

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

---

Forename(s)

---

Candidate signature

---

I declare this is my own work.

# GCSE COMBINED SCIENCE: SYNERGY

# F

Foundation Tier Paper 1 Life and Environmental Sciences

Time allowed: 1 hour 45 minutes

## Materials

For this paper you must have:

- a ruler
- a protractor
- a scientific calculator
- the periodic table (enclosed)
- the Physics Equations Sheet (enclosed).

## Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
<b>TOTAL</b>	

## Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



**0 1**

There are many different types of cell in the human body.

Each type of body cell is specialised for a different function.

**0 1 . 1**

Draw **one** line from each type of cell to the function of that cell.

**[3 marks]****Type of cell**

Gland

Muscle

Neurone

**Function**

To carry impulses

To contract

To produce hormones

To transport oxygen

**Question 1 continues on the next page**

**Turn over ►**

**Figure 1** shows a doctor testing a reflex action of a patient.

**Figure 1**



When the doctor touches the patient's foot with a blunt rod, the patient's toes curl.

**0 1 . 2** Where are the receptors in this reflex action?

**[1 mark]**

Tick (✓) **one** box.

In the brain

In the foot

In the leg



**0 1 . 3** What is the coordinator in this reflex action?

**[1 mark]**

Tick (✓) **one** box.

The blunt rod

The central nervous system

The sensory neurone

**0 1 . 4** What is the response in this reflex action?

**[1 mark]**

Tick (✓) **one** box.

Feeling the blunt rod

The blunt rod touching the skin

The toes curling

**0 1 . 5** Muscle cells use oxygen for respiration.

Explain why muscle cells need to respire.

**[2 marks]**

---

---

---

---

8

Turn over ►



**0 2** Fatty material can build up in coronary arteries.

The flow of blood through coronary arteries may be reduced.

**0 2 . 1** Which organ contains coronary arteries?

[1 mark]

---

**0 2 . 2** There are different treatments for coronary diseases.

Draw **one** line from each treatment to how the treatment works.

[3 marks]

**Treatment**

**How the treatment works**

Replacement valve

Keeps coronary arteries open

Statin

Makes sure blood flows in one direction

Stent

Reduces blood cholesterol concentration

Reduces blood glucose concentration

**0 2 . 3** Some medical drugs can be produced using genetically modified (GM) bacteria.

How are GM bacteria produced?

[1 mark]

Tick (✓) **one** box.

All genes are removed from the bacteria.

Bacteria are grown in a solution of the drug.

Genes are transferred into the bacteria.



**0 2 . 4** What is **one** benefit of producing drugs using GM bacteria?

**[1 mark]**

Tick (✓) **one** box.

Large quantities of the drug can be produced.

Non-GM bacteria live longer than GM bacteria.

The GM bacteria that produce the drug are very infectious.

Scientists are investigating the production of organs from GM animals for transplanting into humans.

**0 2 . 5** What is an advantage of using organs from GM animals compared with using organs from human donors?

**[1 mark]**

Tick (✓) **one** box.

Organs from GM animals are less likely to be rejected by the human immune system.

Organs from GM animals are not likely to function correctly.

There are more human donors than the number of people who need a transplant.

**0 2 . 6** Suggest **one** reason why some people disagree with the use of GM animals.

**[1 mark]**

---



---

8

Turn over ►

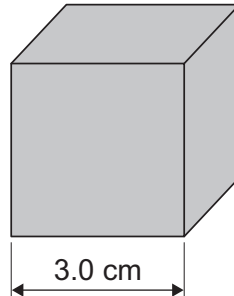


0 3

A student investigated the mass, volume and density of some solid metal cubes.

**Figure 2** shows one of the cubes. The length of one side is shown.

**Figure 2**



0 3 . 1

Name a piece of equipment the student could use to measure the length of one side of the cube.

[1 mark]

---

0 3 . 2

What is the volume of the cube in **Figure 2**?

[1 mark]

Tick (✓) **one** box.

6.0 cm<sup>3</sup>

9.0 cm<sup>3</sup>

27.0 cm<sup>3</sup>

54.0 cm<sup>3</sup>





**0 3 . 3** A different cube has a mass of 13 g.

The volume of this cube is 8.0 cm<sup>3</sup>.

Calculate the density of the cube.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Give your answer to 2 significant figures.

**[3 marks]**

---

---

---

---

---

Density (2 significant figures) = \_\_\_\_\_ g/cm<sup>3</sup>

**Question 3 continues on the next page**

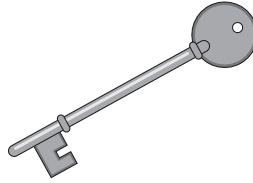
**Turn over ►**



The student also investigated the density of a key.

**Figure 3** shows the key.

**Figure 3**



**0 3 . 4** Which piece of equipment could be used to measure the mass of the key?

**[1 mark]**

Tick (✓) **one** box.

Balance

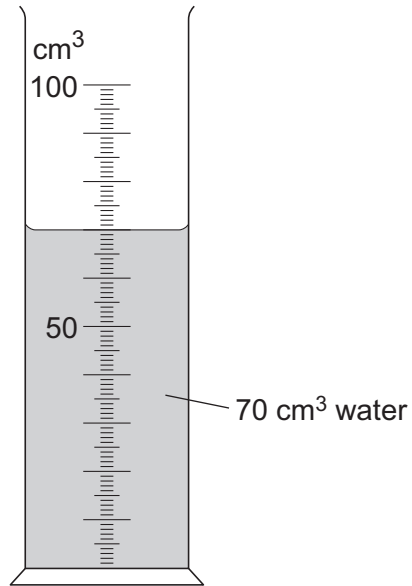
Stopwatch

Thermometer



**0 3 . 5** Figure 4 shows a measuring cylinder containing water.

**Figure 4**



Describe how the equipment in **Figure 4** could be used to measure the volume of the key.

**[2 marks]**

---

---

---

---

8

Turn over ►



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



0 4

Classification of living organisms has changed over time.

0 4 . 1

Complete the sentences about classification.

Choose answers from the box.

[2 marks]

age

appearance

DNA

mass

Traditional classification placed organisms in groups based

on \_\_\_\_\_ .

Modern classification places organisms in groups based

on \_\_\_\_\_ .

Cabbage and cauliflower plants are both the same species, *Brassica oleracea*.

0 4 . 2

What is the genus name of cabbage and cauliflower?

[1 mark]

Tick (✓) **one** box.

*Brassica**Brassica oleracea**Oleracea*

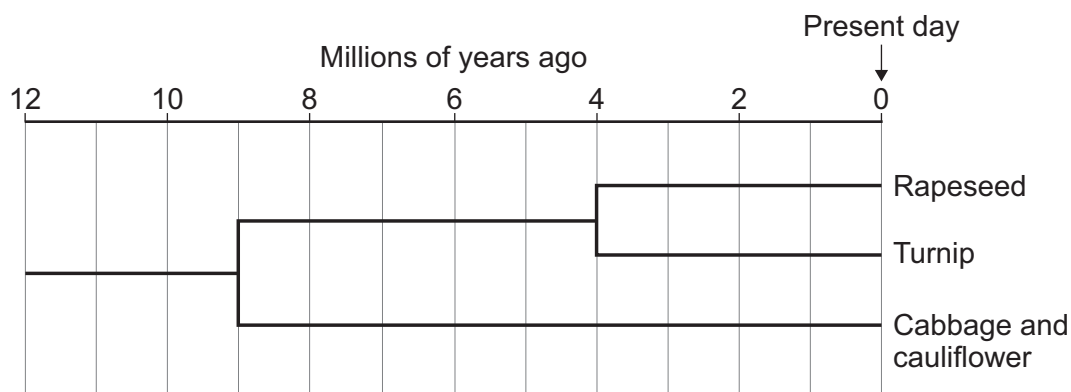
Question 4 continues on the next page

Turn over ►



Figure 5 shows the evolution of some plants.

Figure 5



0 4 . 3 Cabbage and cauliflower evolved into a new species 9 million years ago.

Rapeseed and turnip evolved more recently.

How many million years ago did rapeseed and turnip evolve into two species? **[1 mark]**

\_\_\_\_\_ million years ago

0 4 . 4 Rapeseed is grown to produce rapeseed oil for cooking.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

carbohydrate	lipid	protein
--------------	-------	---------

Rapeseed oil is a type of \_\_\_\_\_.



**0 4 . 5** Farmers have gradually changed *Brassica oleracea* over thousands of years to produce different varieties.

Which process produced the different varieties of *Brassica oleracea*?

**[1 mark]**

Tick (✓) **one** box.

Active transport

Selective breeding

Transpiration

Scientists investigated the genome of cabbage and the genome of cauliflower.

**0 4 . 6** What does genome mean?

**[1 mark]**

Tick (✓) **one** box.

A mutation in the DNA

All of the DNA in an organism

The DNA in one gene

**Question 4 continues on the next page**

**Turn over ►**

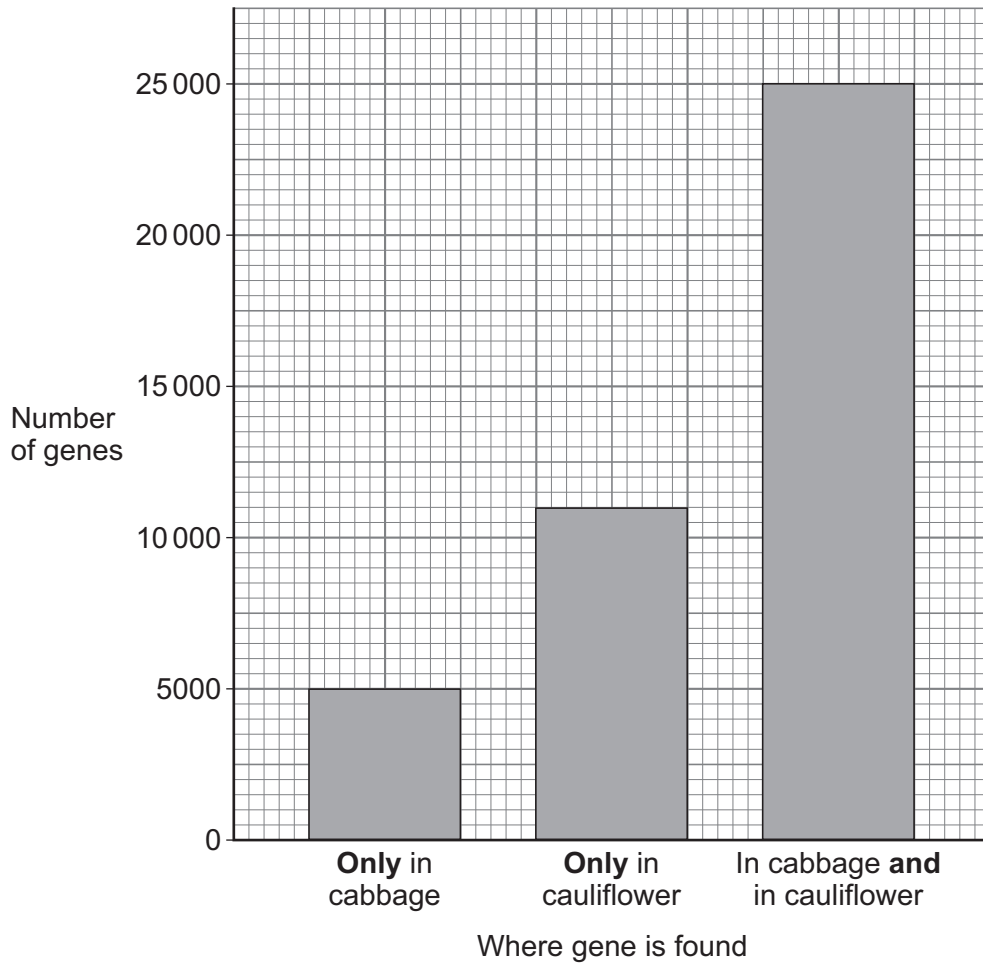


Cabbage and cauliflower have some of the same genes.

**Figure 6** shows the number of genes found:

- **only** in cabbage
- **only** in cauliflower
- in cabbage **and** in cauliflower.

**Figure 6**





**0 4 . 7** Cabbage contains a total of 30 000 genes.

Calculate the percentage of genes in cabbage that are found in both cabbage **and** cauliflower.

Use the equation:

$$\text{percentage} = \frac{\text{number of genes found in cabbage and in cauliflower}}{\text{total number of genes in cabbage}} \times 100$$

**[3 marks]**

---



---



---



---



---

Percentage = \_\_\_\_\_ %

**0 4 . 8** How does **Figure 6** provide evidence that cabbage and cauliflower are closely related?

**[1 mark]**

Tick (✓) **one** box.

Cabbage and cauliflower contain the same number of genes.

More genes are only found in cauliflower than only in cabbage.

Most genes are the same in cabbage and in cauliflower.

**11**

**Turn over ►**



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**



**0 5**

Chlamydia, HIV and human papillomavirus (HPV) are sexually transmitted diseases (STDs).

**0 5 . 1**

Which other disease is sexually transmitted?

**[1 mark]**

Tick (✓) **one** box.

Flu

Gonorrhoea

Malaria

Measles

**Question 5 continues on the next page**

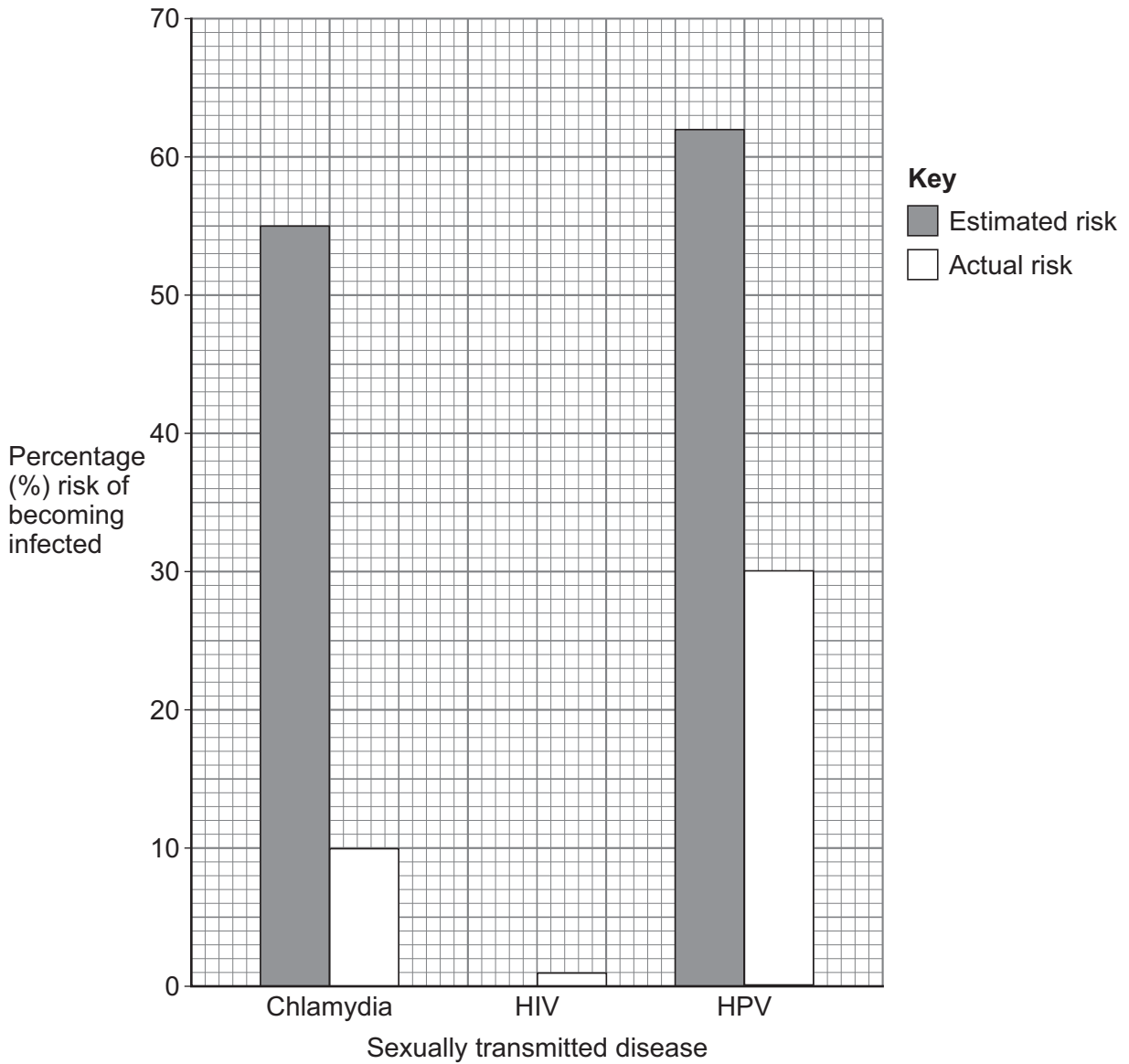
**Turn over ►**

Students were asked to estimate the percentage risk of a person becoming infected with different STDs.

The estimate was compared to the actual percentage risk of infection.

**Figure 7** shows the results.

**Figure 7**



**0 5 . 2** The students estimated that the risk of HIV infection was 60%.

Plot the students' estimated risk of HIV infection on **Figure 7**.

[1 mark]

**0 5 . 3** Which STD in **Figure 7** shows the greatest **actual** risk?

[1 mark]

---

**0 5 . 4** Calculate the difference between the estimated risk and the actual risk of becoming infected with chlamydia.

[2 marks]

---



---



---

Difference = \_\_\_\_\_ %

**0 5 . 5** What conclusion can be made about the estimated risk of infection compared to the actual risk of infection with STDs?

[1 mark]

---



---

**Question 5 continues on the next page**

**Turn over ►**



**0 5 . 6** Name **one** type of contraception that can control the spread of chlamydia.

**[1 mark]**

---

**0 5 . 7** Patients with HPV infections are at increased risk of cancer.

Suggest what effect HPV has on human DNA.

**[1 mark]**

---

---

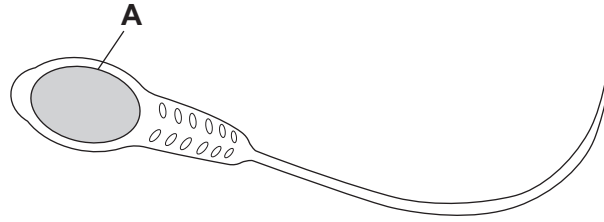
8



0 6

Figure 8 shows a human sperm cell.

Figure 8



0 6 . 1

Cell part **A** contains DNA.Name part **A**.

[1 mark]

---

0 6 . 2

Describe the structure of DNA.

[2 marks]

---



---



---



---

0 6 . 3

Sperm cells are male gametes.

What are female gametes called?

[1 mark]

---

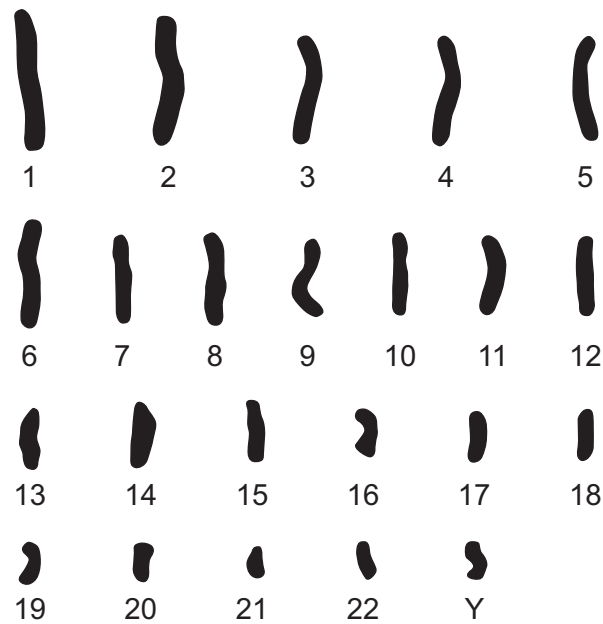
Question 6 continues on the next page

Turn over ►



**Figure 9** shows the chromosomes in a sperm cell.

**Figure 9**



0 6 . 4

Describe **one** difference between the chromosomes in a sperm cell and the chromosomes in a liver cell.

[1 mark]

---



---





0 6 . 5

A sperm with the same chromosomes as those in **Figure 9** fertilises a female gamete.

Explain what sex the offspring would be.

Use information from **Figure 9** in your answer.

**[4 marks]**

---

---

---

---

---

---

---

---

---

---

---

9

Turn over for the next question

Turn over ►



**0 7** This question is about atomic structure.

**0 7 . 1** An atom contains three types of particles.

**Table 1** shows some information about the particles.

**Table 1**

Name of particle	Charge
Electron	-1
Neutron	
Proton	

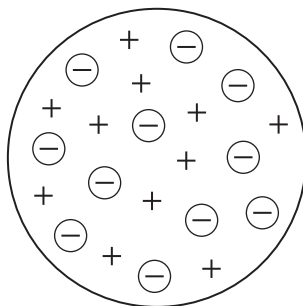
Complete **Table 1**.

**[2 marks]**

**0 7 . 2** Models of the atom have changed over time.

**Figure 10** shows an early model of the atom.

**Figure 10**



What is the name of the model of the atom in **Figure 10**?

**[1 mark]**

Tick (✓) **one** box.

Dalton's model

Nuclear model

Plum pudding model



Alpha particles can be used to investigate the structure of atoms.

**0 7 . 3** Alpha particles have a relative mass of 4.

What is an alpha particle?

**[1 mark]**

Tick (✓) **one** box.

Two electrons and two neutrons

Two neutrons and two protons

Two protons and two electrons

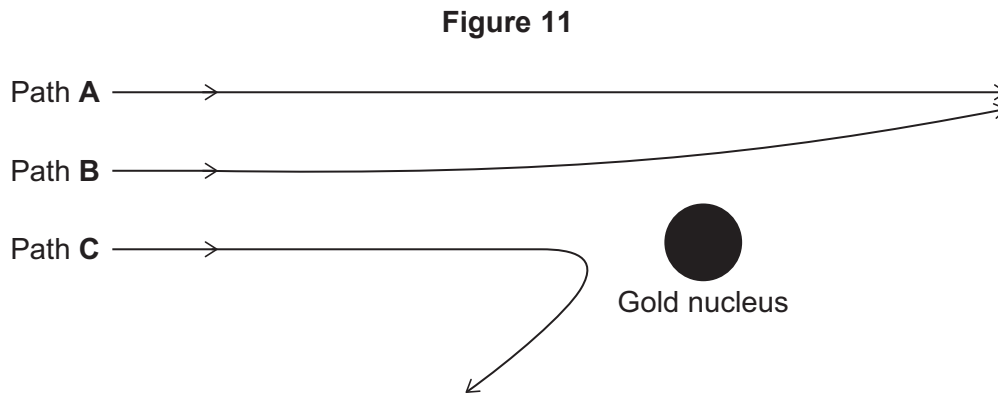
**Question 7 continues on the next page**

**Turn over ►**



Alpha particles from a source were directed at thin gold foil.

**Figure 11** shows some of the paths the alpha particles followed.



**Table 2** shows the number of alpha particles that followed paths **A**, **B** and **C**.

**Table 2**

Path	Number of alpha particles
<b>A</b>	8 289 864
<b>B</b>	7 920
<b>C</b>	198

0 7 . 4

The number of alpha particles on path **A** was greater than the number of alpha particles on path **B**.

Calculate how many times greater.

**[2 marks]**

---



---



---

Number of times greater = \_\_\_\_\_



**0 7 . 5** The ratio of alpha particles on path **B** to alpha particles on path **C** can be shown as:

$$7920 : 198$$

What is 7920 : 198 written as its simplest ratio?

[1 mark]

Tick (✓) **one** box.

40 : 1

500 : 1

8000 : 1

**0 7 . 6** How does **Figure 11** provide evidence for a nucleus in a gold atom?

[1 mark]

Tick (✓) **one** box.

Alpha particles following path **C** are bounced back.

Most alpha particles follow path **A**.

The alpha particles from the source travel in straight lines.

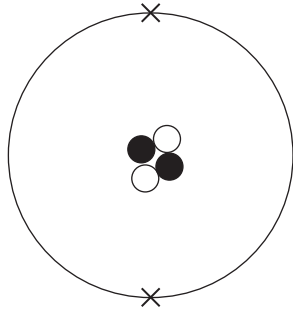
**Question 7 continues on the next page**

Turn over ►

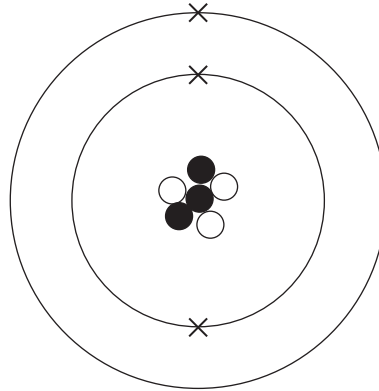


Figure 12 represents four atoms.

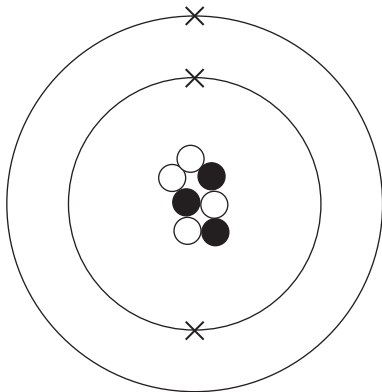
Figure 12



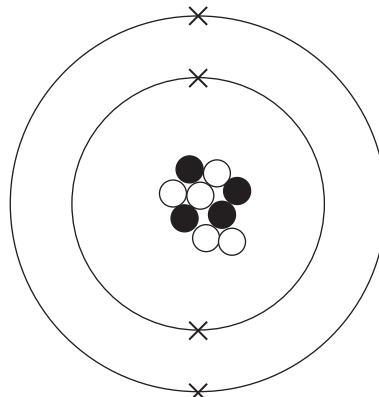
W



X



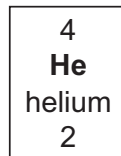
Y



Z



**0 7 . 7** On the periodic table, helium is shown as:



Which atom in **Figure 12** represents an atom of helium?

[1 mark]

Tick (✓) **one** box.

W       X       Y       Z

**0 7 . 8** Which two atoms in **Figure 12** represent isotopes of the same element?

[1 mark]

Tick (✓) **one** box.

W and X

W and Z

X and Y

Y and Z

**0 7 . 9** An atom has a radius of 0.182 nm.

Calculate the radius of the atom in metres.

1 m = 1 000 000 000 nm

[1 mark]

\_\_\_\_\_

\_\_\_\_\_

Radius = \_\_\_\_\_ m

11

Turn over ►



**0 8**

The human immune system responds to pathogens entering the body.

**0 8 . 1**

Which part of the blood is responsible for an immune response?

**[1 mark]**

Tick (✓) **one** box.

Platelets

Red blood cells

White blood cells

**0 8 . 2**

Some pathogens release toxins in the body.

Name the type of substance produced in the body that destroys the toxins.

**[1 mark]**

---

**0 8 . 3**

Cells in the immune system engulf pathogens.

What is the name of this process?

**[1 mark]**

---





Plants release pollen.

**0 8 . 4** The human breathing system has defences against the entry of pollen and pathogens.

Draw **one** line from each adaptation of the breathing system to the description of that adaptation.

**[2 marks]**

**Adaptation**

**Description**

Cilia

A sticky liquid that can trap pollen

Mucus

A type of acid that can destroy pollen

Hair-like structures that can move pollen

**0 8 . 5** The immune response to pollen is an example of an allergy.

Suggest **two** symptoms of an allergy to pollen.

**[2 marks]**

- 1 \_\_\_\_\_  
\_\_\_\_\_
- 2 \_\_\_\_\_  
\_\_\_\_\_

**Question 8 continues on the next page**

**Turn over ►**



**0 8 . 6** An allergy to pollen **cannot** be treated using antibiotics.

Suggest why.

**[1 mark]**

---

---

**0 8 . 7** Explain **one** problem caused by the overuse of antibiotics.

**[2 marks]**

---

---

---

---

---

**10**



0	9
---	---

Ultraviolet, infrared and visible light are part of the electromagnetic spectrum.

0	9	.	1
---	---	---	---

Ultraviolet radiation and infrared radiation are emitted by some objects.

Give **one** use of ultraviolet radiation and **one** use of infrared radiation.

**[2 marks]**

Ultraviolet radiation \_\_\_\_\_

\_\_\_\_\_

Infrared radiation \_\_\_\_\_

\_\_\_\_\_

**Question 9 continues on the next page**

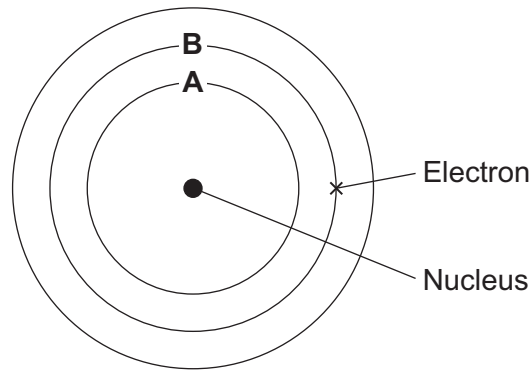
**Turn over ►**



**0 9 . 2** Neon atoms can absorb electromagnetic radiation.

**Figure 13** shows three of the energy levels around the nucleus of a neon atom.

**Figure 13**



The atom in **Figure 13** has absorbed electromagnetic radiation.

What happens as an electron moves from energy level **B** to energy level **A**?

[1 mark]

Tick (✓) **one** box.

Light is absorbed

Light is emitted

Light is reflected



An electromagnetic wave has a speed of 300 000 000 m/s.

**0 9 . 3** What is the speed of the wave in standard form?

[1 mark]

Tick (✓) **one** box.

$3.0 \times 10^7$  m/s

$3.0 \times 10^8$  m/s

$3.0 \times 10^9$  m/s

Use the Physics Equations Sheet to answer questions **09.4** and **09.5**.

**0 9 . 4** Write down the equation that links frequency ( $f$ ), wavelength ( $\lambda$ ) and wave speed ( $v$ ).

[1 mark]

---

**0 9 . 5** The electromagnetic wave has a frequency of 750 000 Hz.

Calculate the wavelength of the electromagnetic wave.

Give the unit.

[4 marks]

---



---



---



---



---



---



---

Wavelength = \_\_\_\_\_ Unit \_\_\_\_\_

9

Turn over ►



1 0

Students investigated the effect of different concentrations of salt solution on the mass of pieces of potato.

This is the method used.

1. Cut three pieces of potato, each with a mass of 2.00 g.
2. Place the pieces of potato into a salt solution with a concentration of 0.2 mol/dm<sup>3</sup>.
3. After 30 minutes, measure the mass of each piece of potato.
4. Calculate the change in mass.
5. Repeat steps 1 to 4 for five other concentrations of salt solution.

**Table 3** shows the results.

**Table 3**

Concentration of salt solution in mol/dm <sup>3</sup>	Change in mass in g			Mean change in mass in g
0.2	0.31	0.34	0.25	0.30
0.4	-0.07	-0.08	-0.13	-0.09
0.6	-0.18	-0.13	-0.11	-0.14
0.8	-0.24	-0.19	-0.17	-0.20
1.0	-0.22	-0.30	-0.32	-0.28
1.2	-0.26	-0.35	-0.32	<b>X</b>



**1 0 . 1** Give **two** control variables the students should have used in the investigation.

Do **not** refer to mass or time in your answer.

**[2 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

**1 0 . 2** Calculate value **X** in **Table 3**.

**[3 marks]**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**X** = \_\_\_\_\_ g

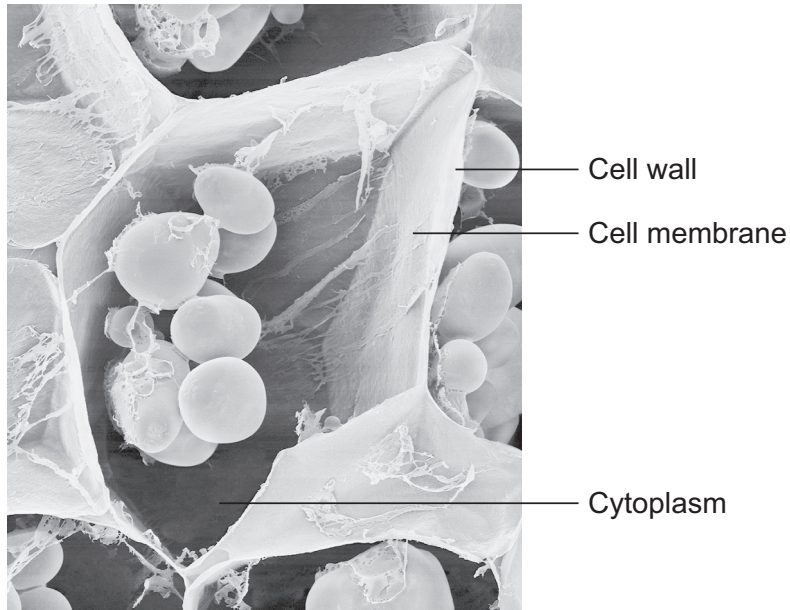
**Question 10 continues on the next page**

**Turn over ►**



Figure 14 shows a potato cell.

Figure 14



1 0 . 3

Explain why the mass of the pieces of potato increased in the 0.2 mol/dm<sup>3</sup> salt solution.

You should refer to the cell parts labelled in **Figure 14**.

[6 marks]

---

---

---

---

---

---

---

---

---

---

---





---



---



---

**1 0 . 4** The image in **Figure 14** was made using an electron microscope and **not** a light microscope.

Give **one** piece of evidence to support this.

[1 mark]

---



---

**1 0 . 5** The potato cell in **Figure 14** contains starch grains.

A starch grain on a different image had a diameter of 1.2 cm.

The starch grain had a real diameter of 0.008 mm.

Calculate the magnification of the image.

[3 marks]

---



---



---



---



---

Magnification =  $\times$  \_\_\_\_\_

**Question 10 continues on the next page**

**Turn over ►**



Starch is digested in the gut.

1 0 . 6 Why is digestion of starch needed?

[1 mark]

Tick (✓) **one** box.

Starch is a carbohydrate.

Starch molecules are insoluble.

Starch molecules are small.

1 0 . 7 Describe the process of starch digestion.

[2 marks]

---

---

---

---

18

END OF QUESTIONS



**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**











**There are no questions printed on this page**

*Do not write  
outside the  
box*

**DO NOT WRITE ON THIS PAGE  
ANSWER IN THE SPACES PROVIDED**

**Copyright information**

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from [www.aqa.org.uk](http://www.aqa.org.uk).

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2022 AQA and its licensors. All rights reserved.



4 8



2 2 6 G 8 4 6 5 / 1 F

G/Jun22/8465/1F