Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

J250/12 Summer 2024 series

Version 1

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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.

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Paper 12 series overview

J250/12 is one of six Higher tier papers for the GCSE (9-1) Gateway Science Combined Science A qualification. It is the second of the two physics papers covering Topics P4 Waves and radioactivity, P5 Energy, P6 Global challenges and CS7 Practical skills. There is assumed knowledge of P1 – P3 and this paper includes synoptic assessment. The four other papers in the suite assess biology and chemistry.

To do well in this paper candidates need to apply their knowledge and understanding to new situations and be familiar with a range of practical activities. In this paper the practical activities included measuring reaction time, modelling radioactive decay, working out the speed of sound and investigating refraction of light in terms of the wavelength and speed of different colours of light.

It is important that candidates understand the command words used in the paper and know what is expected as a response for each different command word. The command word 'calculate' was well understood but other words such as 'describe a trend', 'evaluate', 'explain' and 'determine the ratio' were less well understood. For example, in Question 12 (c) (ii) 'Use this equation to evaluate the accuracy of Derham's value for the speed of sound', the 'evaluate the accuracy' was usually ignored or a simple statement about it being accurate or not accurate were given as the answer.

This year the candidates performed better on questions involving calculations, including questions that required the candidate to convert MHz to kHz, mA to A and Parisian feet per second to m/s. This was also true for calculations involving rearranging equations, the use of data from an unusual graphical representation, percentage difference and three different transformer calculation questions.

There was no evidence to suggest that candidates were short of time in answering the questions on this paper and the omit rate was low.

Questions 1, 2 and 11 are overlap questions with the Foundation paper, J250/06.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• recalled that dissipated energy increases a thermal store (Question 5) and that insulation with a greater thickness increases the efficiency of heating a house (Question 7) • managed the unit conversion of MHz to kHz (Question 8) • calculated correctly: height by rearranging the gravitational potential energy equation (Question 3), mass by rearranging the kinetic energy equation (Question 4), the spring constant (Question 9), energy transferred (Question 11 (c)), charge flow (Queston 11 (d) (iii)) and current, efficiency and power (Question 13 (b)) • used information in graphical form to describe a trend (Question 11 (d) (i)), to calculate time (Question 11 (d) (ii)) and to identify isotopes of the same element (Question 14 (a)) • used knowledge of practical techniques to measure reaction time (Question 1), model	• could not recall the names of the two wires in a plug that carry current (Question 11 (a)) and could not describe or draw what happens to the air particles when the sound wave travels through the room in terms of rarefactions and compressions (Question 12 (d)) • could not suggest another reason why it is dangerous to connect the live wire to the earth wire apart from electrocution, electric shock or explosions (Question 11 (b)) • could not calculate the energy transferred in 1 week rather than 1 day (Question 11 (c)) • could not describe the energy changes involved when firing a cannon (Question 12 (a)) • could not balance a nuclear decay equation (Question 14 (c)) • did not read the requirements of the question carefully, for example, in Question 11 (d) (v), only one RCD was required but often both

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
radioactive decay (Question 2) and to work out the speed of sound (Question 12 (b)).	RCD A and RCD B were selected as the best, and in Question 14 (a) where two points were required often more than two points were circled.

Section A overview

This section consists of 10 multiple choice questions testing AO1 and AO2.

Assessment for learning

Candidates who did well on this section generally:

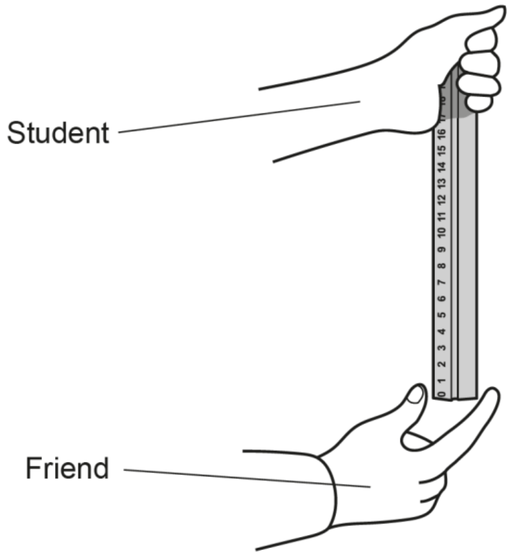
- wrote the equations from the Equation Sheet next to the relevant question
- rearranged the equations for gravitational potential energy and kinetic energy before substituting the numerical values
- worked out which is the larger, MHz or kHz, then crossed out letter A before working through the other distractors methodically
- put each letter carefully in the box provided and ensured letters B and D were not confused by not using lower case letters, for example, a and d
- crossed out letters when changing the answer and wrote the new letter selected next to the box provided.

Questions that were most often answered correctly were 3 and 4. The most challenging questions were 9 and 10. Questions 5 and 6 discriminated well between candidates who achieved different grades.

Almost all candidates completed every question.

Question 1

1 A student uses a ruler to measure a friend's reaction time.



How does the student determine the friend's reaction time?

A Divide the length of the ruler by the time taken to catch the ruler.

B Measure the length of the ruler where the friend catches it and convert to a time.

C Multiply the length of the ruler by the time taken to catch the ruler.

D Time how long it takes the ruler to hit the floor.

Your answer ☐ **[1]**

Few candidates selected the correct answer, B, measure the length of the ruler where the friend catches it and convert it to time. The most common incorrect answer was A, divide the length of the ruler by the time taken to catch the ruler.

Question 2

2 Some students design a practical to model radioactive decay.

Which model is correct?

A Throw a coin in the air 100 times and count the number of heads or tails.

B Throw 10 dice in a tray 10 times and add up the scores.

C Throw 100 dice in a tray and remove the ones with a 6 facing up.

D Throw 100 identical wooden blocks in a tray.

Your answer ☐ **[1]**

Most candidates selected option C, throw 100 dice in a tray and remove the ones with a 6 facing up, as the correct model of radioactive decay. Most of these candidates worked out the possible model by crossing out the other options, A, B and D.

Question 3

3 A bird sits on a branch in a tree.

The mass of the bird is 2.0 kg.
The gravitational potential energy of the bird is 170 J.

What is the height of the bird above the ground?

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

Gravitational field strength = 10 N/kg

A 8.5 m

B 17 m

C 34 m

D 85 m

Your answer ☐ **[1]**

Most candidates chose option A, and most of these showed their working in the 'white space' near the question. They rearranged the equation given in the question and substituted the quantities given in the question to calculate the answer as 170 ÷ (2.0 × 10) = 8.5 m.

Question 4

4 A bus travels at 11 m/s. The kinetic energy of the bus is 726 000 J.

What is the mass of the bus?

Use the equation: kinetic energy = $\frac{1}{2} \times$ mass $\times$ (speed)^2

A 3000 kg

B 6000 kg

C 12 000 kg

D 132 000 kg

Your answer **[1]**

Most candidates chose option C, and most of these showed their working in the 'white space' near the question. They rearranged the equation given in the question and substituted the quantities given in the question to calculate the answer as $(726\,000 \times 2) \div (11)^2 = 12\,000$ kg.

Question 5

5 In energy transfers, some energy is dissipated.

Into which store does the dissipated energy go?

A A chemical store

B A gravitational store

C A nuclear store

D A thermal store

Your answer **[1]**

Most candidates selected option D, a thermal store, as their answer. The most common incorrect answer was option A, a chemical store.

Question 6

6 Wave **X** and wave **Y** are two electromagnetic waves in space.

The frequency of wave **X** is double the frequency of wave **Y**.

Which answer describes the wavelength of wave **X**?

A Double the wavelength of wave **Y**

B Half the wavelength of wave **Y**

C Quadruple the wavelength of wave **Y**

D The same as the wavelength of wave **Y**

Your answer ☐ **[1]**

The relationship between frequency and wavelength of electromagnetic waves in space was well known with most candidates selecting option B, showing that as the frequency of wave X is double the frequency of wave Y it has half the wavelength of wave Y.

Question 7

7 How can a house be heated more efficiently?

A Increase the temperature in the house.

B Turn the radiators on for a longer time.

C Use insulation with a greater thickness.

D Use insulation with a higher thermal conductivity.

Your answer ☐ **[1]**

Most candidates selected option C, use insulation with a greater thickness.

Misconception

A significant number of candidates selected their answer as option D, use insulation with a high thermal conductivity. These candidates perhaps did not appreciate that that having a high thermal conductivity means it is a poor insulator.

Question 8

8 A radio wave has a frequency of 88 MHz.

What is 88 MHz converted to kHz?

A 0.088 kHz

B 88 000 kHz

C 88 000 000 kHz

D 88 000 000 000 kHz

Your answer ☐ **[1]**

Most candidates were able to convert 88 MHz to kHz by multiplying 88 by 1000 to give option B. The most common incorrect answer was option A, 0.088 kHz, where candidates divided 88 by 1000.

Question 9

9 0.18 J of energy is stored in a spring when it stretches by 12 cm.

What is the spring constant of the spring?

Use the Equation Sheet.

A 0.0025 N / m

B 3 N / m

C 12.5 N / m

D 25 N / m

Your answer ☐ **[1]**

Few candidates selected the correct answer, option D, 25 N / m. Most candidates selected option A. These candidates showed their calculation as $0.18 = \frac{1}{2} \times SC \times (12)^2$ rather than $0.18 = \frac{1}{2} \times SC \times (0.12)^2$, so had not converted the 12 cm to 0.12m.

Question 10

10 How do crumple zones make it safer for passengers in cars in a crash?

A They increase the force needed to stop the car.

B They increase the rate of change of momentum of the car.

C They increase the time taken for the car to stop.

D They increase the work done by the brakes.

Your answer [ ] **[1]**

Few candidates selected option C, that crumple zones increase the time taken for a car to stop. The most common incorrect answer was option B, that crumple zones increase the rate of change of momentum of the car.

Misconception

? A significant number of candidates selected their answer as option B, that crumple zones increase the rate of change of momentum of the car. Crumple zones are areas of a car that are designed to crush in a controlled manner during a collision. Crumple zones increase the time taken to change the speed of the passengers in a crash, which reduces the force acting on the passengers.

Section B overview

This section includes short (1 mark) questions, questions requiring longer responses and one Level of Response question (Question 15). This section covers all the assessment objectives, AO1, AO2 and AO3.

Assessment for learning

Candidates who did well on this section generally:

- identified equations from the Equation Sheet and wrote these in the answer space
- gave all steps involved in calculations, so even if the final answer was incorrect, some marks could still be given
- underlined important words in the question, for example, '1 week' in Question 11 (c), 'current of 10 mA' in Question 11 (d) (ii), 'isotopes on the same element' in Question 14 (a) and sees, wavelengths, speeds and refraction in Question 15
- carefully read the information in Question 12 (d) so that the response was about the air particles and not about the general properties of a longitudinal wave
- only circled two points on the graph for Question 14 (a)
- used all the information in the question and ordered the response so that each of the bullet points were fully considered in Question 15
- used the diagram of the prism to write the order of colours as part of the response to Question 15.

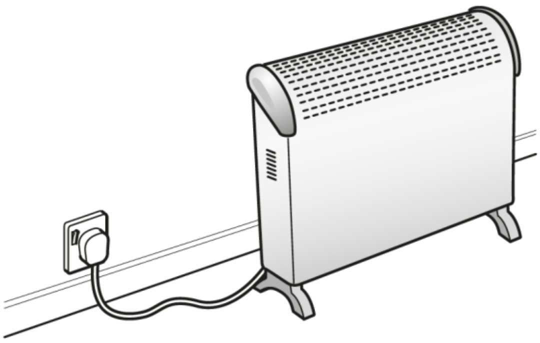
Questions that were most often answered correctly were 11 (c), 11 (d) (ii), 13 (b) (ii) and 13 (b) (iii). The most challenging questions were 12 (b) (ii), 12 (d), 14 (d) and 14 (e). Questions 12 (a), 12 (b) (i) and 15 discriminated well between candidates who achieved different grades.

Almost all candidates completed every question.

Question 11 (a)

11 **Fig. 11.1** shows a heater plugged into an electrical socket.

Fig. 11.1



(a) The heater is operating normally.

What are the names of the two wires in the plug that carry a current?

Tick (✓) **one** box.

Earth and fuse	☐
Earth and neutral	☐
Live and fuse	☐
Live and neutral	☐

[1]

Most candidates identified the live and the neutral as the two wires in the plug that carry a current. Live and fuse were the most common incorrect answer.

Question 11 (b)

(b) A live wire is accidentally connected to the earth wire in the house. This causes a large current to flow in the earth wire.

This can cause electrocution.

Suggest **another** reason why this is dangerous.

....

.... **[1]**

Most candidates suggested that a large current in the earth wire would cause a fire or cause the fuse to blow. Incorrect responses included causing an electric shock, overpowering the earth wire and the whole appliance exploding.

Question 11 (c)

(c) A 2.4 kW heater is used for 2.5 hours each day for 1 week.

Calculate the energy transferred in kWh by the heater in 1 week.

Use the equation: energy transferred = power × time

Energy transferred in 1 week = ... kWh **[2]**

Most candidates were given 2 marks for the answer of 42 (kWh). A few candidates did not calculate the energy transferred in a week, 7 days, and so gave their final answer as 6 (kWh).

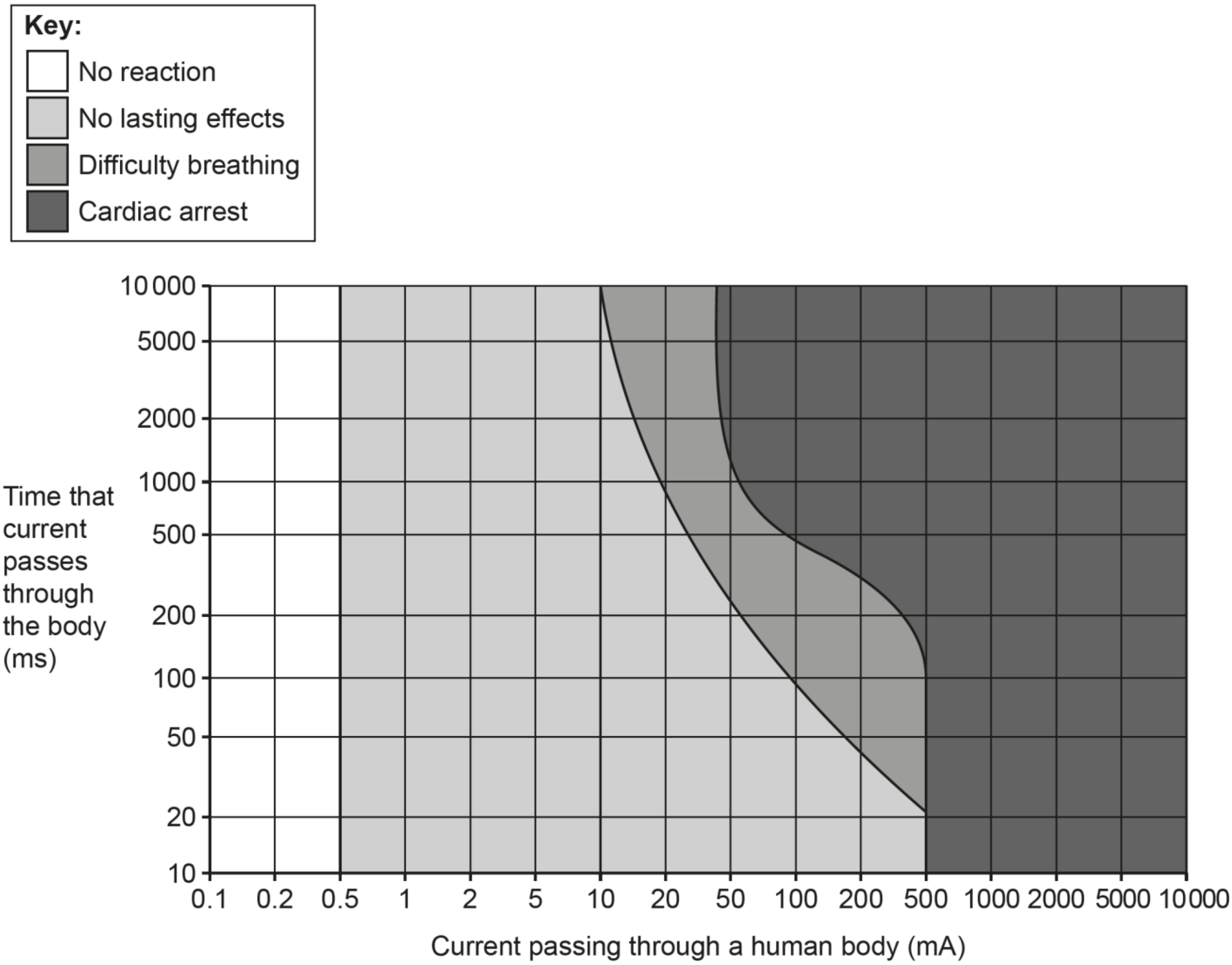
Question 11 (d) (i)

(d) A residual current device (RCD) is a safety feature found in homes.

The RCD turns off the electricity quickly if it detects a fault due to a difference between the current in the live wire and the current in the neutral wire.

Fig. 11.2 shows the effects that mains current has on a human body.

Fig. 11.2



(i) Describe **one** trend shown by **Fig. 11.2**.

....

.... **[1]**

Most candidates described the trend as the current passing through the body increases, the danger increases. A few candidates incorrectly tried to describe that as the current increases the time that the current is passing through the body also increases.

Assessment for learning

In this question the candidate is asked to describe one trend shown in Fig. 11.2.

Some candidates did not describe a trend for the whole graph but selected a single part of Fig. 11.2. These candidates wrote, for example, 'below 0.5 mA there is no danger', this is not a trend. A trend is the overall pattern in a set of results.

Question 11 (d) (ii)

(ii) A current of 10 mA is passing through a human body.

How long can the current pass through the body before the person has difficulty breathing?

.... **[1]**

Most candidates used the information in Fig.11.2 to give the answer of 10 000 (ms), however a few candidates gave the incorrect answer of 10 000 seconds.

Question 11 (d) (iii)

(iii) Calculate the charge flowing when 150 mA is in the human body for 0.3 s.

Use the equation: charge flow = current × time

Charge flow = ... C **[3]**

Most candidates were given 2 marks out of a possible 3 marks for calculating the charge flow. These candidates either did not convert the 150 mA to 0.15 A or incorrectly converted the 150 mA. Many candidates incorrectly converted the 150 mA to 150 000 A.

Question 11 (d) (iv)

(iv) Sensitive RCDs are designed to shut off the electricity supply within 40 ms.

Suggest why this is an important feature for a current of 200 mA. Use **Fig. 11.2**.

....

.... **[1]**

Most candidates suggested that with 40 ms and 200 mA this would prevent difficulty breathing. A few candidates just gave vague responses, for example, safer or less dangerous, so did not demonstrate that they had used the information in Fig. 11.2.

Question 11 (d) (v)

(v) An electrician has a choice of two different RCDs, **A** and **B**, to use in a house.

	RCD A	RCD B
Minimum difference in current needed between the live wire and neutral wire before electricity turns off (mA)	10	30
Time taken to turn off electricity (ms)	100	40

Suggest which RCD the electrician should use in the house.

Give **two** reasons. Use **Fig. 11.2**.

1 ....

....

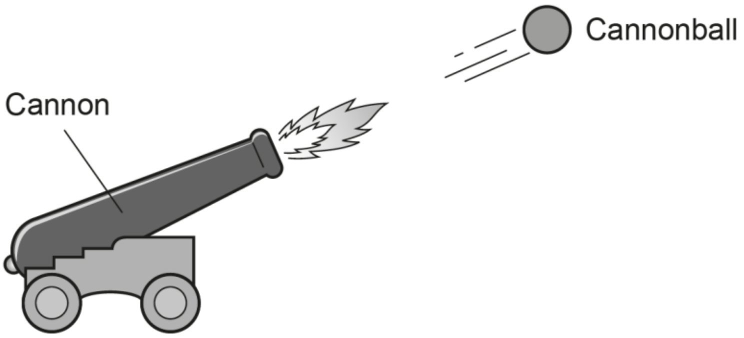
2 ....

....
[2]

Most candidates were given 1 mark for suggesting that the electrician uses RCD B and linked this to being safer because it switches off faster. These candidates found it difficult to give a second reason for using RCD B and often then selected RCD A for a second reason. This approach limited the candidate to just 1 mark.

Question 12 (a)

12 In 1709, William Derham measured the speed of sound using a cannon.



(a) A cannon contains an explosive called gunpowder. When a cannon is fired, the gunpowder acts as a fuel and is ignited. A cannonball moves upwards through the air.

Describe the change in energy stores when a cannon is fired.

....

....

....

.... **[2]**

Most candidates were given 1 mark for this question. This mark was usually for the transfer to a kinetic energy store or gravitational store. These candidates usually did not mention that the gunpowder, a fuel, has a chemical store. Instead, these candidates thought that gunpowder has a nuclear store or thermal energy store.

Question 12 (b) (i)

(b) Derham climbed a church tower to look for the flash from the cannon and to hear its bang.

The cannon was fired a long distance away from the church.

Derham measured the distance between the cannon and the church.

(i) Describe how Derham used the firing of the cannon to work out the speed of sound.

....

....

....

.... **[2]**

Most candidates were given at least 1 mark for this question. These candidates usually explained how to calculate speed using the distance between the cannon and the church divided by time. Many candidates gave vague responses about measuring the time without mentioning the time between seeing the flash and hearing the bang.

Question 12 (b) (ii)

(ii) Why is it important that the cannon is a long distance away?

....

.... **[1]**

Few candidates were given the mark for appreciating why it is important that the cannon is a long distance away from the church. These candidates tended to write about the time being short rather than the idea of a smaller percentage error. A significant number of candidates just wrote about the cannon being dangerous and that the cannon ball would hit the person or the church if it was closer.

Question 12 (c) (i)

(c)

(i) Derham calculated the speed of sound using an old unit of distance called the Parisian foot.

One value he calculated for the speed of sound was 1122 Parisian feet per second.

1 Parisian foot = 32.5 cm

Calculate Derham's value for the speed of sound in **m / s**.

Speed = ... m / s **[2]**

Most candidates were given 2 marks for this answer, clearly showing their steps in the calculation, with a final answer of 364.65 (m / s). Some candidates did not divide by 100 (to convert cm to m) and so gave the answer as 36 465.

Question 12 (c) (ii)

(ii) Today, scientists know the speed of sound is 1056 Parisian feet per second.

The percentage difference between Derham's value and today's value for the speed of sound is calculated using this equation:

$$\text{percentage difference} = \frac{(\text{Derham's value} - \text{today's value})}{\text{today's value}} \times 100\%$$

Use this equation to evaluate the accuracy of Derham's value for the speed of sound.

....

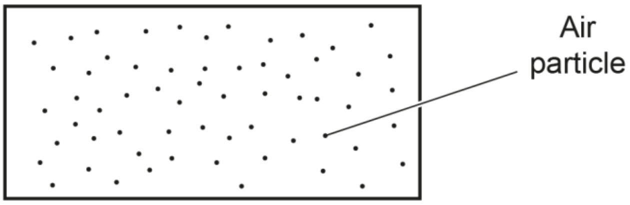
.... **[3]**

Most candidates were given 2 out of the 3 marks for this question. These candidates calculated the percentage difference as 6.25 (%) but then did not use this percentage to evaluate the accuracy.

Question 12 (d)

(d) **Fig. 12.1** shows air particles in a room.

Fig. 12.1

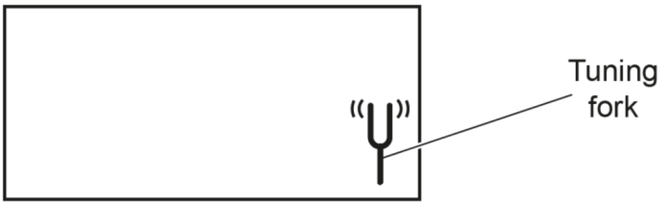


A scientist produces a sound wave in the room using a vibrating tuning fork.

Describe what happens to the air particles when the sound wave travels through the room as a longitudinal wave.

You can draw on **Fig. 12.2** to support your answer.

Fig. 12.2



....

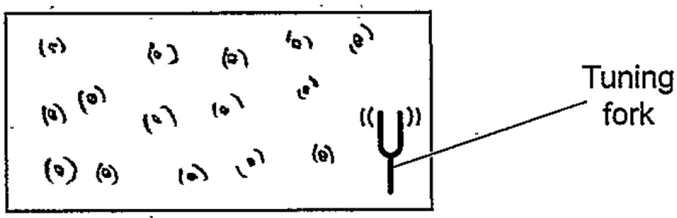
....

....

.... **[2]**

Few candidates were given marks for this question. Many candidates did not describe what happens to the air particles but stated that the wave oscillates rather than the air particles oscillate. The diagrams were usually just of a wave or air particles evenly or randomly spaced rather than as compressions and rarefactions. The diagrams were often not labelled or just labelled with compressions. 'Refractions' was often seen instead of 'rarefactions'.

Exemplar 1



when the air particles vibrate, they create an area that will blur out other soundwaves travelling through them. **[2]**

In this response the candidate has drawn evenly spaced air particles and has made them appear to be vibrating. This on its own would not be sufficient to gain the air particles vibrate mark. The candidate is given 1 mark for stating that the air particles vibrate on the response lines. There is no mention of compressions and rarefactions in this response.

Question 13 (a)

13 This question is about transformers.

(a) Complete the sentences to describe how transformers are used in the national grid.

Put a (ring) around each correct option.

A **step-up** / **step-down** transformer increases **current** / **potential difference** at the power station.

A **step-up** / **step-down** transformer **increases** / **decreases** potential difference locally for domestic use. **[1]**

Most candidates were given the mark for putting a ring around each of the four correct options. The most common incorrect response was to put a ring around current rather than potential difference in the first sentence.

Question 13 (b) (i)

(b) A student researches three different transformers **A**, **B** and **C**.

(i) Transformer **A** is used to decrease a potential difference from 240 V to 20 V.

The current in the primary coil is 0.8 A.

Calculate the current in the secondary coil.

Use the Equation Sheet.

Current = ... A **[2]**

Most candidates were given 2 marks for calculating the current in the secondary coil as 9.6 (A).

Misconception

A significant number of candidates subtracted the 20 V from the 240 V before calculating the current in the secondary coil. These candidates correctly copied the equation

potential difference across primary coil × current in primary coil =

potential difference across secondary coil × current in secondary coil

but then used 220 V as the potential difference across primary coil in their calculation.

Question 13 (b) (ii)

(ii) Transformer **B** is used in a lighting circuit.

The energy input to the primary coil is 175 J.

The energy output from the secondary coil is 140 J.

Calculate the efficiency of the transformer.

Use the Equation Sheet.

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

Most candidates were given 3 marks for the answer of 0.8 or 80%. A few candidates gave answers of 0.8%, 80 J or just 80 and so were only given 2 marks as the unit used was incorrect.

Question 13 (b) (iii)

(iii) A lamp is connected to the secondary coil of transformer **C**.

The current in the lamp is 0.25A. The resistance of the lamp is 800 Ω.

The lamp is at its normal brightness.

Calculate the output power of transformer **C**.

Use the Equation Sheet.

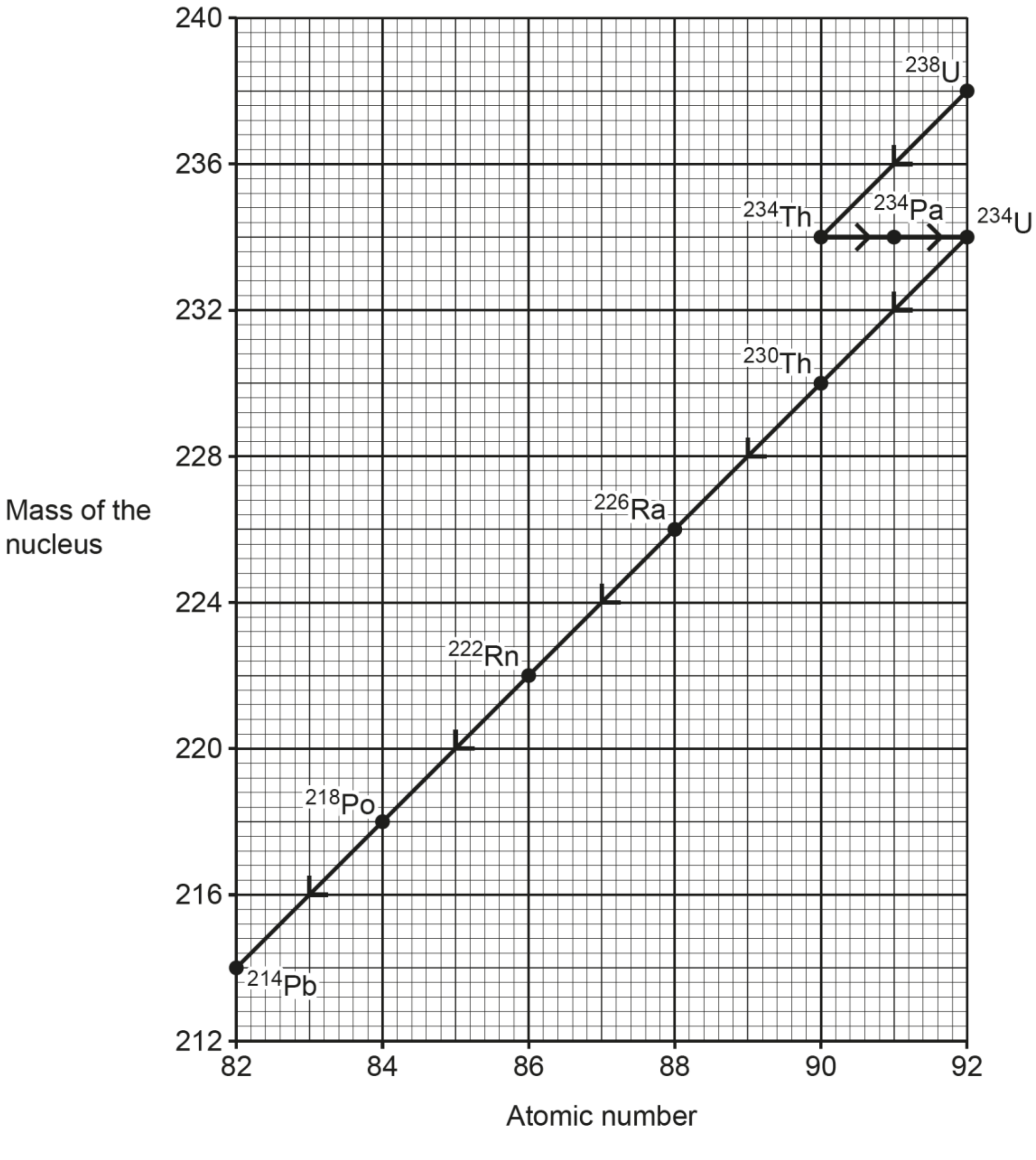
Power = ... W **[3]**

Most candidates were given 3 marks for the calculation of power being 50 (W). A few candidates correctly gave the equation as power = $(\text{current})^2 \times$ resistance from the Equation Sheet but then did not square the current in their calculation.

Question 14 (a)

14 When uranium-238 decays, it forms isotopes of different elements.

The graph shows part of the decay chain produced when uranium-238 decays.



(a) Circle **two** points on the graph which are isotopes of the same element.

Explain how you worked out your answer.

....

.... **[2]**

Most candidates were given 2 marks for this question. A few candidates circled four points on the graph and so were not given this mark unless it was clear than the four points circled were pairs of isotopes of the same element.

Question 14 (b) (i)

(b)

(i) Describe what happens to the atomic number and mass of a nucleus of ^{234}Th as it decays into ^{234}Pa.

Atomic number ....

Mass ....

[2]

Most candidates were given at least 1 mark for describing that the mass stays the same. Fewer candidates were given the second mark for describing the atomic number as increasing by 1. These candidates tended to just write that the atomic number changes, or changes by 1, or is 91 or as going from 90 to 91 without actually describing the change as increasing by 1.

Question 14 (b) (ii)

(ii) Which type of radiation is emitted when ^{234}Th decays into ^{234}Pa?

.... **[1]**

Most candidates identified the type of radiation as beta but a range of incorrect answers, for example, alpha, gamma, nuclear, atomic, ionising and wave, were seen.

Question 14 (c)

(c) Complete the **balanced nuclear decay equation** for the decay of ^{222}Rn into ^{218}Po.

$$^{222}_{\ldots\ldots}\text{Rn} \longrightarrow \,^{218}_{\ldots\ldots}\text{Po} + \,^{\ldots\ldots}_{\ldots\ldots}\text{He}$$

[2]

Most candidates were given 2 marks for the completion of the balanced nuclear decay equation. The 4 and 2 for He was usually correct with a few candidates incorrectly writing 84 for Rn and 86 for Po or 2 for Rn and 2 for Po.

Question 14 (d)

(d) Eventually the isotope ^{206}Pb is formed and the decay chain stops.

Explain why the decay chain stops at ^{206}Pb.

.... **[1]**

Few candidates explained that the decay chain stops because ^{206}Pb is stable. There were many incorrect answers, for example, it has decayed, it is a different element, it is a heavy element, it has reached its half-life or the half-life slows down.

Question 14 (e)

(e) The half-life of ^{238}U is 4.5×10^9 years.

Determine the ratio of ^{238}U : ^{234}Th after 1.8×10^{10} years.

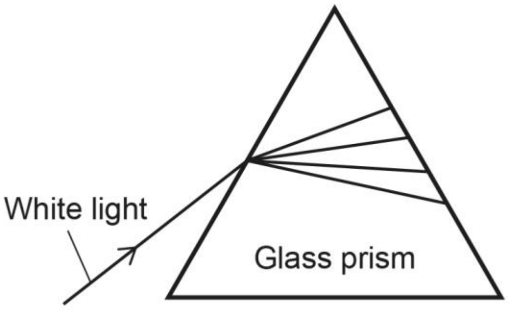
Ratio of ^{238}U : ^{234}Th = ... : .... **[3]**

Few candidates were awarded full marks for this question. Some candidates calculated the time as 4 half-lives, but many multiplied or added $4.-5 \times 10^9$ and 1.8×10^{10} together.

Question 15*

15* A student shines a ray of white light from air into a glass prism.

White light is made up of many different colours of light. The diagram shows the path of **four** of these colours of light in the prism.



The speed of these four colours of light in air is 3.0×10^8 m/s.

The table shows the wavelengths and the speeds of these four different colours of light in the glass prism.

Colour	**Wavelength in glass prism (nm)**	**Speed in glass prism (m/s)**
Red	640	1.986×10^8
Yellow	589	1.984×10^8
Blue	486	1.976×10^8
Violet	434	1.971×10^8

Describe:
- what the student sees when the light travels into the glass prism
- the relationship between the wavelengths of the four different colours of light and their speeds in the glass prism.

Explain your answer using the data in the table and ideas about refraction.

....

....

....

....

....

.... **[6]**

This is the Level of Response question. This question was attempted by the majority of candidates and the full range of the marks available were given. Where a candidate had used the diagram of the prism in the question to write their answers this was also considered as part of their response. Most candidates gained credit for AO2.2 by describing what the student sees in simple terms, for example, the different colours spread out. These candidates also gained credit for AO3.1a by analysing the information to show a simple relationship between wavelength and speed in glass, for example, as wavelength decreases the speed in glass decreases. Some candidates thought that the light was reflected when it enters the prism or that red light is refracted away from the normal. A significant number of candidates thought that as the wavelength increases the speed decreases. Some candidates just quoted all the data given in the table without describing the relationship between wavelength and speed. Fewer candidates were able to give detailed descriptions for AO2.2 or detailed explanations for AO3.1a and AO3.2b.

Exemplar 2

The student would see the red light first and the violet light last. The red would also be a lot more visable because it has a higher wavelength. It would be difficult to see the violet light as it has a lower wave length. The yellow and blue lights would be easier to see than the violet but not as well as the red.

In this response the candidate thinks that as the speed of red light is the greatest that it will appear first and that as red light has a higher wavelength it would be more visible. These were common misconceptions for responses that were only given Level 1. In this response there is no mention of the different colours being spread out, AO2.2. The candidate has only used the data in the table to state that red has a larger wavelength, AO3.1a, so just Level 1 and 1 mark given.

Exemplar 3

When light is shone into a prism it refracts (bends) and it also slows down. The white light is split into the four different colours of visible light. The more refracted a colour is (the more it bends) the ~~longer its~~ shorter its wavelength and higher the frequency. The beams of light that are more refracted have more of the prism to get through. Therefore if Red has a wavelength of 640 nm then it has ~~been~~ refracted the least amount and has a quicker speed of 1.986×10^8 through prism. Compare this too violet **[6]**

15 light which has the shortest wavelength at 434 nm and travels the slowest speed through the glass 1.971×10^8. Therefore the shorter the wavelength, the more it refracts and the longer it takes inside the glass prism.

In this response the candidate has described that white light is split/spread into different colours of light and that red is refracted the least amount. This is a detailed explanation of what the student sees. The candidate has identified that the different colours have different wavelengths. The candidate has stated that light slows down when it enters the prism. Also, that red light is refracted the least and then linked this to red light having a higher speed. We have ignored references to frequency. Therefore, a good comparison and analysis for AO3.2b, so Level 3 and 6 marks given.

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