Oxford Cambridge and RSA

# Monday 16 June 2025 – Morning

## GCSE (9–1) Physics A (Gateway Science)

**J249/02** (Foundation Tier)

**Time allowed: 1 hour 45 minutes**

**You must have:**
- a ruler (cm/mm)
- the Equation Sheet for GCSE (9–1) Physics A (inside this document)

**You can use:**
- a scientific or graphical calculator
- an HB pencil

F

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

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

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 **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **28** pages.

**ADVICE**
- Read each question carefully before you start your answer.

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## Section A

You should spend a **maximum** of **30 minutes** on this section.

Write your answer to each question in the box provided.

**1** Which statement describes how the Sun was formed?

**A** By the electromagnetic attraction of dust and gas

**B** By the gravitational attraction of dust and gas

**C** By the heating of gas in a large cloud of dust and gas

**D** By the nuclear fission of gas in a large cloud of dust and gas

Your answer ☐ **[1]**

**2** A hot drink is poured into a mug.

Which method would **not** help to keep the drink hot?

**A** Use a lid on the mug.

**B** Use a mug with a larger surface area.

**C** Use a mug with thicker sides.

**D** Wrap the mug with an insulating material.

Your answer ☐ **[1]**

**3** Which row explains how energy moves from object **X** to object **Y** by an **electromagnetic wave**?

| | **Object X** | **Electromagnetic wave** | **Object Y** |
|---|---|---|---|
| **A** | absorbs energy | emits energy | transfers energy |
| **B** | absorbs energy | transfers energy | emits energy |
| **C** | emits energy | absorbs energy | transfers energy |
| **D** | emits energy | transfers energy | absorbs energy |

Your answer ☐ **[1]**

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**4** A ball is lifted vertically from a height of 1.6 m to a height of 2.0 m.

The force used to lift the ball is 3.0 N.

What is the **work done** on the ball?

Use the equation: work done = force × distance

**A** 1.2 J

**B** 3.2 J

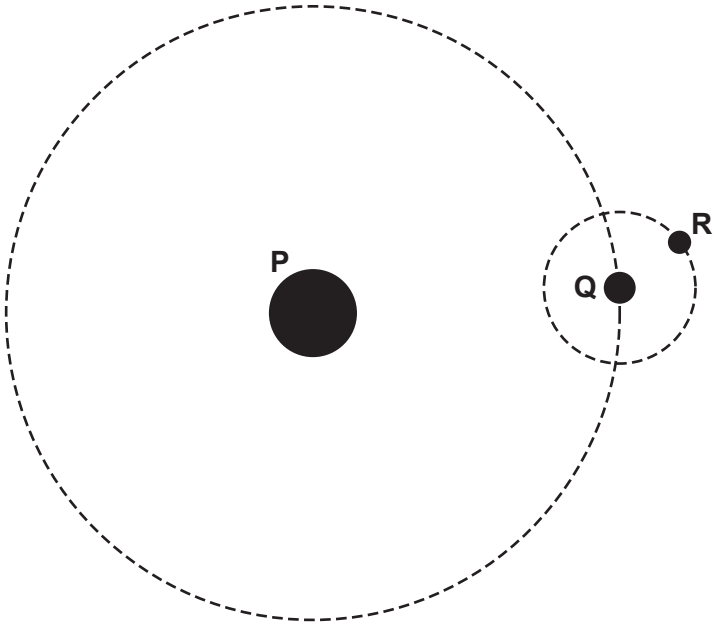
**C** 4.8 J

**D** 6.0 J

Your answer ☐ **[1]**

**5** The diagram shows a model of the Sun, the Earth and the Moon.

The dashed lines show the orbits of object **Q** and object **R**.




**Not to scale**

Which row identifies each object?

| | Object P | Object Q | Object R |
|---|---|---|---|
| **A** | the Earth | the Moon | the Sun |
| **B** | the Moon | the Earth | the Sun |
| **C** | the Sun | the Earth | the Moon |
| **D** | the Sun | the Moon | the Earth |

Your answer ☐ **[1]**

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**6** The isotope aluminium-27 has the symbol $^{27}_{13}Al$.

How many **neutrons** are in a nucleus of aluminium-27?

**A** 13

**B** 14

**C** 27

**D** 40

Your answer ☐ **[1]**

**7** What is the function of the **earth wire** in an electrical device?

**A** To complete the circuit

**B** To melt if the current is too high due to a fault

**C** To provide a low resistance path for the current if there is a fault

**D** To provide power to the device

Your answer ☐ **[1]**

**8** Which material will gamma radiation **not** easily penetrate?

**A** A sheet of paper

**B** A thick block of lead

**C** A thin sheet of aluminium

**D** Human skin

Your answer ☐ **[1]**

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**9** Redshift provides evidence for the Big-Bang model of the universe.

Which statement describes redshift of light from a galaxy that is moving away from the Earth?

**A** The observed speed of light on the Earth is greater than the speed of light emitted by the galaxy.

**B** The observed speed of light on the Earth is smaller than the speed of light emitted by the galaxy.

**C** The observed wavelength of light on the Earth is greater than the wavelength of light emitted by the galaxy.

**D** The observed wavelength of light on the Earth is smaller than the wavelength of light emitted by the galaxy.

Your answer ☐ **[1]**

**10** The table shows the speed of a person walking and the speed of an aeroplane flying.

| **Object** | **Speed (m / s)** |
|---|---|
| Aeroplane | 150 |
| Person | 1.5 |

What is the ratio of aeroplane's speed : person's speed?

**A** 1 : 10

**B** 1 : 100

**C** 10 : 1

**D** 100 : 1

Your answer ☐ **[1]**

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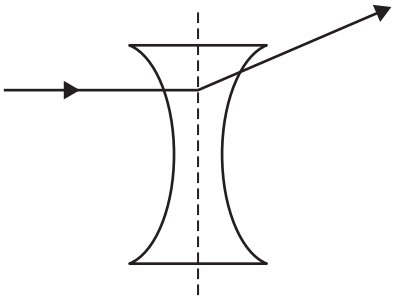
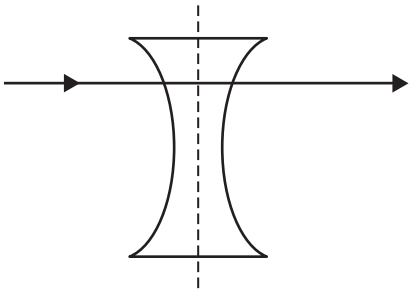
**11** Which diagram shows a ray of light passing through a **concave** lens?

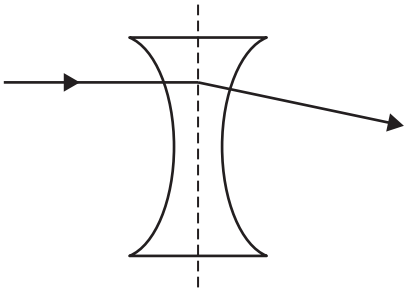
**A**



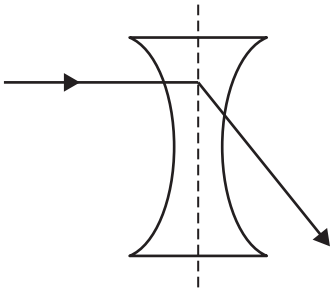
**B**



**C**



**D**



Your answer ☐ **[1]**

**12** Which value is a typical acceleration of a family car?

**A** $2.5\,m/s^2$

**B** $25\,m/s^2$

**C** $250\,m/s^2$

**D** $2500\,m/s^2$

Your answer ☐ **[1]**

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**13** A league is an old unit of distance.

One league is approximately equal to 4800 m.

What is 4 leagues in metres?

**A** $1.92 \times 10^2$ m

**B** $1.92 \times 10^3$ m

**C** $1.92 \times 10^4$ m

**D** $1.92 \times 10^5$ m

Your answer ☐ **[1]**

**14** An electromagnetic wave travels in a vacuum.

A second electromagnetic wave travelling in a vacuum has a smaller wavelength.

Which row describes how the frequency and velocity of the second electromagnetic wave compares with the frequency and velocity of the original wave?

| | **Frequency** | **Velocity** |
|---|---|---|
| **A** | larger | equal |
| **B** | larger | larger |
| **C** | smaller | equal |
| **D** | smaller | larger |

Your answer ☐ **[1]**

**15** A sound wave travels from air to water. The speed of the sound wave is directly proportional to its wavelength.

The wavelength of the sound wave in air is 80 cm.

The speed of the sound wave increases by a factor of 4 when it enters the water.

What is the wavelength of the sound wave in the water?

**A** 20 cm

**B** 40 cm

**C** 160 cm

**D** 320 cm

Your answer ☐ **[1]**

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## Section B

**16** Energy sources are used to generate electricity.

**(a)** The list shows some energy sources.

| | | | |
|---|---|---|---|
| **coal** | **hydroelectric** | | **nuclear** |
| **oil** | **solar** | **tidal** | **wind** |

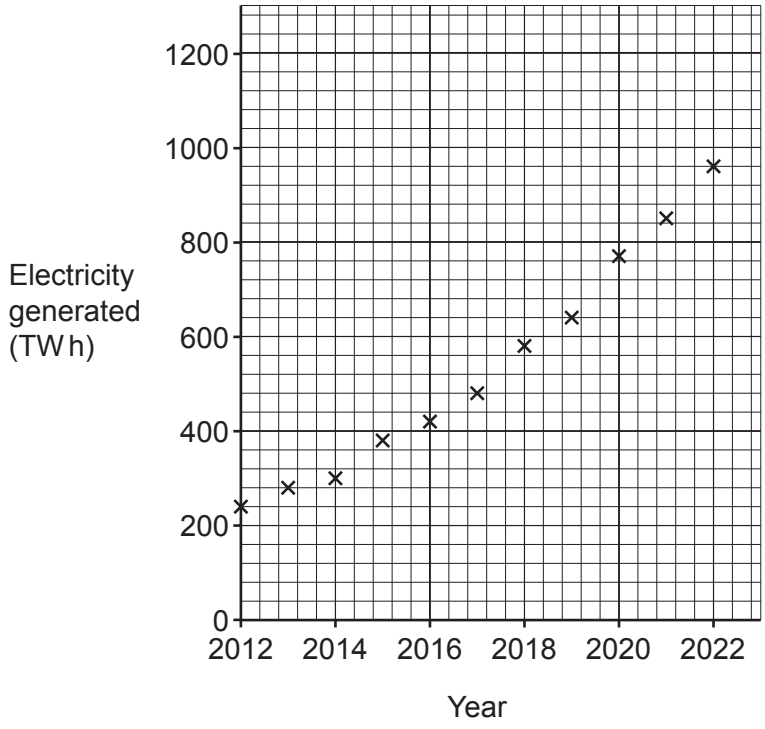
**(i)** Write down the name of **one renewable** energy source from the list.

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

**(ii)** Write down the name of **one non-renewable** energy source from the list.

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

**(b)** The graph shows the electricity generated by some renewable energy sources in the UK between 2012 and 2022.




**(i)** Draw a curve of best fit on the graph.

**[1]**

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**(ii)** Describe how the electricity generated by these renewable energy sources has changed between 2012 and 2022.

.....

.....

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

**(iii)** Give **two** reasons why it is important that the trend shown on the graph continues.

1 .....

.....

2 .....

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

**(iv)** Calculate the change in the electricity generated between 2012 and 2022.

Use the graph.

Change in electricity generated = ..... TW h **[3]**

**(v)** Calculate the average change in the electricity generated by these renewable energy sources **per year** between 2012 and 2022.

Average change per year = ..... TW h / year **[2]**

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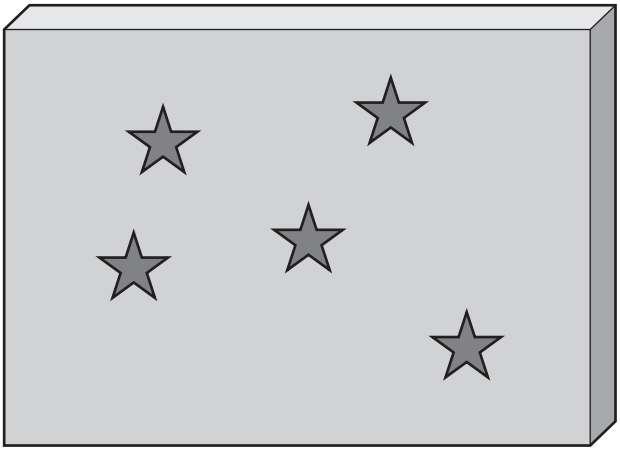
**17** The diagram shows star shaped stickers attached to a wall.

The stickers can sometimes be seen in the dark because they emit electromagnetic waves and glow.



**(a)** Which region of the electromagnetic spectrum is emitted by the stickers so they can be seen in the dark?

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

**(b)** A student thinks the stars look green when they glow.

Green light has a wavelength of $5.3 \times 10^{-7}$ m and a speed of $3.0 \times 10^{8}$ m/s.

Calculate the frequency of green light.

Use the equation: wave speed = frequency × wavelength

Frequency = ..... Hz **[3]**

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**(c)** The student observes that the stickers only glow in the dark after being exposed to light for a few hours.

Complete the sentences to explain the student's observation.

Use words from the list.

| | | | | | |
|---|---|---|---|---|---|
| **absorb** | **emit** | **higher** | **lower** | **reflect** | **refract** |

When light shines onto a sticker, atoms in the sticker ..... energy from the light.

When this happens, the electrons in the atoms move to a ..... energy level.

After some time, the electrons will move back to a ..... energy level.

When this happens, the electrons ..... green light.

**[3]**

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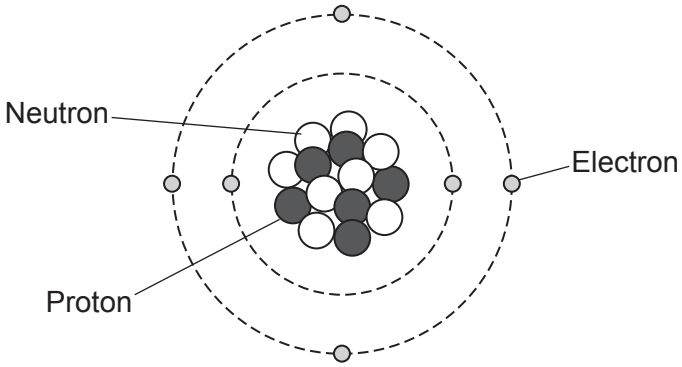
**18** The diagram shows a radioactive atom of carbon-14.




**(a)** The carbon-14 atom has 6 protons and 8 neutrons in its nucleus.

Carbon-12 is a different isotope of carbon.

State **one** similarity and **one** difference between an atom of carbon-14 and an atom of carbon-12.

Similarity .....

.....

Difference .....

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

**(b)** An atom of carbon-14 decays by emitting a negatively charged beta particle from the nucleus.

Describe the effect this has on the mass number and on the charge of the nucleus.

Mass number .....

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

**(c)** Technicians store carbon-14 as a gas in sealed metal containers.

**(i)** Explain how the sealed metal containers prevent the technicians from being **irradiated** by beta particles emitted from carbon-14.

.....

.....

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

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**(ii)** Explain how the sealed metal containers prevent the technicians from being **contaminated** by carbon-14.

.....

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

**(iii)** The technicians check the safety of the containers by measuring the count rate next to the container. The count rate is the number of counts of radiation per minute.

State the name of **two** pieces of equipment the technicians use to measure the count rate.

1 .....

2 .....

**[2]**

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**19** X-rays and infrared radiation are involved in the scanning of patients in hospitals.

**(a)** A radiographer uses X-rays to scan the inside of a patient's body.

**(i)** Describe **one** hazardous effect of X-rays on human tissue.

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

**(ii)** The radiographer stands behind a lead barrier while doing the scan.

Explain how the barrier will protect the radiographer.

.....

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

**(b)** A hospital technician scans the infrared radiation emitted by a patient.

The technician:
- measures the peak wavelength of infrared radiation emitted by the patient
- repeats the measurement 3 times and records the results in **Table 19.1**.

**Table 19.1**

| Measurement | Peak wavelength (μm) |
|---|---|
| 1 | 9.36 |
| 2 | 9.42 |
| 3 | 9.40 |

**(i)** Calculate the mean peak wavelength using the data in **Table 19.1**.

Give your answer in **standard form** in **metres**.

Mean peak wavelength = ..... m **[2]**

**(ii)** Give **one** reason why the technician repeats the measurements.

.....

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

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**(iii)** The technician scans a different patient and records the results as shown in **Table 19.2**.

**Table 19.2**

| Measurement | Peak wavelength (μm) |
|---|---|
| 1 | 9.43 |
| 2 | 9.41 |
| 3 | 8.25 |

What should the technician do with measurement 3 before calculating the mean peak wavelength in **Table 19.2**?

Explain your answer.

.....

.....

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

**(c)** Describe **one** other practical use of infrared radiation.

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

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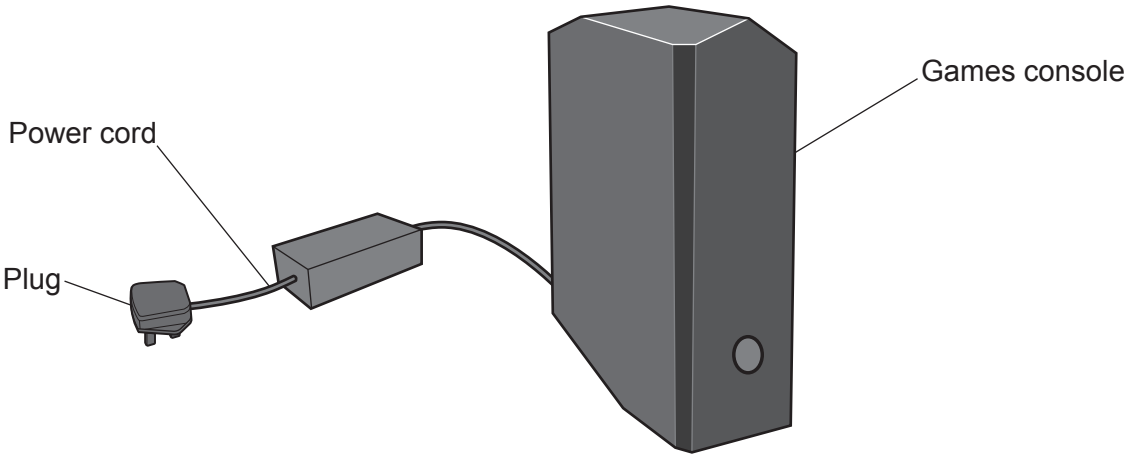
**20** The diagram shows a games console.

A games console is an electrical device used to play computer games.




**(a)** The games console is connected to the mains supply and switched on.

Describe how energy is **transferred** through the power cord to the games console.

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

**(b)**
**(i)** The games console uses $4.2 \times 10^5$ J of energy per hour when a student is playing on it.

The actual energy input to the games console in one hour is $5.2 \times 10^5$ J.

Calculate the energy **wasted** by the games console in one hour of playing.

Energy wasted = ..... J **[2]**

**(ii)** Explain why some energy is wasted when the student is playing on the games console.

.....

.....

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

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**(iii)** Calculate the efficiency of the game console.

Use the equation: efficiency = $\frac{\text{useful output energy transfer}}{\text{input energy transfer}}$

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

Efficiency = ..... **[3]**

**(c)** The games console has a transformer built into the power cord.

The transformer needs to decrease the potential difference of the mains supply from 230 V to 12.1 V.

**(i)** State the type of transformer used in the games console.

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

**(ii)** The current in the primary coil of the transformer is 0.51 A.

Calculate the current in the secondary coil of the transformer.

Assume the transformer is 100% efficient.

Use the Equation Sheet.

Current in secondary coil = ..... A **[3]**

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**21** A nuclear power station uses fission to produce electricity.

**(a)** The total power output of the nuclear power station is 1.0 GW.

The average power output of **one** fission reaction is $3.2 \times 10^{-11}$ W.

Calculate the number of fission reactions that occur per second.

Use the equation:

$$\text{number of fission reactions per second} = \frac{\text{total power output}}{\text{average power output per fission reaction}}$$

Number of fission reactions per second = ..... **[3]**

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**(b)*** Scientists think that nuclear **fusion** would be a better energy source than nuclear **fission**.

The table gives information about nuclear fission power stations and nuclear fusion power stations.

| **Type of power station** | **Fuel used** | **Average power output from power station (GW)** | **Where fuel is obtained from** | **Waste products** |
|---|---|---|---|---|
| Nuclear fission | uranium | 1.0 | mined from underground | very radioactive with long half life |
| Nuclear fusion | hydrogen | more than 1.0 (predicted) | extracted from water | slightly radioactive with short half life |

Explain why scientists think that nuclear **fusion** would be a better energy source than nuclear **fission**.

In your answer, write about

- differences between a fission reaction and a fusion reaction
- the benefits of nuclear fusion using the information in the table.

.....

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..... **[6]**

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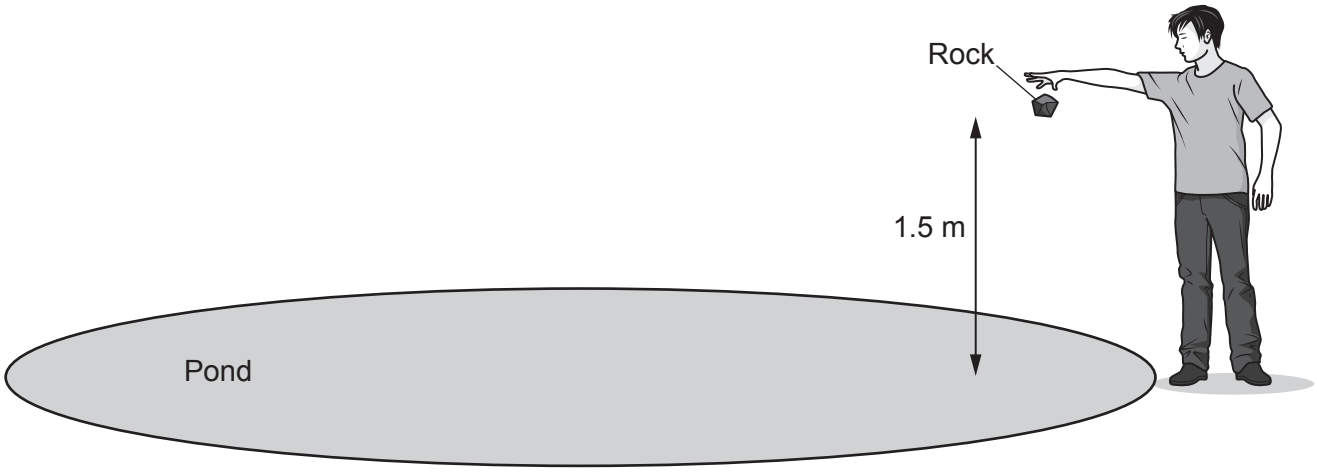
**22** A student drops a rock into a pond from a height of 1.5 m.




**(a)** When the rock hits the water, it makes a sound. At the same time ripples form on the surface of the water.

The sound and the ripples are different types of waves.

Complete the table to describe the two waves.

| | **Type of wave** | **Direction of particle vibration** |
|---|---|---|
| Sound | ..... | Particles vibrate ..... to wave direction |
| Water ripples | ..... | Particles vibrate ..... to wave direction |

**[4]**

**(b)** The student drops an identical rock from a height of 2.0 m.

The student notices that the ripples produced by this rock have a larger amplitude than the ripples produced by the first rock.

**(i)** Explain why the rock dropped from a greater height produces ripples with a larger amplitude.

.....

.....

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

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**(ii)** Describe how the student uses a metre ruler and a stop clock to determine the speed of the ripples.

.....

.....

.....

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

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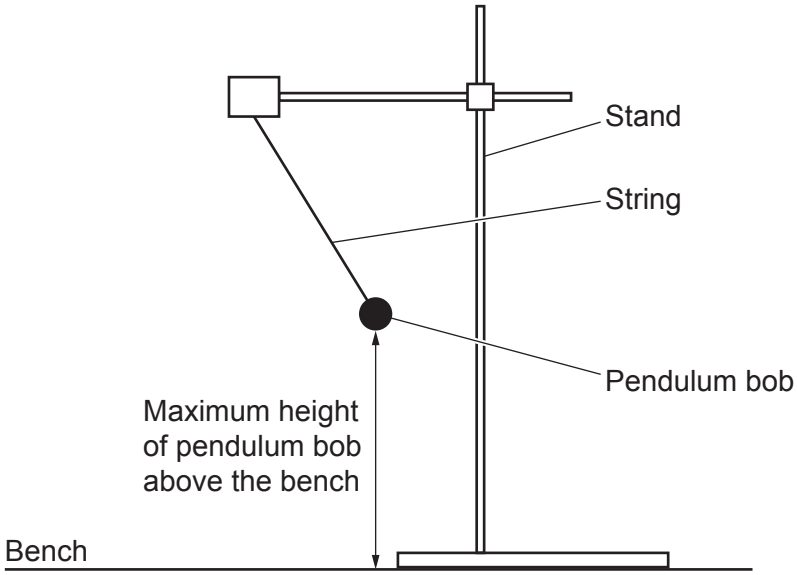
**23** The diagram shows a pendulum bob attached to a stand using string.




A student lifts the pendulum bob to the position shown on the diagram.

The student then releases the pendulum bob so that it swings freely.

**(a)** The student notices that the maximum height of the pendulum bob above the bench decreases after each swing.

Explain why the maximum height of the pendulum bob decreases after each swing.

.....

.....

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

**(b)** The student holds a metre ruler behind the swinging pendulum bob and measures the maximum height of the pendulum bob above the bench.

**(i)** Give **two** reasons why the student's method might **not** give an **accurate** value for the maximum height of the pendulum bob.

1 .....

.....

2 .....

.....

**[2]**

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**(ii)** Describe **two** ways to improve the student's method to obtain a more accurate value of the maximum height of the pendulum bob at the end of each swing.

1 .....

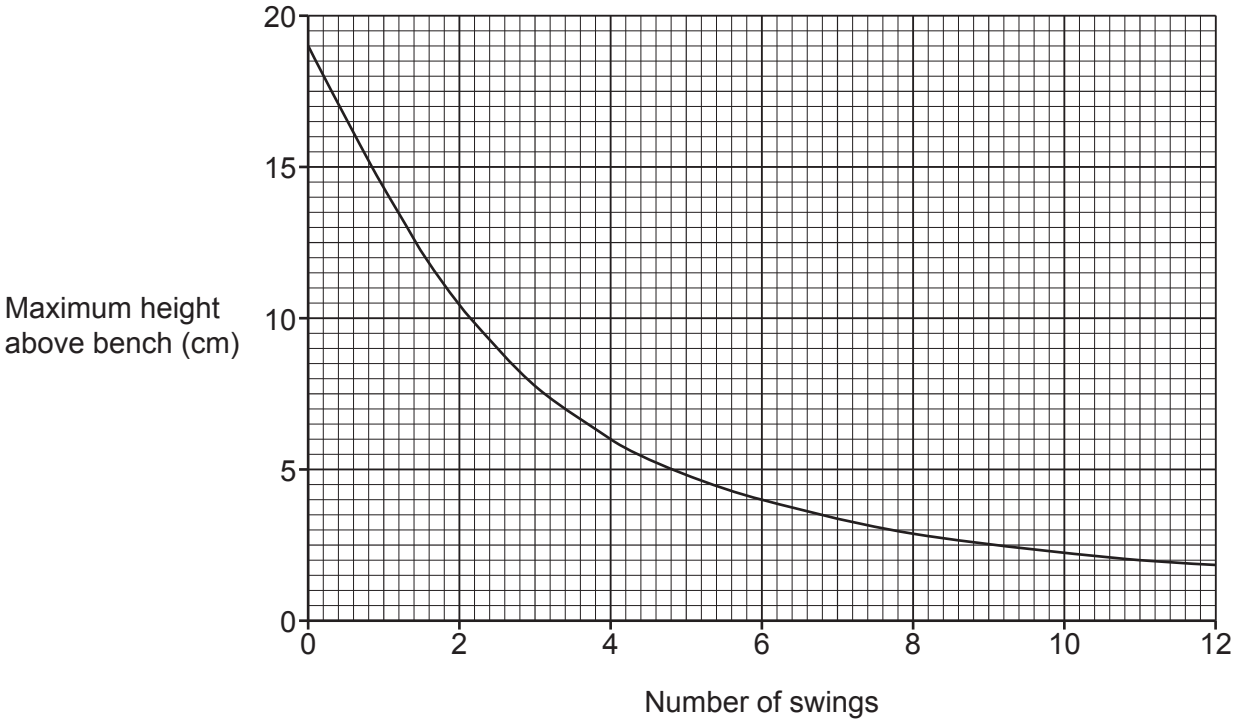
.....

2 .....

.....

**[2]**

**(c)** The graph shows how the maximum height of the pendulum bob above the bench changes as the pendulum bob swings.




The initial release height of the pendulum bob above the bench is 19 cm.

Determine the maximum height after 6 swings as a percentage of the initial release height.

Percentage of the initial release height = ..... % **[3]**

**END OF QUESTION PAPER**

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## EXTRA ANSWER SPACE

If you need extra space use these lined pages. You must write the question numbers clearly in the margin.

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