Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE PHYSICS A

J249

For first teaching in 2016

J249/04 Summer 2023 series

Version 1

ocr.org.uk/science

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. A selection of candidate answers is also provided. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Would you prefer a Word version?

Did you know that you can save this PDF as a Word file using Acrobat Professional?

Simply click on **File > Export to** and select **Microsoft Word**

(If you have opened this PDF in your browser you will need to save it first. Simply right click anywhere on the page and select **Save as . . .** to save the PDF. Then open the PDF in Acrobat Professional.)

If you do not have access to Acrobat Professional there are a number of **free** applications available that will also convert PDF to Word (search for PDF to Word converter).

Paper 4 series overview

J249/04 is one of the two Higher Tier papers for the GCSE (9-1) Physics A (Gateway Science).

This paper is designed to assess content from Topics P5 to P8 as well as P9 and with assumed knowledge of Topics P1 to P4. This paper requires candidates to have knowledge and understanding of all the topics within the course. The first two questions of each section overlap with the Foundation tier paper.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• identified and applied or manipulated equations, and wrote down all of their calculations • answered questions in depth using appropriate scientific terminology, e.g. the Level of Response (LOR) question • interpreted graphs and tables to draw conclusions.	• found it difficult to identify and apply or manipulate equations, especially those with four terms • lacked the necessary knowledge to describe and apply ideas about fission and fusion • did not read the question or command word carefully or gave answers that lacked the necessary detail.

Section A overview

Section A consists of 15 multiple choice questions, concentrating on Assessment Objectives 1 and 2 (AO1 and AO2).

Almost all candidates attempted every question.

In numerical questions, candidates should be encouraged to use the "white" space around the question to show equations and working. This should help them to answer the question and assist them with checking their answer.

In other questions, as candidates read through the question, it is helpful to underline keywords; a useful technique is to use small crosses to eliminate incorrect options.

Question 1

1 A sound wave travels from air into water.

Which quantity stays the **same**?

A Amplitude

B Frequency

C Speed

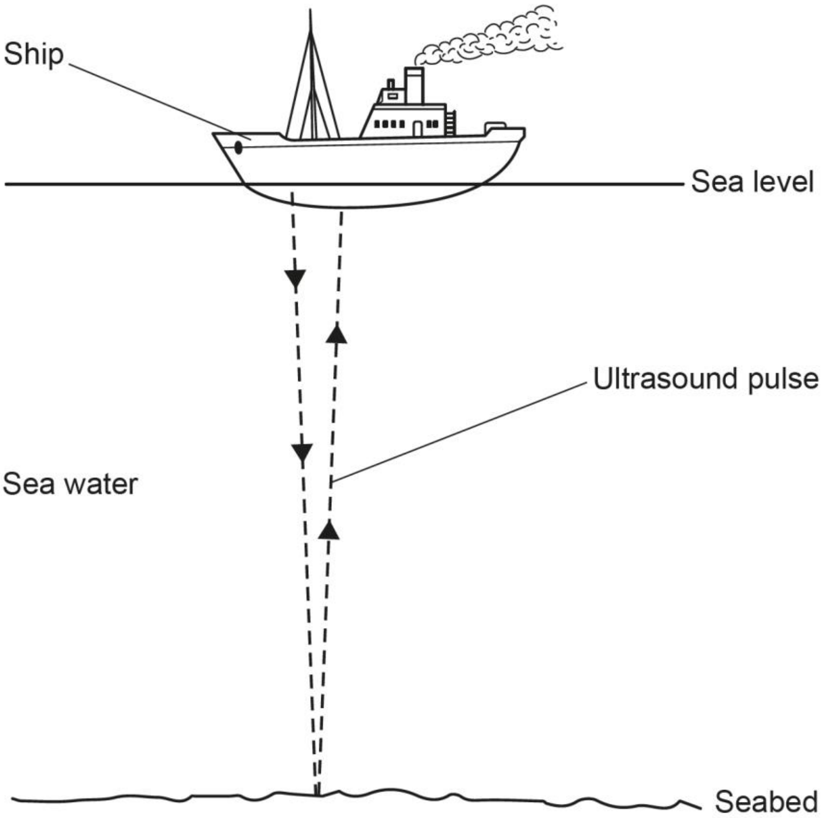
D Wavelength

Your answer ☐ **[1]**

This question assessed candidates' knowledge of describing wave motion when the wave travels from one medium to another. Just under half of candidates did not know that the frequency of the wave stays the same.

Question 2

2 Ultrasound pulses can be used to measure the depth of the seabed.



The speed of ultrasound in sea water is 1500 m/s.

The seabed is 3600 m below sea level.

An ultrasound pulse is emitted from the ship.

How long is it before the ultrasound pulse **returns** to the ship?

Use the equation: distance travelled = speed × time

A 0.40 s

B 0.80 s

C 2.4 s

D 4.8 s

Your answer [ ] **[1]**

The majority of candidates rearranged the equation provided to calculate a time. However, some candidates did not realise that they had to double the time that they calculated; the question asked for the time to **return** to the ship, and these candidates incorrectly chose option C.

Question 3

3 A radioactive element emits gamma rays.

A teacher accidentally spills some of the radioactive element on their hands.

Which sentence describes what happens to the teacher?

A They are contaminated and irradiated.

B They are contaminated only.

C They are irradiated only.

D They are not contaminated and not irradiated.

Your answer ☐ **[1]**

Under half of candidates answered this question correctly. The most common incorrect answer was B – the teacher is only contaminated, and not irradiated, when they spill the radioactive element on their hands.

Question 7

7 A teacher plugs an electric kettle into the domestic electricity supply.

The kettle has a power rating of 2300 W.

What is the current in the kettle?

Use the Equation Sheet.

A 0.10A

B 3A

C 10A

D 13A

Your answer ☐ **[1]**

This question assessed candidates' recall of the voltage of the mains supply in the UK and rearrangement of the relevant equation from the Equation Sheet. The vast majority of candidates did this successfully. There was evidence that some candidates who chose the incorrect option had tried to use an incorrect equation such as $P = I^2 R$.

Exemplar 1

7 A teacher plugs an electric kettle into the domestic electricity supply.

The kettle has a power rating of 2300 W.

What is the current in the kettle?

Use the Equation Sheet.

A 0.10A

B 3A

C 10A

D 13A

Your answer $\boxed{C}$ **[1]**

4V2=21R

$p = pd \times c$

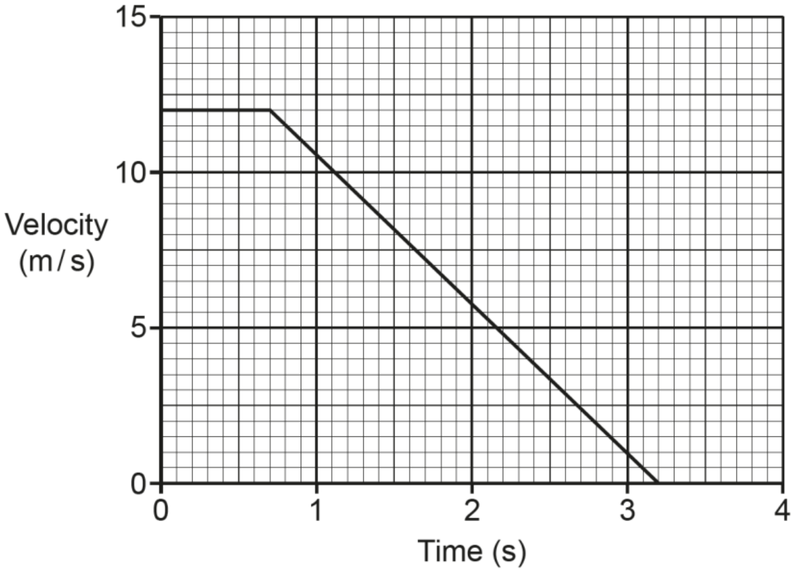
$p = 230 \times c$

$\frac{2300}{230} = c = 10$

This response shows how the candidate identifies the correct equation from the equation sheet, recalls the voltage of the mains supply in the UK and rearranges the equation to calculate the current in the kettle.

Question 8

8 The velocity–time graph shows how the velocity of a car changes after the driver sees a hazard in the road.



What is the braking distance of the car?

A 8.4 m

B 15.0 m

C 17.5 m

D 23.4 m

Your answer **[1]**

Some candidates believed the car was braking in the first 0.7 seconds of the journey, and therefore calculated the area under that section of the graph (option A); this is the thinking distance rather than the braking distance.

Question 9

9 Ultrasound scans are used to take pictures of unborn babies.

Before the ultrasound scan, gel is placed on the skin.

Which sentence explains why the scan **only** works when the gel is used?

A The gel amplifies the ultrasound waves.

B The gel lubricates the skin.

C The gel reflects the ultrasound waves.

D The gel transmits the ultrasound waves.

Your answer [ ] **[1]**

Just over half of candidates answered this question correctly, with many candidates incorrectly thinking that the gel amplifies the ultrasound waves.

Question 10

10 The kinetic energy of a car is 180 kJ when its speed is 20 m/s.

What is the mass of the car?

Use the Equation Sheet.

A 225 kg

B 450 kg

C 900 kg

D 18 000 kg

Your answer ☐ **[1]**

This question required candidates to identify the relevant equation from the equation sheet and rearrange it to determine the mass of the car. The vast majority of candidates were able to do this successfully, often writing down their calculations next to the question.

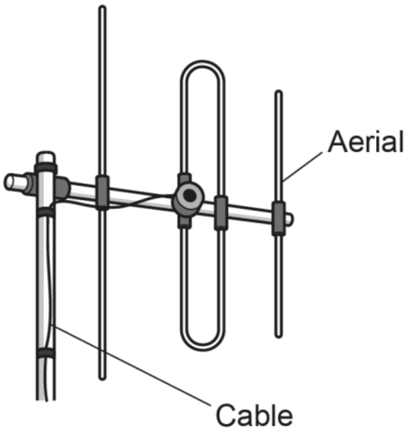
Assessment for learning

Even though there are no compensatory marks for an incorrect answer to a numerical multiple choice question, it will still benefit candidates to write down their calculations next to the question. By doing this, they are less likely to make a mistake compared to working out the answer purely on the calculator and/or in their head.

Question 11

11 A radio aerial receives radio signals.

The aerial is connected to a radio receiver using a cable.



How does the radio signal travel through the cable?

A As a light wave

B As a radio wave

C As a sound oscillation

D As an electrical oscillation

Your answer **[1]**

Approximately two thirds of candidates answered this correctly, with the most common incorrect answer being option B.

Question 13

13 0.090 J of energy is transferred when stretching a spring.

The spring constant of the spring is 50 N / m.

What is the extension of the spring?

Use the Equation Sheet.

A 0.0036 m

B 0.030 m

C 0.060 m

D 0.084 m

Your answer ☐ **[1]**

This question required candidates to identify the relevant equation from the equation sheet and rearrange it to determine the extension of the spring. The majority of candidates wrote down their calculations next to the question and were able to manipulate the equation correctly to find the extension. Some common errors seen included choosing the wrong equation, incorrectly rearranging the equation, or calculating $(\text{extension})^2$ but forgetting find the square root of this number.

Question 15

15 A vehicle is travelling at 30 m/s.

The vehicle travels 75 m while decelerating to a stop.

What is the deceleration of the vehicle?

Use the Equation Sheet.

A 2.5 m/s^2

B 6.0 m/s^2

C 12 m/s^2

D 24 m/s^2

Your answer [ ] **[1]**

This was a challenging question. Over half of candidates chose an incorrect option. Candidates needed to identify the relevant equation from the equation sheet and rearrange it to determine the deceleration of the vehicle. An alternative approach can be used: use the equation (average) speed = distance ÷ time to determine the deceleration time, and then use acceleration = change in velocity ÷ time. Where this was seen, candidates used the initial speed of 30 m/s instead of the average speed.

Section B overview

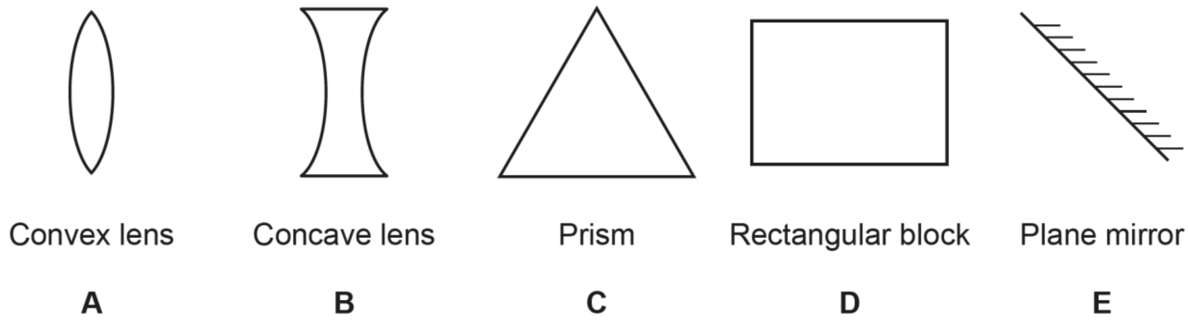
Section B consisted of short, 1 mark, questions as well as questions requiring longer answers and the Level of Response question. It covered all of the AOs, and many questions needed candidates to use mathematical skills. Questions 16 and 17 were the overlap questions with the Foundation tier paper.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• underlined key words and command words • identified/rearranged equations and wrote down all of their calculations • worked methodically in order to give a detailed description of fission and fusion (LOR question) • interpreted graphs to draw conclusions, for example, about fusion power stations (LOR question) • interpreted a table of data to compare the motion of two galaxies.	• struggled to identify or rearrange equations, especially those with four terms • made unnecessary unit changes • only wrote the answers to questions involving equations, showing no working • did not read the question or command word carefully, or gave answers that were too vague • gave responses that lacked depth e.g. LOR question.

Question 16 (a)

16 (a) A student shines three parallel rays of red light at different glass objects. **Fig. 16.1** shows the glass objects.

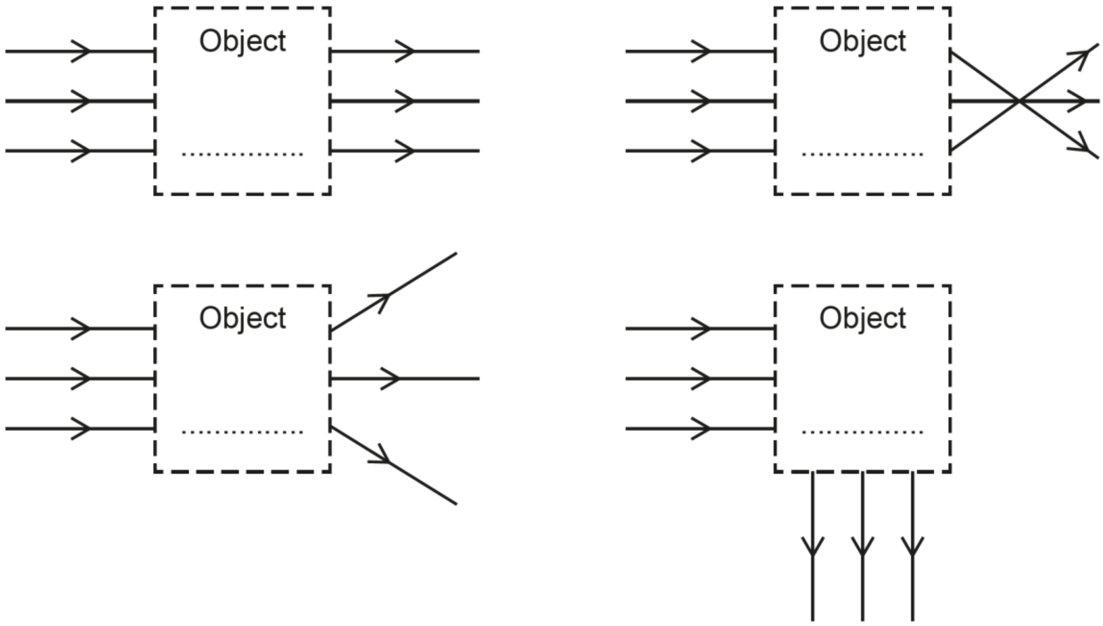
Fig. 16.1



The student draws ray diagrams to show what happens to the three parallel rays of red light.

Write **one** letter in each box in **Fig. 16.2** to identify which glass object produces that ray diagram.

Fig. 16.2



[4]

This was an overlap question with the Foundation tier paper. It assessed candidates' ability to recognise the path of light rays after they pass through different objects. Approximately half of candidates gained full credit. Many candidates scored 2 marks, and a common error was to confuse the concave lens with the convex lens.

Question 16 (b)

(b) The wavelength of red light in glass is 4.33×10^{-7} m.

The speed of red light in glass is 2.0×10^{8} m/s.

Calculate the frequency of the red light in glass.

Use the equation: wave speed = frequency × wavelength

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

Frequency = ... Hz **[4]**

The vast majority of candidates gained full credit. Some common errors included:

- incorrectly rearranging the equation
- substituting the values for speed and wavelength incorrectly into a correctly rearranged equation
- missing out the power of ten when writing the final answer
- not writing the final answer to two significant figures.

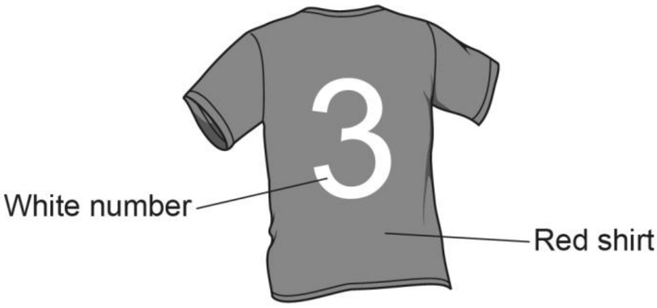
Some candidates could not enter the numbers into their calculator correctly, so did not gain the mark for the final answer, but scored method marks as they had written down their calculations.

Assessment for learning

Candidates should, as always, note how essential it is to write down every step of their workings so that method marks can be awarded if the final answer is incorrect.

Question 16 (c) (i) and (ii)

(c) A football player wears a red shirt with a white number 3 on the back.



(i) What is the colour of the shirt and the number when viewed under **blue** light?

Colour of shirt ....

Colour of number .... **[1]**

(ii) Another football player says, 'Under **red** light, I cannot read the number on the shirt.'

Explain why.

....

.... **[1]**

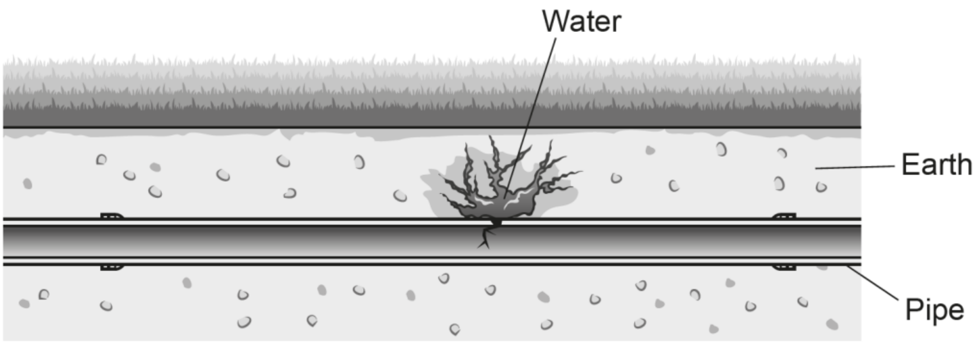
These questions assessed candidates' knowledge of how colour is related to absorption and reflection (P5.3). Although there were many correct responses, there were also various random colours mentioned in Question 16 (c) (i). Most of the higher scoring candidates answered these questions correctly.

Misconception

Some candidates had the misconception that red light had to be absorbed by an object, instead of reflected, in order for it to be seen.

Question 17 (a) (i)

17 An underground water pipe has a leak, as shown in the diagram.



A tracer called sodium-24 is used to detect leaks in underground pipes.

(a) **(i)** Sodium-24 has a half-life of 15 hours.

Give **two** reasons why this is useful.

1 ....

....

2 ....

.... **[2]**

This question assessed AO3 and was fairly well answered, with approximately three quarters of candidates gaining at least 1 mark. Candidates who did not gain the marks usually had poor quality of communication, and were not specific enough about the time scales, e.g. vague statements about 15 hours being 'too dangerous'.

Question 17 (a) (ii)

(ii) Sodium-24 emits beta and gamma radiation.

Explain why this makes sodium-24 a good tracer.

....

.... **[1]**

Fewer than a quarter of candidates answered this question correctly. Most incorrect answers referred to generic statements about alpha, beta and/or gamma and were not related to this situation.

Question 17 (a) (iii)

(iii) Sodium-24 decays to form a stable isotope.

Explain why this is important.

....

.... **[1]**

This question was answered correctly by just over half of the candidates. Some candidates used incorrect terminology, e.g. about the reactivity of the isotope or the outer electron shell being full.

Question 17 (b)

(b) The tracer is monitored using a gamma radiation detector.

How is the location of the leak found?

....

....

....

.... **[2]**

Fewer than two thirds of candidates scored any marks in this question and only the highest scoring candidates gained full credit. Some responses referred to gamma being picked up by the detector but did not link an increase in the reading to where the leak was located.

Misconception

Some common misconceptions included:

- confusion with ultrasound scanning where the waves reflect off object being imaged
- the tracer in the pipe is blocked by the crack so the reading on the detector decreases.

Question 17 (c)

(c) A 12 mg mass of sodium-24 is added to water.

The half-life of sodium-24 is 15 hours.

What mass of sodium-24 remains in the water after 30 hours?

Mass remaining = ... mg **[2]**

The vast majority of candidates gained full credit for this question.

Question 18 (a) (i)

18 (a) Polonium-210 is a radioactive material which emits alpha particles.

(i) Complete **Table 18.1** to show the composition of an **alpha particle**.

Table 18.1

Number of protons	....
Number of neutrons	....
Number of electrons	....

[2]

Most candidates scored at least 1 mark for this question. Some candidates thought that there were also electrons in an alpha particle.

Question 18 (a) (ii)

(ii) A person swallows a small amount of polonium-210. Doctors examine the person using a Geiger-Müller tube outside the body.

Explain why the doctors do **not** detect the polonium-210 inside the body.

....

.... **[1]**

This question was of standard demand but many candidates struggled to express themselves clearly enough to gain credit, referring to general properties of alpha particles but not linking these properties directly to the question asked.

Question 18 (b) (i)

(b) Polonium-210, $^{210}_{84}Po$, can be made in a nuclear reactor in two steps.

(i) In the first step, bismuth-209, $^{209}_{83}Bi$ is bombarded with neutrons to make $^{210}_{83}Bi$.

State the name given to these different forms of the element bismuth.

.... **[1]**

Question 18 (b) (ii)

(ii) In the second step, $^{210}_{83}Bi$ decays to form $^{210}_{84}Po$.

Complete the **balanced nuclear** equation for this decay.

$$^{210}_{83}Bi \rightarrow {}^{210}_{84}Po + \text{........................}$$

[2]

Question 18 (c) (i)

(c) 1 μg of polonium-210 is enough to kill a human being.
210 g of polonium-210 has an activity of 3.57×10^{16} Bq.

Calculate the activity of a sample of 1 μg of polonium-210.

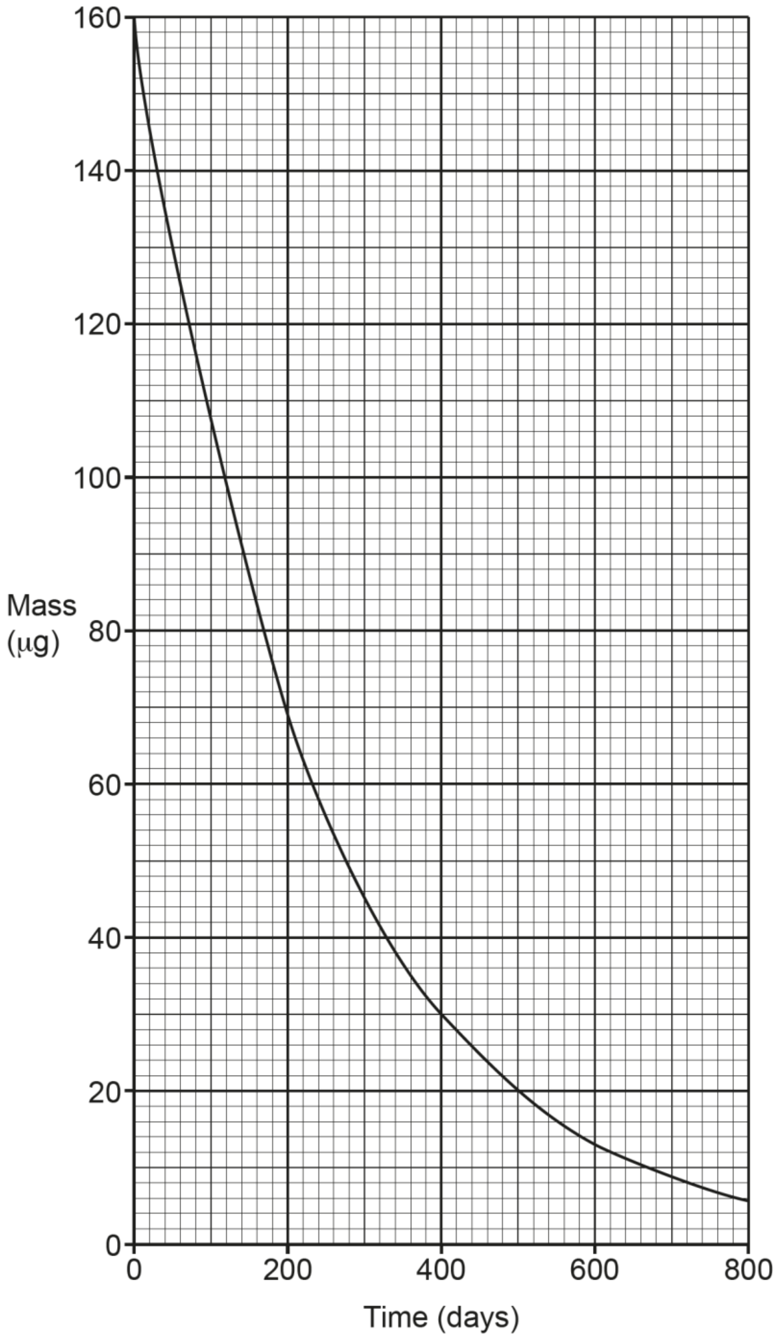
Give your answer in **standard form**.

Activity = ... Bq **[3]**

The majority of candidates scored 2 or 3 marks for this question. The main error occurred with the power of 10 in the answer, as many candidates had either incorrectly converted micrograms into grams, or had not attempted to convert the unit at all, so scored 2 marks.

Question 18 (d) (i)

(d) The graph shows how the mass of a sample of polonium-210 changes with time.



(i) Use the graph to complete **Table 18.2**. Two answers have been filled in for you.

Table 18.2

Time (days)	Mass (µg)
0	160
200	....
400	30
600	....

[1]

Question 18 (d) (ii)

(ii) A teacher explains half-life and radioactive decay to their class.

The teacher says,
'For equal time periods, the ratio:

$$\frac{\text{mass at the start of the time period}}{\text{mass at the end of that time period}}$$

is constant.'

Use this ratio and your answers in **Table 18.2** to determine if the teacher is correct for the sample of polonium-210.

....

.... **[2]**

This question required candidates to calculate two ratios from the table and state that they were close enough to be considered constant.

The majority of candidates correctly calculated two ratios, although some candidates left the ratio as a fraction. Some candidates did not gain the second mark as, even though the ratios rounded to 2.3, they stated they were not constant.

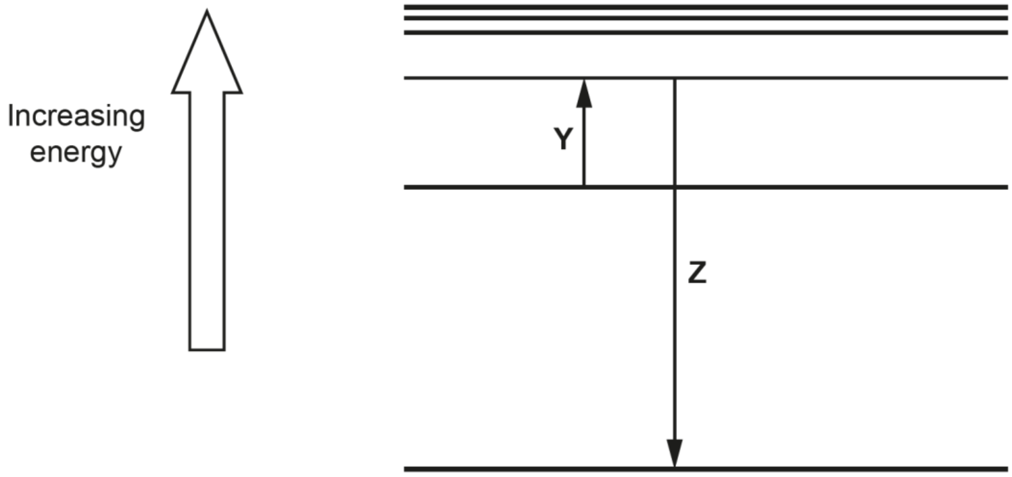
Assessment for learning

In Science, candidates should usually fully calculate their final answer and write it as a decimal number, not as the fraction which is usually shown on their calculator (unless asked for otherwise).

Question 19 (a) (i) and (ii)

19 (a) Atoms can emit or absorb electromagnetic radiation when electrons move between energy levels.

The diagram shows electron transitions **Y** and **Z** between energy levels in an atom.



(i) Draw an arrow on the diagram showing the transition of an electron in the **lowest** energy level when it is lost from the atom. **[2]**

(ii) Complete each sentence about the electron transitions in the diagram.

Use the words in the list.

absorbed	**emitted**	**excited**	**ionised**
higher than	**lower than**	**the same as**	

When an electron is ...., as shown by arrow **Y**, electromagnetic

radiation is .... by the atom.

The frequency of electromagnetic radiation involved in transition **Z** is

.... the frequency of the electromagnetic radiation involved in

transition **Y**.

[2]

The topic of energy levels (P6.1) was not well understood by candidates, with approximately half of candidates not gaining any credit in part (a). A number of candidates did not attempt part (a) (i) and, of those who did, many had the arrow pointing downwards.

In part (a) (ii), few scored both marks, with various combinations of words from the list used to complete the sentences.

Question 19 (b)

(b) Line spectra give astronomers information about the motion of distant galaxies.

The table gives the wavelength of a line in the spectrum of hydrogen observed in a laboratory on the Earth.

The table also gives the wavelength of the **same** line in the spectrum of hydrogen observed from galaxy **A** and galaxy **B**.

Source	Wavelength of line (nm)
Laboratory on the Earth	656
Galaxy **A**	712
Galaxy **B**	739

Explain how the data in the table can be used to compare the motion of galaxy **A** with galaxy **B**.

....

....

....

....

....

.... **[4]**

This question assessed AO1 and AO3. Candidates had to use their knowledge of red-shift to interpret the data in the table. It was generally well attempted, although many answers were too vague, comparing only the wavelengths and not linking to the data in the table. Many lower scoring candidates only described red-shift, rather than explaining what the data showed about the motion of the two galaxies. The question differentiated well, with higher achieving candidates scoring well.

Assessment for learning

Candidates could benefit from highlighting the command word in the question. It is essential that candidates understand what they need to do for different command words.

Exemplar 2

Using measurements from the red shifts, more distant galaxies absorb longer wavelengths than closer galaxies so galaxy B is more distant than galaxy A as the wavelength is 27mm greater. Calculations also show that more distant galaxies are moving away faster than closer galaxies so Galaxy B has a higher velocity **[4]**

This response achieved full credit. The explanation of the data in the table is very detailed, using correct scientific terminology to conclude that galaxy B is further away than galaxy A (marking point 4) and is moving away faster (marking points 3 and 5).

Question 20 (a)

20 (a) The Sun is a star.

Describe how the Sun was formed.

....

....

....

....

....

.... **[3]**

Candidates appeared very familiar with the formation of the Sun and more than half of the candidates gained full credit. Most marks were gained for the mention of clouds of dust/gas, and for the formation of a protostar. Some candidates wrote far more than was necessary, as they described the whole life cycle of a star.

Misconception

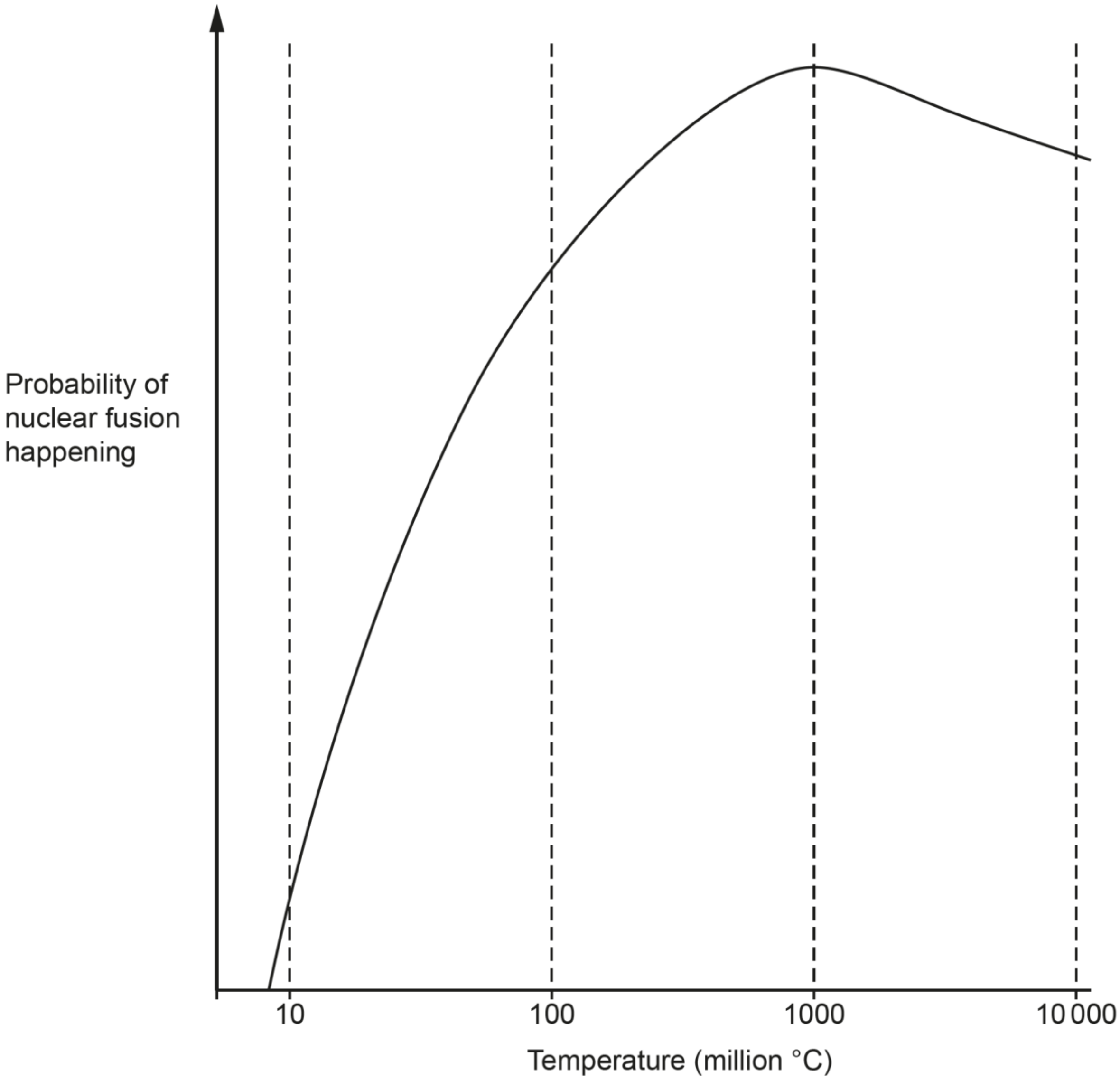
Some common misconceptions about the formation of a star included:

- nuclear fission occurring
- nuclear fusion happening at the very start
- a proton star is formed.

Question 20 (b)*

(b)* Nuclear power stations use nuclear fission rather than nuclear fusion to generate energy.

This graph shows how the probability of a nuclear fusion reaction changes with temperature.



Compare the processes of fission and fusion.

Explain why power stations only use nuclear fission at present.

Use the graph, and your scientific knowledge.

....

....

....

....

....

.... **[6]**

This was the Level of Response question, targeted up to Grade 9, and assessing AO1 and AO3. There was a wide range of marks achieved, with some responses of an excellent standard, and the question discriminated very well. Very few candidates did not achieve any credit.

The majority of candidates were able to give a basic description of fission or fusion, or they explained why power stations only use nuclear fission at present, although the values they read from the graph were not always correct. Many candidates achieving Level 1 had answers which lacked detail or did not answer every part of the question. More detailed responses required for Level 2 and 3 included using correct scientific terminology and a detailed analysis of the graph.

Poor quality of communication, including incorrect scientific terminology, or the same facts repeated a number of times, prevented some candidates from achieving a higher mark.

Misconception

Some common misconceptions and errors seen in responses included:

- using the term 'atom' instead of 'nucleus' when describing fission and fusion
- stating that an electron (rather than a neutron) is used to bombard a uranium nucleus
- stating that the largest probability of fusion happening was at 1000 °C, because the unit of the axis was not read carefully enough
- confusing ideas about fission and fusion
- fusion reactors are more dangerous than fission reactors.

Exemplar 3

o Nuclear fission is the splitting of a nuclei ~~to form~~ into two. Two nuclei in an ~~st~~ unstable isotope split into two, which causes the release of a neutron in the form of electromagnetic radiation. ~~This neutr~~ This neutron then joins a stable isotope making it unstable causing the nuclei to split ~~and~~ again and release a neutron. This happens repeatedly causing a chain reaction, good for ~~nuclear~~ power stations as the release of energy is continuous.

o Nuclear fusion is the ~~to~~ 'fusing' / joining of ~~the~~ two nuclei to form a heavy nuclei. The sum of the two nuclei's mass is greater than the mass of the 'fused' nuclei **[6]** as energy is dissipated and emmited.

o ~~The power stations~~ Nuclear fusion requires a significantly higher amount of temperature and pressure. ~~the~~ (less moderate conditions) than fission and emits higher amounts of energy.

o Power stations only use fission because as shown by the graph the probability of nuclear ~~fiss~~ fusion happening is ~~a lot higher when~~ at its maximum when the temperature is ~~1100 million~~) (1000 million °C). These conditions are impossible to be achieved on the Earth currently, but can be achieved in space only.

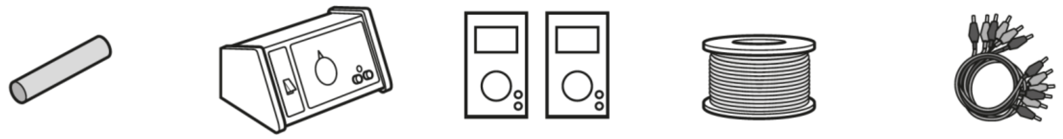
o As the optimum conditions for fusion are too difficult to be achieved on Earth, power stations only use nuclear fission.

This response achieved Level 3, 6 marks. The description of both fission and fusion is very detailed, using correct terminology about nuclei. The candidate has also given a full explanation about why power stations only use nuclear fission at present.

Question 21 (a)

21 (a) A student investigates how the potential difference across the secondary coil of a transformer changes with the number of turns on the secondary coil.

The diagram shows the student's equipment.



Describe a method that the student uses to obtain valid results.

You can include a labelled diagram to support your answer.

....

....

....

....

....

.... **[4]**

It was evident that most candidates found this question the most challenging on the paper, with usually only the highest achieving candidates gaining more than 1 mark. The question assessed AO3. It required candidates to describe how to use the equipment provided to make a transformer to investigate the relationship between the p.d. across the secondary coil and the number of turns on this coil.

Some candidates confused the transformer with an electromagnet and many did not mention primary and secondary coils, this allowed access to the first marking point only. Many drew diagrams where the primary coil and the secondary coil were joined together in a circuit. A few students described bending the iron rod into a square shape like a conventional transformer, and usually these candidates then gained the most marks, because they went on to label the two coils and connected the power supply and voltmeter in the correct places.

Most candidates were not specific about which coil they were referring to when writing about the power supply, voltmeter and changing the number of turns.

Question 21 (b) (i) and (ii)

(b) A transformer is used to change the potential difference (p.d.) of a supply.

The table shows the data for this transformer.

Number of turns on the primary coil	3540
Number of turns on the secondary coil	300
p.d. across primary coil	230 V
Current in secondary coil	4.62 A

(i) Calculate the p.d. across the secondary coil of the transformer.

Use the Equation Sheet.

p.d. across the secondary coil = ... V **[3]**

(ii) Calculate the current in the primary coil of the transformer.

Use the Equation Sheet.

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

The calculations in Questions 21 (b) (i) and (b) (ii) were generally answered well, with a significant number of candidates gaining full credit. Other candidates struggled with rearranging the equations, but still gained marks for substituting the given information into an unrearranged equation.

Assessment for learning

Candidates could benefit from short activities where they practise rearranging the transformer equations with four terms.

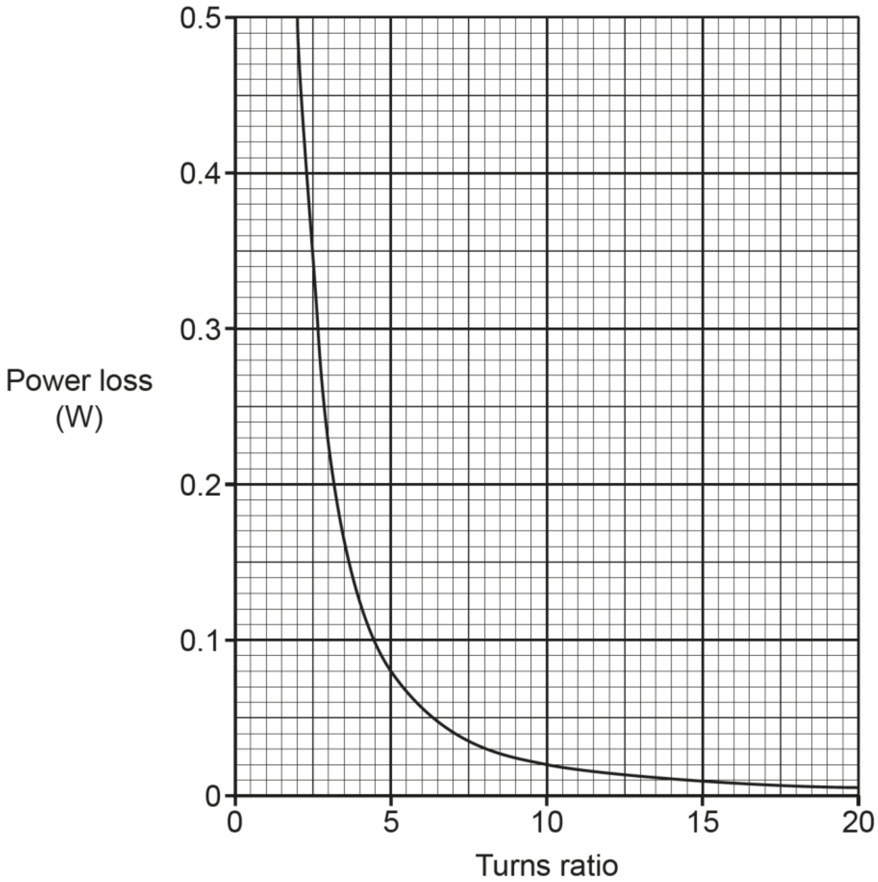
Question 21 (c) (i)

(c) A teacher calculates power losses in a model power line.

The teacher changes the 'turns ratio' of a step-up transformer using the equation:

$$\text{turns ratio} = \frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}}$$

The graph shows how power loss in the power line changes with the turns ratio.



(i) A student says, 'As the turns ratio doubles, the power loss halves.'

Use data from the graph to explain why the student is **incorrect**.

....

....

.... **[2]**

This question was answered well, with correct values read from the graph and the calculation completed, along with the correct conclusion. Some candidates misread the graph, so could score a maximum of 1 mark, for example, a power loss of 0.8 W was stated instead of 0.08 W for a turns ratio of 5, or a power loss of 0.5 W for a turns ratio of 2.5.

Question 21 (c) (ii)

(ii) Explain why step-up transformers are used in the national grid.

....

....

....

.... **[2]**

This question has often been asked in past GCSE Physics papers, and candidates performed slightly better, but still more than one in five candidates did not gain credit. Many gained one mark for the idea of less energy lost (as heat), but only the higher achieving candidates were able to link this to higher voltages resulting in a lower current.

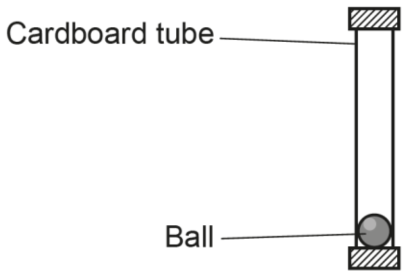
Assessment for learning

Candidates should be aware that the idea of **no** energy losses will not gain credit.

Question 22 (a)

22 (a) **Fig. 22.1** shows a sealed cardboard tube containing a ball.

Fig. 22.1



The cardboard tube is quickly turned upside down so that the ball falls the whole length of the tube.
Fig. 22.2 shows the energy stores of the ball at the **top** of the tube.

Complete **Fig. 22.3** to show the energy stores of the ball before it hits the **bottom** of the tube. **[3]**

Fig. 22.2

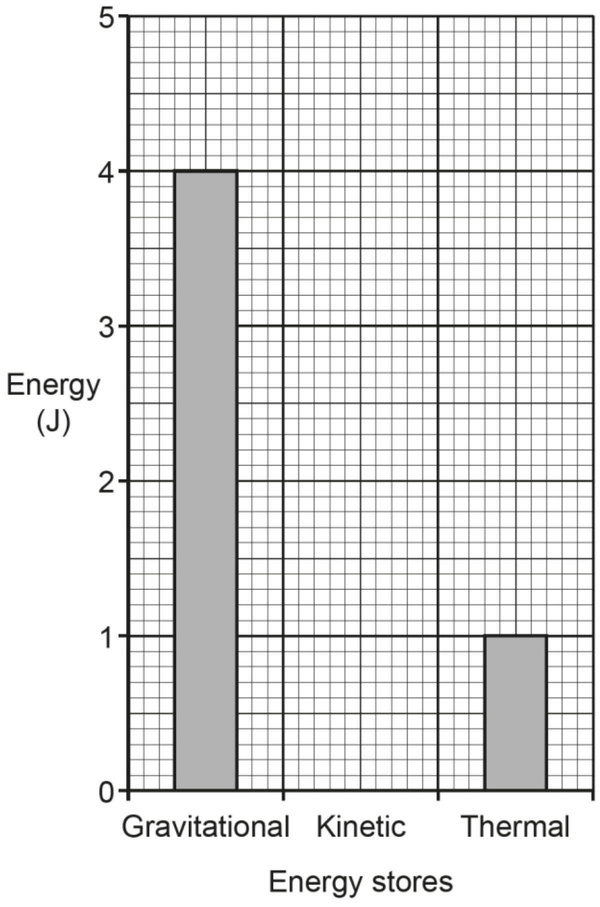
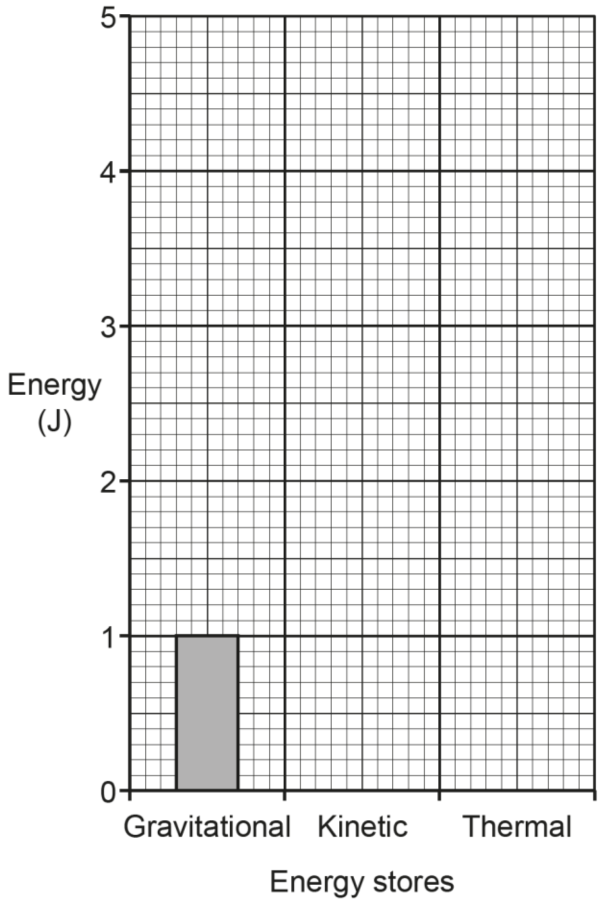


Fig. 22.3



Nearly all candidates scored at least 1 mark (marking point 1), with the majority of candidates scoring two marks (marking point 1 and either marking point 2 or 3). The most common errors included candidates not realising that the total energy in Fig. 22.3 had to add up to 5 J.

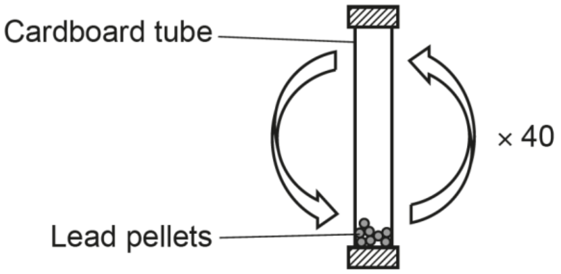
Question 22 (b) (i) and (ii)

(b) Student **A** and student **B** determine the specific heat capacity of lead using this method.

- Measure the mass and initial temperature of small lead pellets.
- Place the pellets in a sealed cardboard tube.
- Quickly turn the tube upside down 40 times.
- Measure the final temperature of the lead pellets.

Fig. 22.4 shows a diagram of the equipment:

Fig. 22.4



(i) State **one** way to improve the experiment.

....

.... **[1]**

(ii) Explain why the cardboard tube is turned upside down very quickly.

....

.... **[1]**

Fewer than half of candidates scored a mark in part (b) (i). There was a variety of suggestions including repeating the experiment, but this did not score on its own, as candidates also needed to say that they would calculate the mean.

Very few candidates answered part (b) (ii) correctly.

Question 22 (b) (iii) and (iv)

(iii) **Student A** uses 0.030 kg of lead pellets and a 1.5 m long cardboard tube.

Calculate the change in potential energy of the pellets when the tube is turned upside down **once**.

Use the equation: potential energy = mass × height × gravitational field strength

Potential energy = ... J **[2]**

(iv) **Student B** repeats the experiment using a different tube.

The total change in potential energy of 0.030 kg of lead pellets for this tube is 21 J.
The temperature change of the lead pellets is 5 °C.

Calculate the specific heat capacity of lead. Include the correct unit.

Use the Equation Sheet.

Specific heat capacity = ... Unit .... **[4]**

The calculations in both parts (b) (iii) and (b) (iv) were answered very well, with over three quarters of candidates giving the correct numerical answers. The unit of specific heat capacity was less well known. Lower scoring candidates sometimes unnecessarily attempted to change kilograms into grams and metres into centimetres.

Assessment for learning

Candidates could benefit from mini-tests on quantities in the specification and their units.

OCR support

Appendix 5e of the specification includes a table of quantities, common symbols, their SI units and their abbreviations. A student friendly printable version is available online and on Teach Cambridge.

OCR's Alphabet of physics includes a table that highlights where confusion might otherwise occur. It includes practice questions.

Question 22 (b) (v)

(v) Student **A** says, 'I think we should use a metal with a higher specific heat capacity. This will give us more accurate results.'

Student **B** says, 'I think we should turn the tube upside down 100 times. This will give us more accurate results.'

Explain why both student **A** and student **B** are **not** correct.

Student **A** ....

....

....

....

Student **B** ....

....

....

....

[3]

It was evident that most candidates found this question, assessing AO3, the most challenging on the paper with only the higher achieving candidates gaining credit. Although nearly all candidates attempted to give an answer, many merely repeated what the students suggested and then stated that they were incorrect, rather than explaining why they were incorrect.

Copyright information

Question 11, Picture of a radio aerial,20/7/21.

Supporting you

Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

For the June 2023 series, Exams Officers will be able to download copies of your candidates' completed papers or 'scripts' for all of our General Qualifications including Entry Level, GCSE and AS/A Level. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals.

Find out more.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
- **twitter.com/ocrexams**
- **instagram.com/ocrexaminations**
- **linkedin.com/company/ocr**
- **youtube.com/ocrexams**

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to. Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT