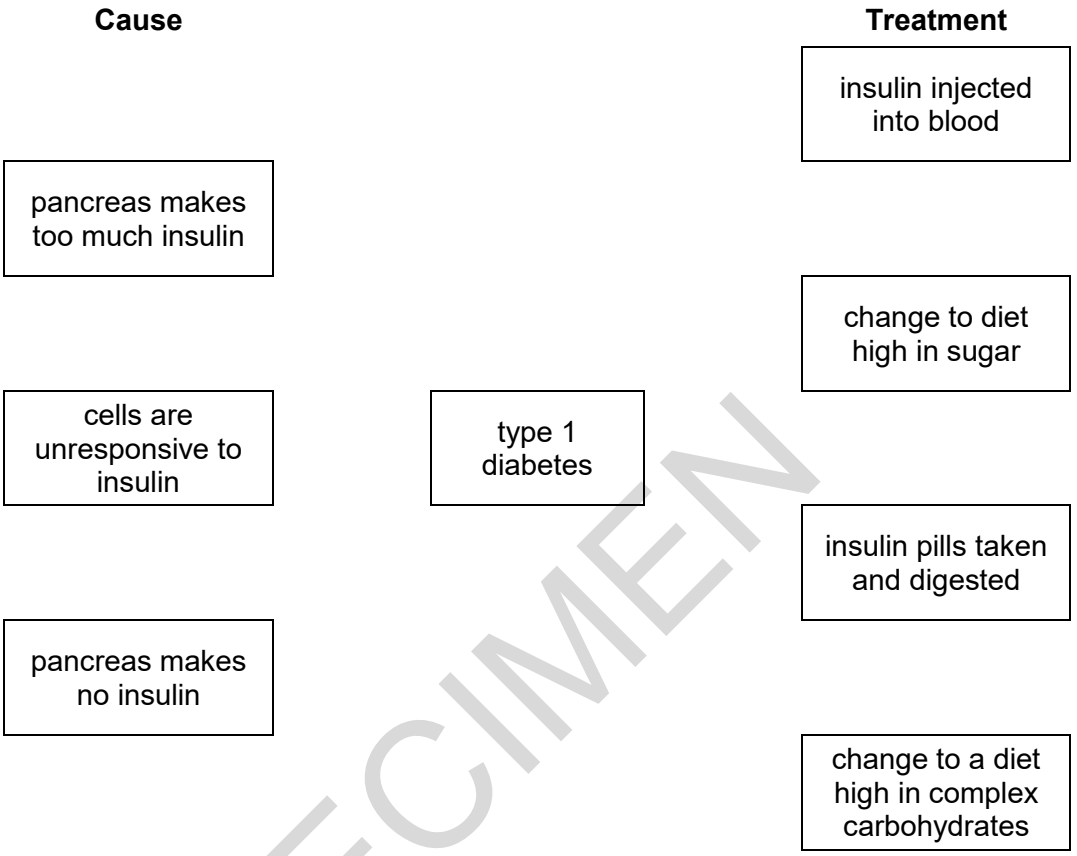
Use the information from the graph to diagnose each person and complete the table.

Person	Diagnosis
1	
2	
3	

[2]

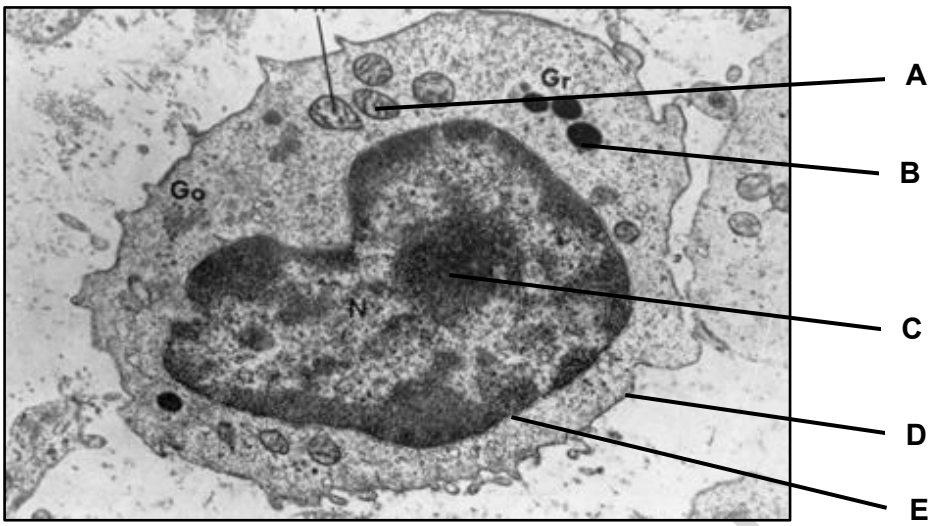
(e) Type 1 and type 2 diabetes have different causes and different treatments.

Use **two** straight lines to complete the diagram to show the correct **cause** and **treatment** for **type 1 diabetes**.



[2]

6 (a) (i) The picture is a micrograph of a type of human cell.



Write down the letter **A**, **B**, **C**, **D** or **E** which indicates a mitochondrion.

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

(ii) A scientist is trying to identify the cell in the photograph. He knows his photograph has a magnification of 8 000.

On his photograph a scientist measures the diameter of the cell to be = 100 mm.

Calculate the actual diameter of the cell.

Show your working.

diameter **.....**mm **[2]**

(b) The scientist observes another cell using an electron microscope. It is found to be much smaller than the first cell and also has no mitochondria.

Put a tick (✓) in the box next to the possible second cell type.

Cell type	
Liver cell	☐
Bacterial cell	☐
Leaf palisade cell	☐
Neurone	☐

[1]

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

Cells need to be constantly supplied with inputs for cellular respiration and the waste outputs need to be removed from cells.

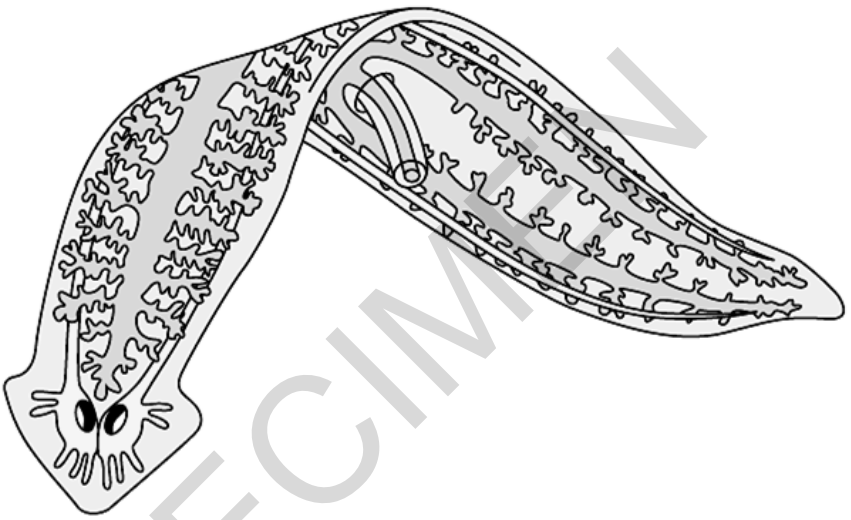
Write down the waste outputs of aerobic and anaerobic cellular respiration in humans.

Aerobic waste outputs ……..…

Anaerobic waste outputs ……..……

[2]

(b) The image below shows a type of animal called a flatworm.



Flatworms can grow quite large. However, flatworms do not have a circulatory system.

Explain why even large flatworms can exchange gases efficiently and do not need a transport system.

Use ideas about surface area, volume and diffusion in your explanation.

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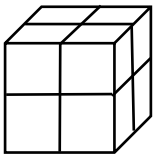
……..…….……. **[3]**

(c) Earthworms have a circulatory system but have no specialised gas exchange surface. Gases diffuse in and out of the earthworm across its moist skin.

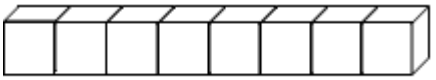
A scientist makes two models **A** and **B** using 1cm^3 blocks.

A is a 2 x 2 x 2 cube and B eight blocks in a line.

A



B (earthworm)

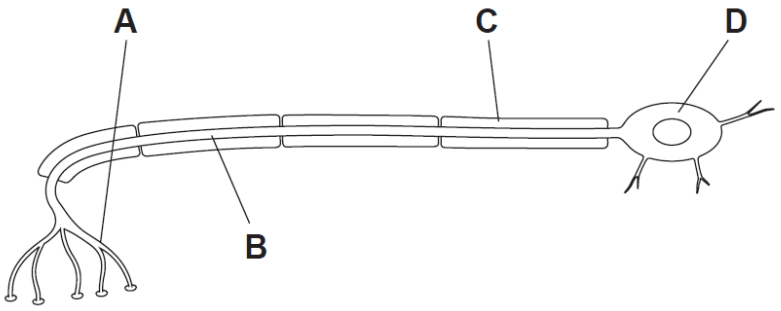


Calculate the values to complete the scientist's results table.

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

[2]

8 (a) The diagram below shows a motor neuron.



Describe the effect on the function of the motor neuron if part C is damaged.

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…… **[1]**

(b) Lucy picks up a hot plate and quickly drops it. This is a reflex action.

Describe the sequence of events that happens in Lucy's nervous system during this reflex action.

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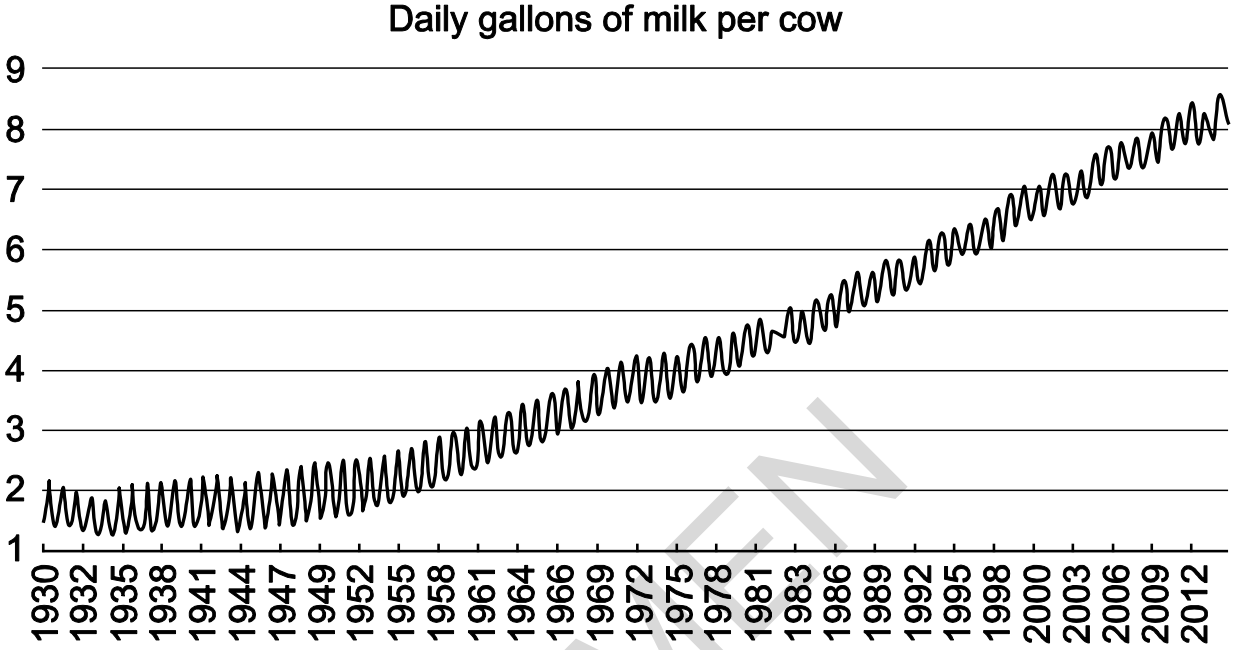
…… **[5]**

9 **(a)** Humans have changed the characteristics of domesticated animals and crop plants by selective breeding.

Look at the graph below.



The graph shows how 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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…… **[4]**

(b) Other ways of improving milk production in cows have been developed over this time period.

State another way of improving milk production that is used by farmers.

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…… **[1]**

10 (a) The human menstrual cycle is controlled by hormones.

Draw a line from each hormone to describe the role of the hormone in the menstrual cycle.

Hormone	Interaction
Oestrogen	Causes the ovaries to develop a follicle containing an egg, which will then produce oestrogen
FSH	Causes the uterus lining to thicken
Progesterone	Causes the follicle to release an egg, the remaining corpus luteum produces progesterone
LH	Maintains the lining of the uterus

[3]

(b) (i) Some data was collected from an IVF clinic.

The table below shows the percentage of IVF treatments that resulted in live births in 2010.

Age of female receiving treatment	Percentage of live births
Under 35	32.2
35 - 37	27.7
38 - 39	20.8
40 - 42	13.6
43 - 44	5

Current guidelines in the UK recommend that women aged 40 and under should be offered 3 rounds of free IVF treatment, those aged 40 to 42 should be offered only one round.

Evaluate the data in the table to suggest why these decisions are made.

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……..……..……..

……..… **[1]**

(ii) In one year, the fertility clinic treated 387 females.

90 of these females were successful and gave birth to live babies.

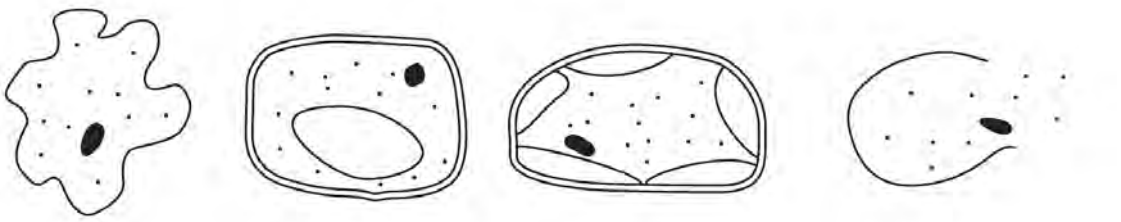
Calculate the percentage of live births.

Show your working.

percentage of live births =……% **[1]**

11 **(a)** Jamie carried out an experiment by putting various animal and plant cells in different solutions.

The diagrams below show the appearance of the four cells down a microscope after one hour.



A **B** **C** **D**

In the table below, write the letter **A**, **B**, **C** or **D** next to the description that best matches the diagram. One has been done for you.

Description	Letter
A plant cell that has been placed in distilled water.	**B**
A plant cell that has been placed in a concentrated sugar solution.	
An animal cell that has been placed in distilled water.	
An animal cell that has been placed in a concentrated sugar solution.	

[3]

(b) Explain, in terms of osmosis, what has happened to cell **B**.

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…… **[2]**

12 A student viewed a large number of cells from an onion root tip under a microscope.

She recorded the number of cells that were in each stage of the cell cycle of mitosis.

The results are shown in the table below.

Stage of mitosis	Number of cells in stage	Cells in stage as percentage of total
Interphase	176	79.7
First stage of division of nucleus	20	9.1
Second stage of division of nucleus	12	5.4
Third stage of division of nucleus	6	2.7
Fourth stage of division of nucleus	7	

(a) Calculate the percentage of cells that were observed in the fourth stage of division of the nucleus.

Show your working.

percentage of cells……% **[2]**

(b) Before the division of the nucleus of a cell by mitosis, the genetic material must replicate.

Explain why this is essential.

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……... **[2]**

(c) The nucleus of a gamete such as a sperm cell is produced by **meiosis**.

During meiosis a cell undergoes two divisions.

Suggest how cells produced by meiosis may differ from those produced by mitosis.

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…….. **[2]**

END OF QUESTION PAPER