

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Monday 16 June 2025 – Morning

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

J249/02 (Foundation Tier)

**Time allowed: 1 hour 45 minutes
plus your additional time allowance**

YOU MUST HAVE:

a ruler (cm/mm)

**the Equation Sheet for GCSE (9–1) Physics A (with
this document)**

YOU CAN USE:

**a scientific or graphical calculator
an HB pencil**

Please write clearly in black ink.

Centre number

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Candidate number

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First name(s) _____

Last name _____

READ INSTRUCTIONS OVERLEAF



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 (*).

ADVICE

Read each question carefully before you start your answer.

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SECTION A

You should spend a MAXIMUM of 30 MINUTES plus your additional time allowance on this section.

Write your answer to each question in the box provided.

1 Which statement describes how the Sun was formed? [1]

- 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

2 A hot drink is poured into a mug.

Which method would NOT help to keep the drink hot? [1]

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

3 Which row explains how energy moves from object X to object Y by an ELECTROMAGNETIC WAVE? [1]

	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

- 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? [1]

Use the equation: work done = force $\times$ distance

A 1.2 J

B 3.2 J

C 4.8 J

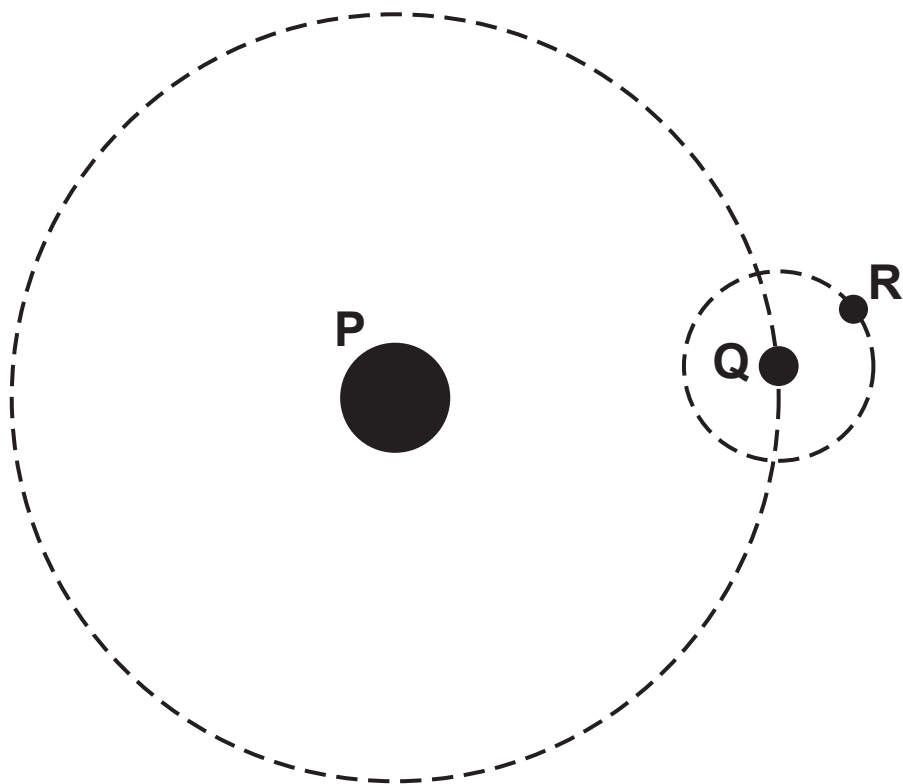
D 6.0 J

Your answer

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? [1]

	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

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

How many NEUTRONS are in a nucleus of aluminium-27? [1]

A 13

B 14

C 27

D 40

Your answer

7 What is the function of the EARTH WIRE in an electrical device? [1]

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

8 Which material will gamma radiation NOT easily penetrate? [1]

- A A sheet of paper**
- B A thick block of lead**
- C A thin sheet of aluminium**
- D Human skin**

Your answer

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? [1]

- 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

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

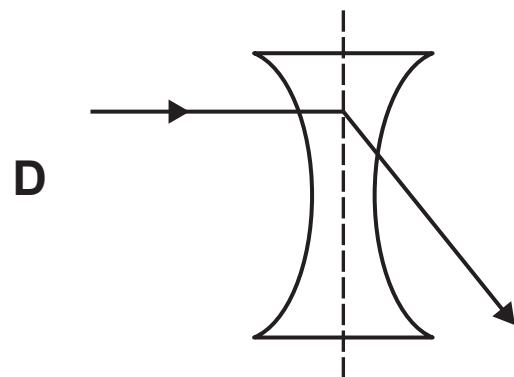
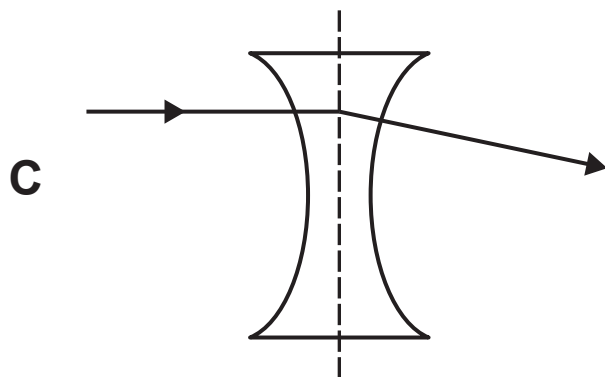
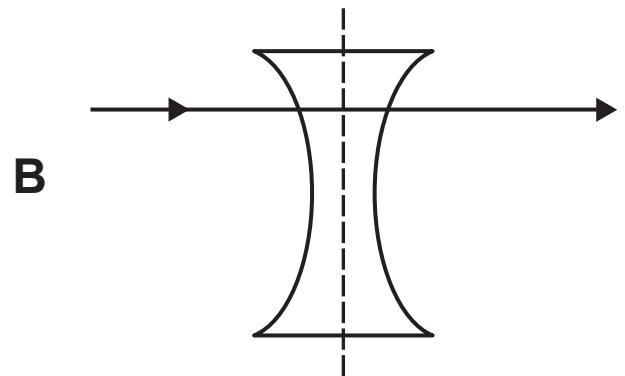
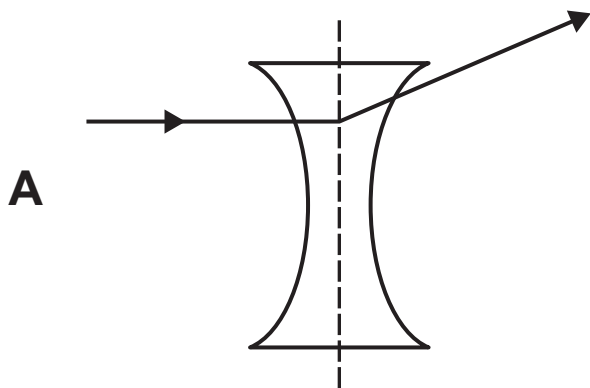
OBJECT	SPEED (m/s)
Aeroplane	150
Person	1.5

What is the ratio of aeroplane's speed : person's speed? [1]

- A 1 : 10
- B 1 : 100
- C 10 : 1
- D 100 : 1

Your answer

11 Which diagram shows a ray of light passing through a **CONCAVE** lens? [1]



Your answer

☐

12 Which value is a typical acceleration of a family car? [1]

A 2.5m/s^2

B 25m/s^2

C 250m/s^2

D 2500m/s^2

Your answer

13 A league is an old unit of distance.

One league is approximately equal to 4800 m.

What is 4 leagues in metres? [1]

A $1.92 \times 10^2\text{m}$

B $1.92 \times 10^3\text{m}$

C $1.92 \times 10^4\text{m}$

D $1.92 \times 10^5\text{m}$

Your answer

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? [1]

	FREQUENCY	VELOCITY
A	larger	equal
B	larger	larger
C	smaller	equal
D	smaller	larger

Your answer

- 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? [1]

- A 20 cm**
- B 40 cm**
- C 160 cm**
- D 320 cm**

Your answer

SECTION B

16 Energy sources are used to generate electricity.

(a) The list shows some energy sources.

coal

hydroelectric

nuclear

oil

solar

tidal

wind

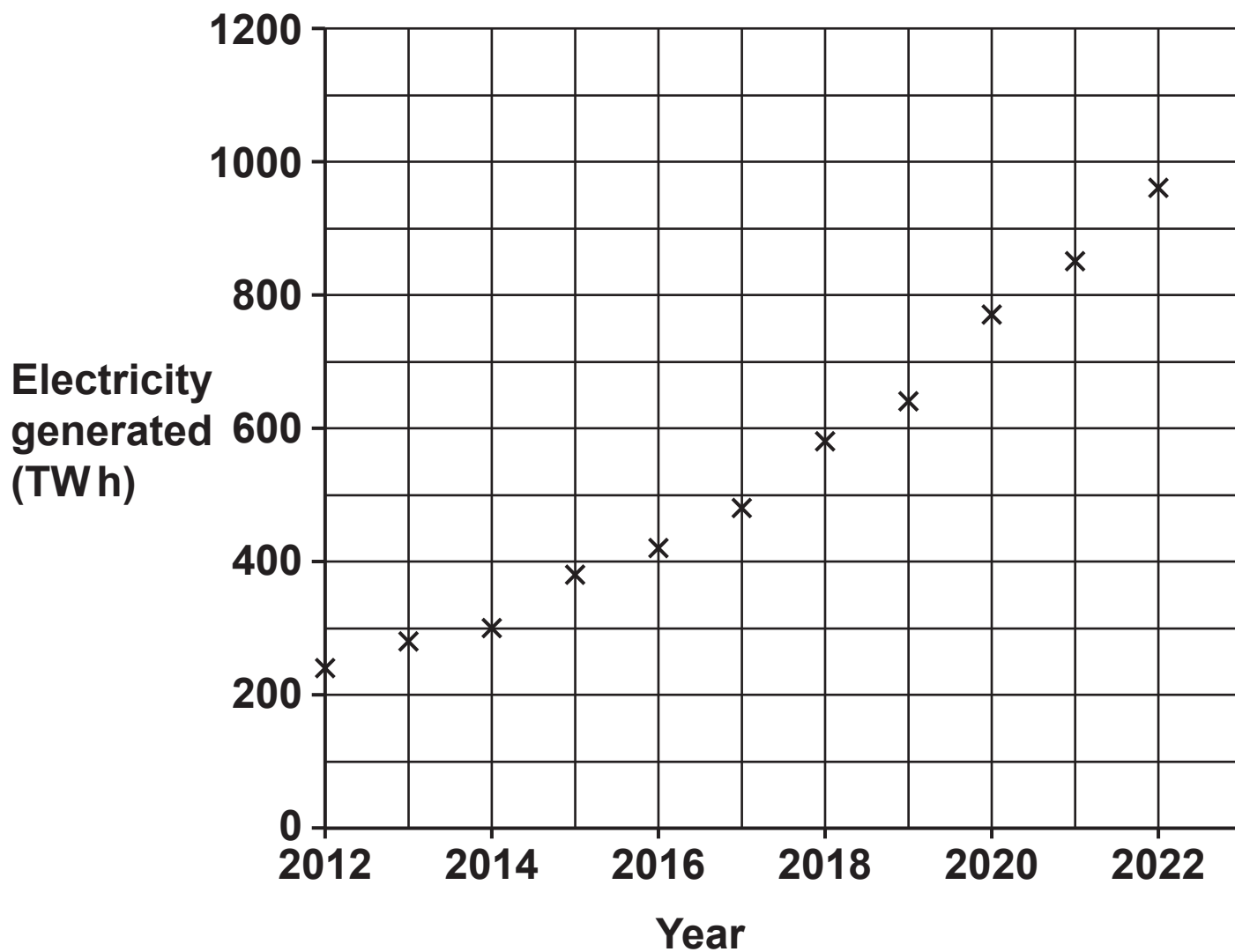
(i) Write down the name of ONE RENEWABLE energy source from the list.

_____ **[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]

- (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 = _____ TWh [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 = _____ TWh/year [2]

- 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 5.3×10^{-7} m and a speed of 3.0×10^8 m/s.

Calculate the frequency of green light.

Use the equation:

wave speed = frequency $\times$ wavelength

Frequency = _____ Hz [3]

- (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. [3]

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.

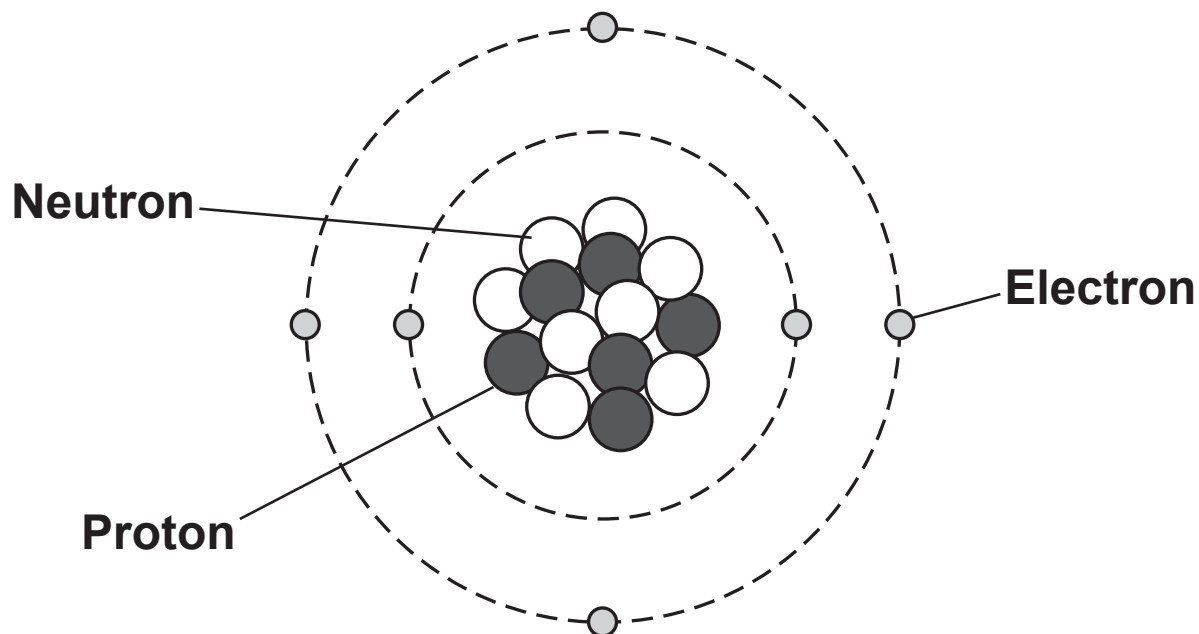
After some time, the electrons will move back to a

_____ energy level.

When this happens, the electrons

_____ green light.

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]

- (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]

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]

- (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.

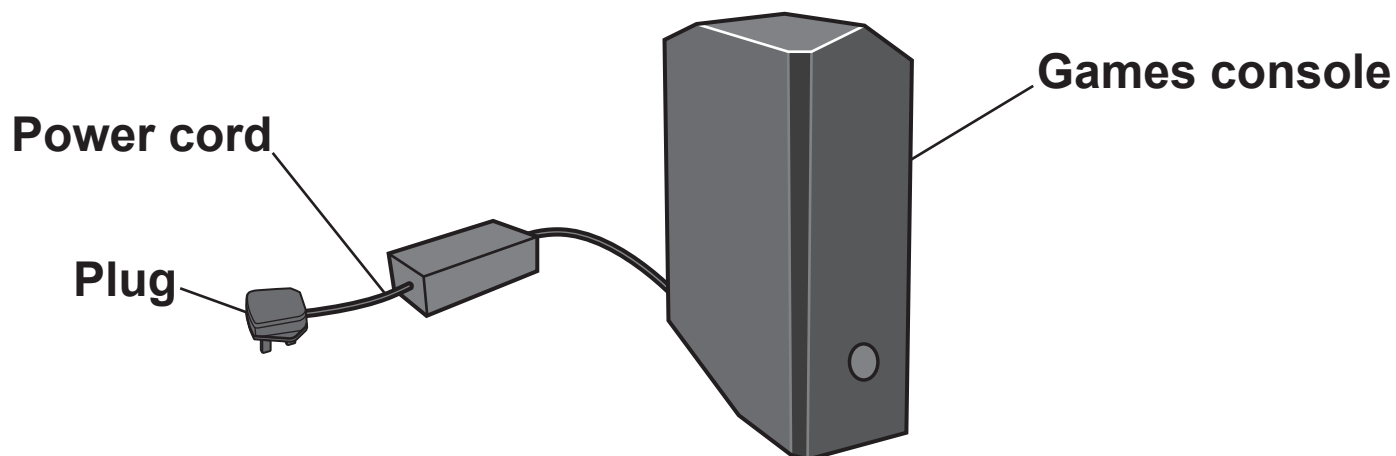
[2]

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

[1]

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 $4.2 \times 10^5 \text{ J}$ of energy per hour when a student is playing on it.**

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

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]

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

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{input energy transfer}}$$

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 $3.2 \times 10^{-11} \text{ W}$.

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]**

(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.

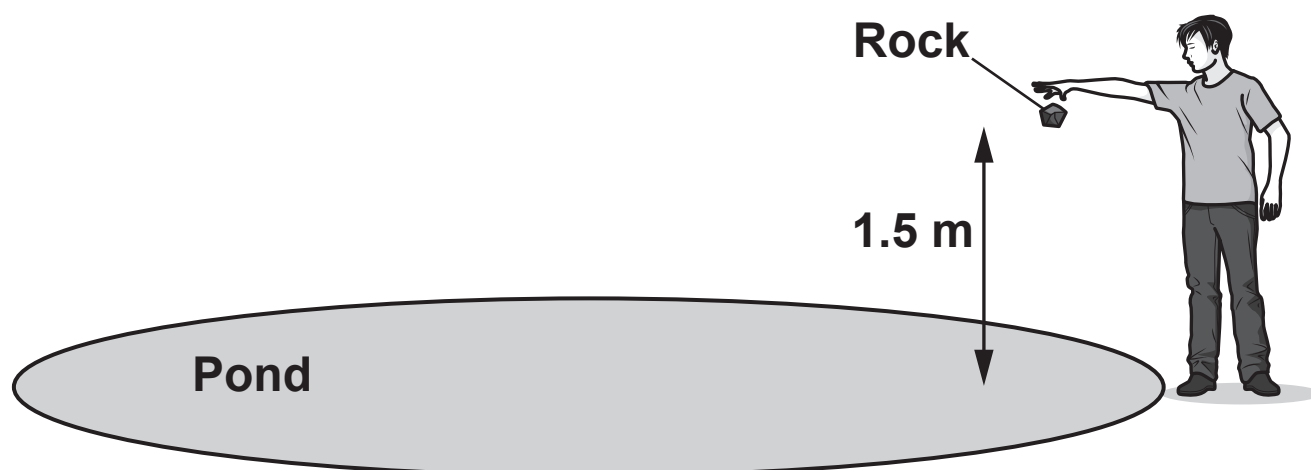
In your answer, write about

differences between a fission reaction and a fusion reaction

the benefits of nuclear fusion using the information in the table.

[6]

- 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. [4]

	Type of wave	Direction of particle vibration
Sound		Particles vibrate to wave direction
Water ripples		Particles vibrate to wave direction

- (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.

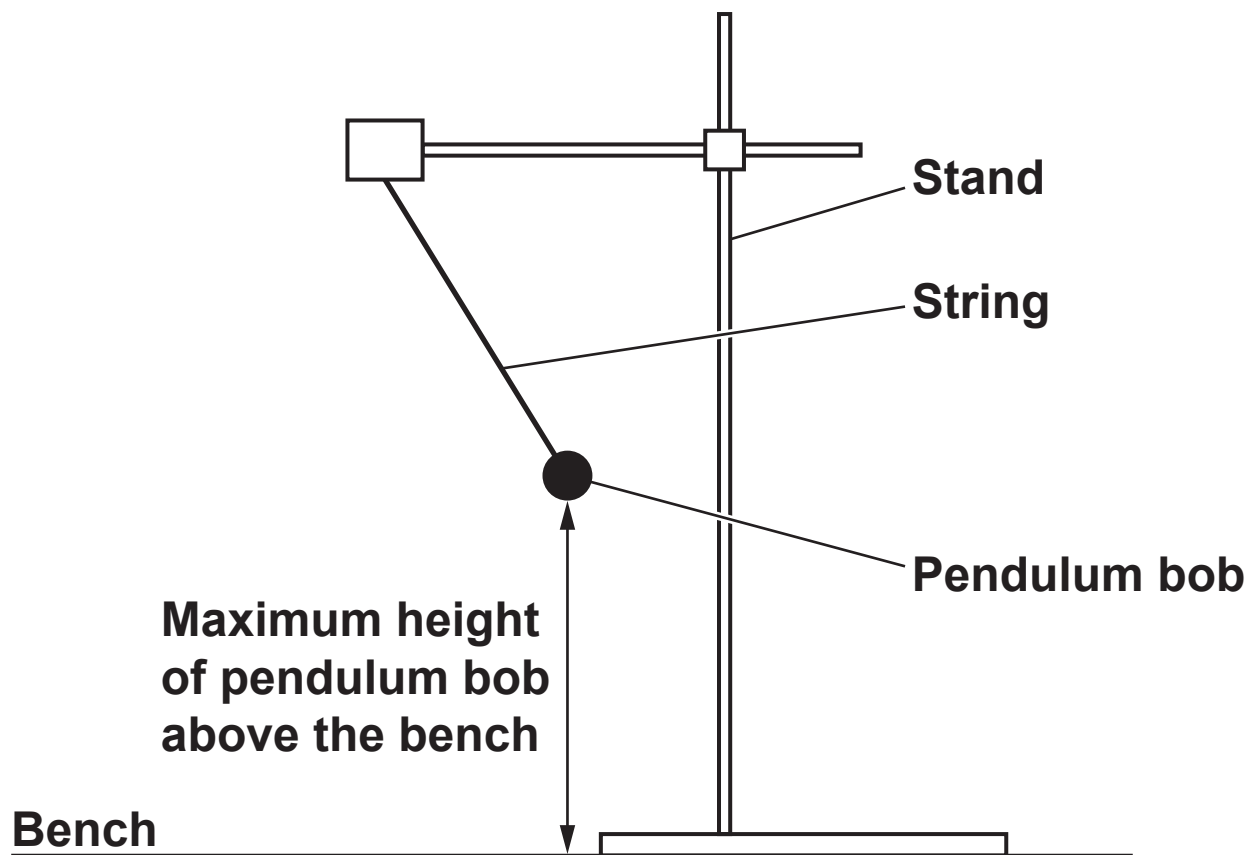
- (i) Explain why the rock dropped from a greater height produces ripples with a larger amplitude.**

[2]

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

[3]

- 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]

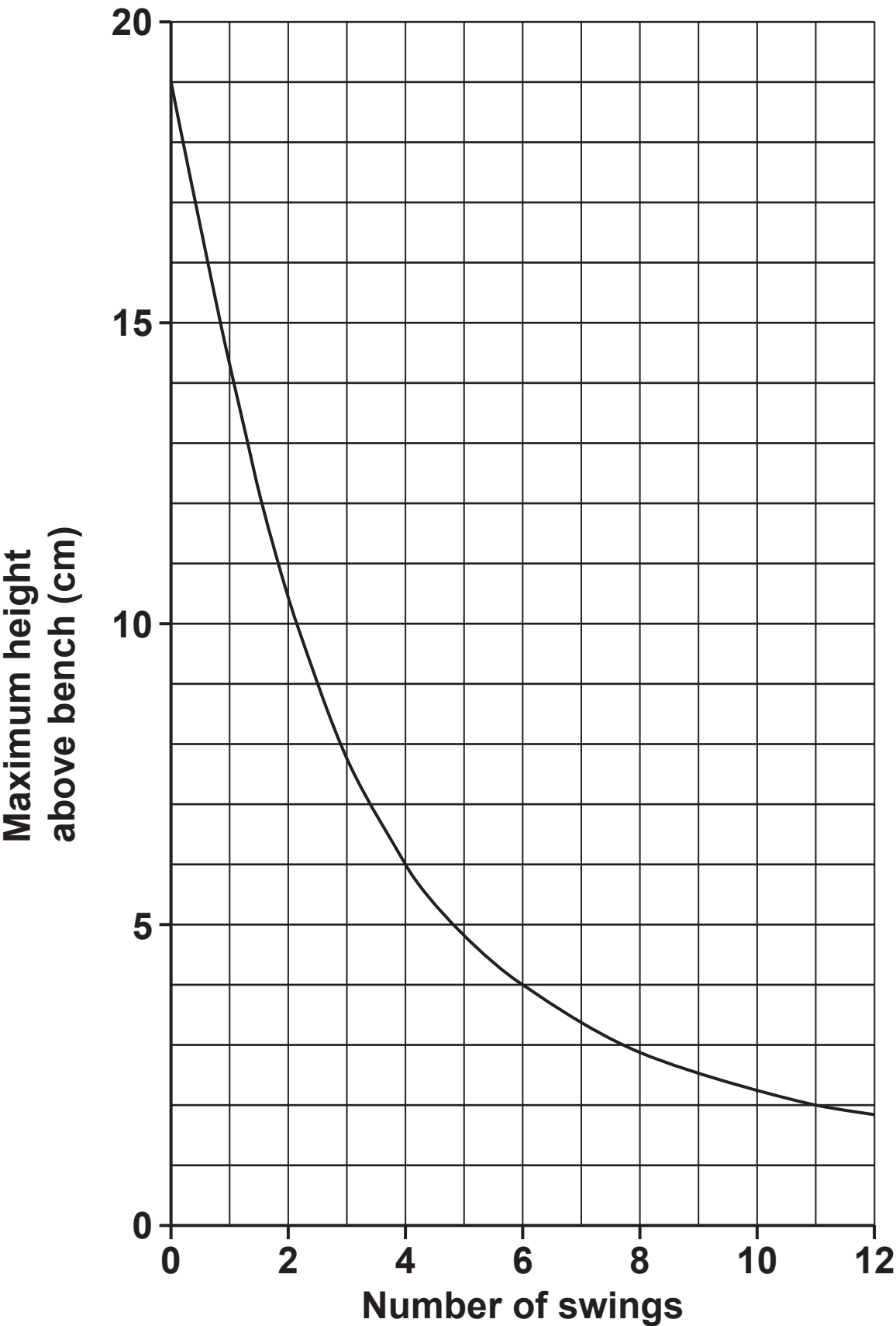
(ii) Describe TWO ways to improve the student's method to obtain a more accurate value of the maximum height of the pendulum bob at the end of each swing.

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

EXTRA ANSWER SPACE

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

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]



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