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

H

Higher 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	
TOTAL	

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.

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There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 1 Ultraviolet, infrared and visible light are part of the electromagnetic spectrum.

0 1 . 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 _____

_____

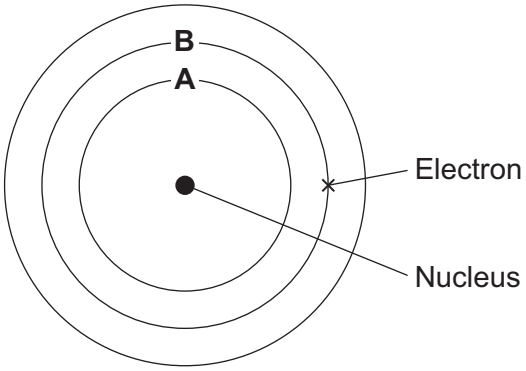
Question 1 continues on the next page

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0 1 . 2 Neon atoms can absorb electromagnetic radiation.

Figure 1 shows three of the energy levels around the nucleus of a neon atom.

Figure 1



The atom in **Figure 1** 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 ☐

Do not write outside the box

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

0 1 . 3 What is the speed of the wave in standard form?

[1 mark]

Tick (✓) **one** box.

3.0×10^7 m/s ☐

3.0×10^8 m/s ☐

3.0×10^9 m/s ☐

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

_____

0 1 . 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

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0 2 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^3.
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 1 shows the results.

Table 1

Concentration of salt solution in mol/dm^3	**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	**X**

Do not write outside the box

0 2 . 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 _____

_____

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

[3 marks]

_____

_____

_____

_____

_____

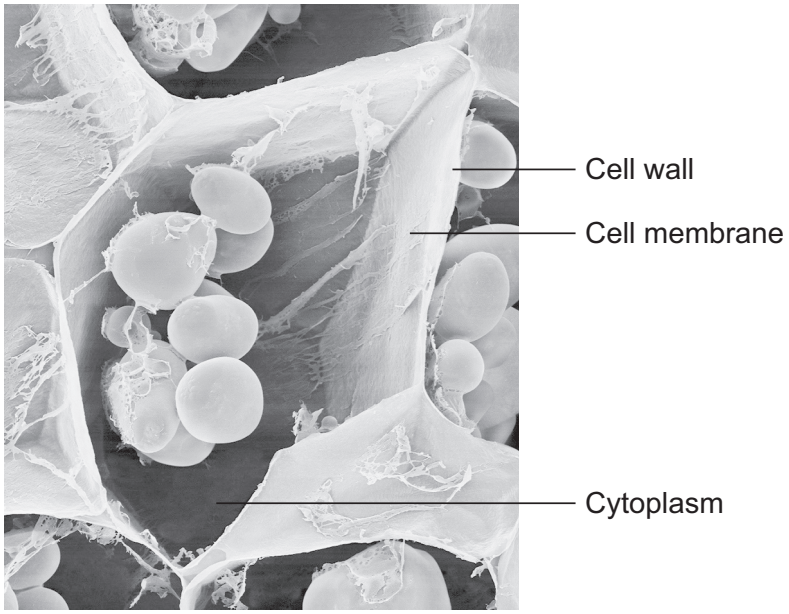
X = _____ g

Question 2 continues on the next page

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Figure 2 shows a potato cell.

Figure 2



0 2 . 3 Explain why the mass of the pieces of potato increased in the 0.2 mol/dm^3 salt solution.

You should refer to the cell parts labelled in **Figure 2**.

[6 marks]

Do not write outside the box

0 2 . 4 The image in **Figure 2** was made using an electron microscope and **not** a light microscope.

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

[1 mark]

0 2 . 5 The potato cell in **Figure 2** 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 = × _____

Question 2 continues on the next page

Do not write outside the box

Starch is digested in the gut.

0 2 . 6 Why is digestion of starch needed?

[1 mark]

Tick (✓) **one** box.

Starch is a carbohydrate. ☐

Starch molecules are insoluble. ☐

Starch molecules are small. ☐

0 2 . 7 Describe the process of starch digestion.

[2 marks]

_____

_____

_____

_____

18

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Turn over for the next question

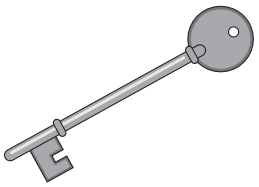
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ANSWER IN THE SPACES PROVIDED

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0 3 Keys are usually made from metal.

Figure 3 shows a metal key.

Figure 3



0 3 . 1 Describe a method to determine the density of the metal the key is made from.

You should include the measuring instruments you would use.

Use the Physics Equations Sheet.

[4 marks]

Do not write outside the box

0 3 . 2 A manufacturer of keys buys metal as small solid cubes.

A solid metal cube has a density of 2.70×10^3 kg/m^3.

The cube has a mass of 0.0216 kg.

Calculate the surface area of the cube.

Use the Physics Equations Sheet.

[5 marks]

Surface area = _____ m^2

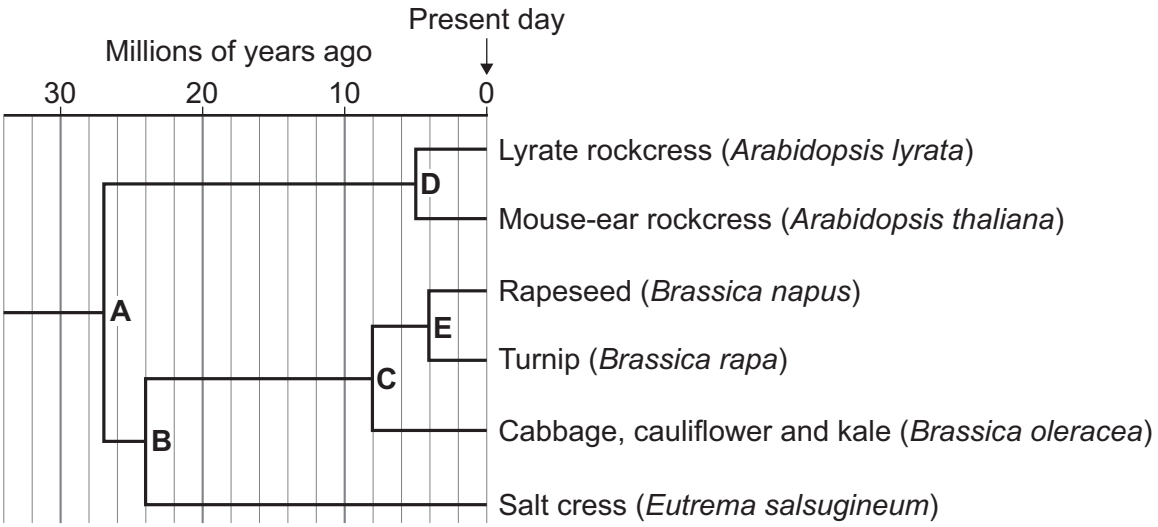
9

Turn over for the next question

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0 4 **Figure 4** shows the evolution of some plants.

Figure 4



A, **B**, **C**, **D** and **E** show when one species evolved into two species.

Use **Figure 4** to answer Questions **04.1** to **04.3**.

0 4 . 1 Give the genus name of salt cress.

[1 mark]

_____

0 4 . 2 Cabbage, cauliflower and kale are all varieties of one species, *Brassica oleracea*.

How many years ago did rapeseed evolve to become a different species from cabbage, cauliflower and kale?

[1 mark]

_____ million years ago

0 4 . 3 Give the **binomial** names of **two** species that evolved 5 million years ago.

[1 mark]

1 _____

2 _____

Do not write outside the box

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

Describe how a sample of rapeseed oil could be tested to show it contains lipid.

[2 marks]

Test _____

_____

Positive result for lipid _____

0 4 . 5 It has taken thousands of years for farmers to produce the different varieties of *Brassica oleracea*.

Describe how farmers have been able to produce the different varieties of *Brassica oleracea*.

[3 marks]

_____

_____

_____

_____

_____

_____

0 4 . 6 Describe how scientists can prove that cabbage and cauliflower plants are the same species.

Do **not** refer to DNA analysis in your answer.

[2 marks]

_____

_____

_____

_____

Question 4 continues on the next page

Do not write outside the box

Scientists investigated the genomes of three varieties of *Brassica oleracea*.

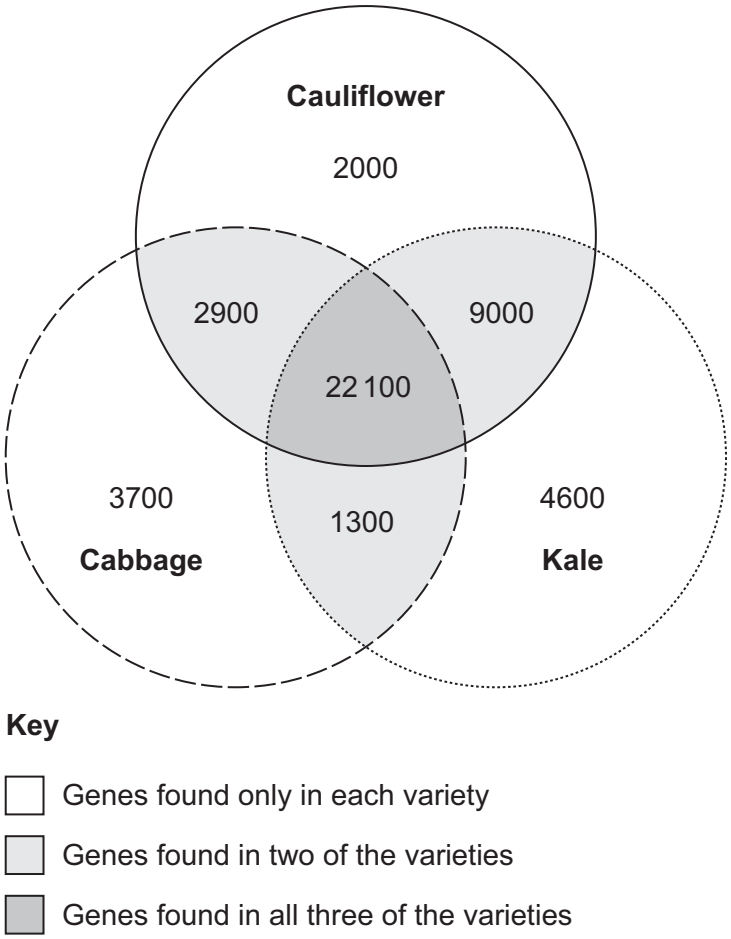
0 4 . 7 What is meant by 'genome'?

[1 mark]

Figure 5 shows the number of genes in *Brassica oleracea* that are:

- found only in each variety
- found in two of the varieties
- found in all three of the varieties.

Figure 5



Do not write outside the box

0 4 . 8 How does **Figure 5** show that cauliflower and kale are more closely related than cauliflower and cabbage?

[1 mark]

_____

_____

0 4 . 9 Calculate the percentage of the total number of genes in cauliflower that are in kale, but **not** in cabbage.

[2 marks]

_____

_____

_____

_____

Percentage = _____ %

14

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 5 The atomic model has changed over time.

0 5 . 1 Alpha particles have been used to investigate the atomic model.

Describe the structure of an alpha particle.

[1 mark]

_____

_____

0 5 . 2 An atom has a radius of 0.182 nm.

1 m = 1 000 000 000 nm

What is the radius of the atom in metres?

[1 mark]

Tick (✓) **one** box.

1.82×10^{9} m ☐

1.82×10^{10} m ☐

1.82×10^{-9} m ☐

1.82×10^{-10} m ☐

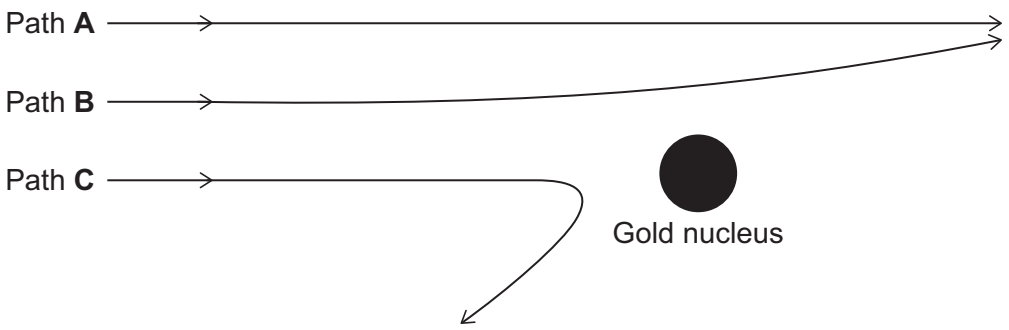
Question 5 continues on the next page

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

Figure 6 shows some of the paths the alpha particles followed.

Figure 6



During one experiment the number of alpha particles following different paths was recorded.

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

Table 2

Path	Number of alpha particles
A	8 289 864
B	7 920
C	198

Do not write outside the box

0 5 . 3 Determine the simplest ratio of alpha particles following paths **A**, **B** and **C**.

[2 marks]

Simplest ratio of **A : B : C** = _____ : _____ : 1

0 5 . 4 Explain how the results provide evidence for the nuclear model of the atom.

Use **Figure 6** and **Table 2**.

[4 marks]

Question 5 continues on the next page

Do not write outside the box

An atom of boron can be represented as $^{11}_{5}B$

An atom of carbon can be represented as $^{12}_{6}C$

0 5 . 5 Compare the number of sub-atomic particles in the atom of boron and in the atom of carbon.

[2 marks]

0 5 . 6 Boron and carbon both have isotopes.

What does 'isotope' mean?

[1 mark]

11

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0 6 Organisms have been genetically modified (GM) for many reasons.

0 6 . 1 What has been genetically modified to produce a hormone that reduces blood glucose concentration?

[1 mark]

Tick (✓) **one** box.

Algae ☐

Bacteria ☐

Viruses ☐

Scientists are researching the production of GM pigs.

Organs from GM pigs could be transplanted into humans.

0 6 . 2 What is **one** advantage of using organs from GM pigs instead of using organs from human donors?

[1 mark]

_____

_____

0 6 . 3 Describe how a human gene could be used to genetically modify a pig embryo.

[2 marks]

_____

_____

_____

_____

Question 6 continues on the next page

Do not write outside the box

Farmers produce cotton from cotton plants.

Figure 7 shows a cotton plant.

Figure 7



Insects feed on cotton plants.

Cotton plants have been genetically modified to produce a pesticide that kills insects.

0 6 . 4 Give **one** advantage to a farmer of growing cotton plants that are able to kill insects.

[1 mark]

Do not write outside the box

Bollworms are insects that eat cotton plants.

Most bollworms are killed if they eat the GM cotton.

Some bollworms have a gene that allows the bollworm to eat GM cotton and survive.

- The allele for being killed by eating GM cotton is dominant.
- The allele for being able to eat GM cotton and survive is recessive.

0 6 . 5 Two bollworms mate. Both bollworms would be killed by eating GM cotton.

80 offspring are produced.

Some offspring are able to eat GM cotton and survive.

Predict how many of the 80 offspring are likely to be able to eat GM cotton and survive.

You should:

- draw a Punnett square diagram
- identify the genotypes of the two parent bollworms
- identify the phenotype of each offspring genotype
- use the symbols: **B** = dominant allele
  b = recessive allele

[5 marks]

Predicted number of offspring that will be able to eat GM cotton and survive = _____

Turn over ▶

Do not write outside the box

0 6 . 6 The allele in bollworms for being able to eat GM cotton and survive is recessive.

A bollworm may evolve that has a new dominant allele that allows the bollworm to eat GM cotton and survive.

Explain how a **new dominant allele** emerging would cause a greater problem than the recessive allele that already exists.

[4 marks]

14

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0 7 This question is about health.

0 7 . 1 Some pathogens cause food poisoning.

Explain how the stomach is adapted to prevent food poisoning.

[2 marks]

_____

_____

_____

_____

0 7 . 2 Different types of disease may interact.

Suggest **one** type of disease that may be triggered by infection with human papillomavirus (HPV).

[1 mark]

_____

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

0 7 . 3 Chlamydia is caused by the same type of microorganism as gonorrhoea.

Suggest how chlamydia infections are treated.

[1 mark]

_____

0 7 . 4 One symptom of chlamydia infection is damage of the uterus lining.

Which **two** hormones are involved in maintaining the uterus lining?

[2 marks]

1 _____

2 _____

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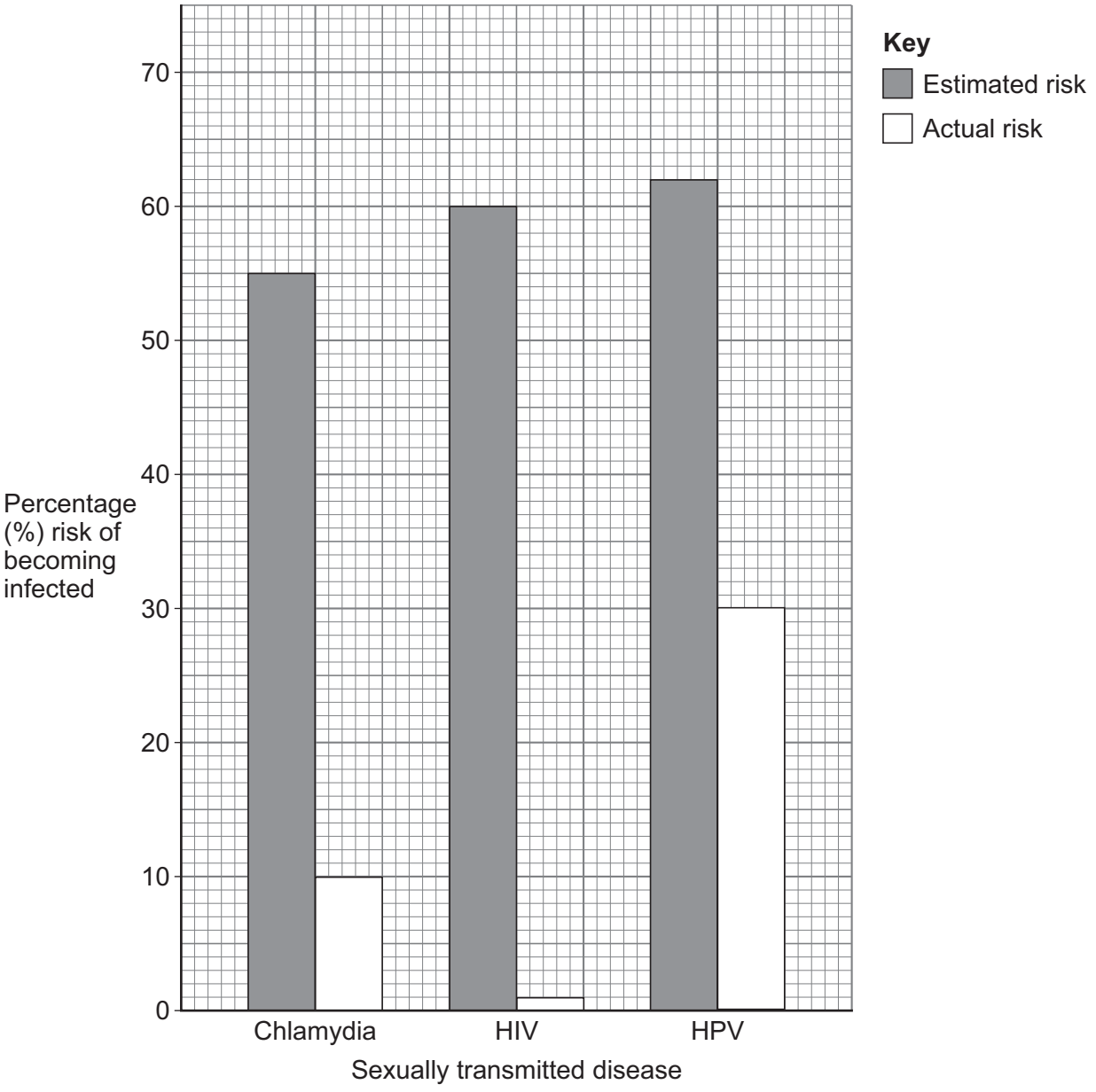
Students were asked to estimate the percentage risk of a person becoming infected with different STDs.

`

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

Figure 8 shows the results.

Figure 8



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0 7 . 5 Why is the data in **Figure 8** plotted as a bar chart and **not** as a line graph?

[1 mark]

0 7 . 6 The difference between the estimated risk and the actual risk is **not** the same for each STD.

Suggest **two** reasons why.

[2 marks]

1

2

0 7 . 7 Explain how only some types of contraception reduce the spread of STDs.

[2 marks]

Question 7 continues on the next page

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0 7 . 8 Explain why patients with late-stage HIV infection or AIDS are likely to become very ill from other infections.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

15

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 8 It is important to keep our feet healthy.

0 8 . 1 **Figure 9** shows a doctor testing a reflex action of a patient.

Figure 9



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

Describe the pathway of this reflex action.

[6 marks]

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0 8 . 2 Sometimes runners tie their shoelaces too tightly.

Tight shoes can cause muscle pain part-way through a long run.

Explain why the muscle pain starts part-way through the run.

[4 marks]

10

END OF QUESTIONS

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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