

**GCSE (9-1)**

**Examiners' report**

**GATEWAY SCIENCE  
COMBINED  
SCIENCE A**

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**J250**

For first teaching in 2016

**J250/06 Summer 2023 series**

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## 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 6 series overview

J250/06 is the second physics Foundation tier paper in the Gateway GCSE Combined Science suite. It assesses content from specification topics P4-P6. It also assumes knowledge of the topics in P1-P3. To perform well on this paper, candidates need to have a sound knowledge of the theory covered in topics P4-P6 and be able to apply this to novel situations. They also need to apply the skills and understanding that they have developed in the practical activities covered in topic CS7. This paper also contains questions that have elements of synopticity, drawing on material covered by topics P1-P3. There are also questions that involve the examination of key mathematical requirements from Appendix 5f of the specification.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
<ul style="list-style-type: none"> <li>• performed calculations involving substituting into equations on Question 11 (d) (iii), Question 15 (a) and (b) and Question 17 (f)</li> <li>• always showed their working out, picking up credit for manipulating equations and substitutions on Question 15 (b) and Question 17 (f)</li> <li>• had an understanding of standard form on Question 17 (c) and (d)</li> <li>• demonstrated good knowledge, identifying alpha, beta and gamma radiation on Question 13</li> <li>• correctly interpreted the information from tables on Question 13 and graphs and charts, Question 11 (d) (ii) and (iii), Question 12 (c) and Question 17</li> <li>• applied their knowledge of physics concepts to novel situations on Question 14 (b) and Question 17.</li> </ul>	<ul style="list-style-type: none"> <li>• found questions that depended on recall of prior knowledge difficult, e.g. Question 2, Question 11 and Question 14</li> <li>• did not show working out in calculations on Question 11 (d) (iii), Question 15 (a) and (b) and Question 17 (f)</li> <li>• could not interpret results of an experiment for comparing different types of radioactive sources on Question 13</li> <li>• found scales on graphs difficult on Question 12 (c).</li> </ul>

## Section A overview

This section consisted of ten multiple choice questions. Virtually all candidates attempted these questions. Questions 1, 3, 4, 5, 6 and 10 were generally well answered and tended to be questions using mathematical skills. Question 2, which required background knowledge (AO1), was not so well answered.

### Question 1

- 1 In an experiment, three students work out values for the speed of sound.

Student	Speed of sound (m/s)
1	313
2	330
3	320

What is the **range** of values for the speed of sound?

- A 313 m/s – 320 m/s
- B 313 m/s – 330 m/s
- C 320 m/s – 330 m/s
- D 321 m/s – 330 m/s

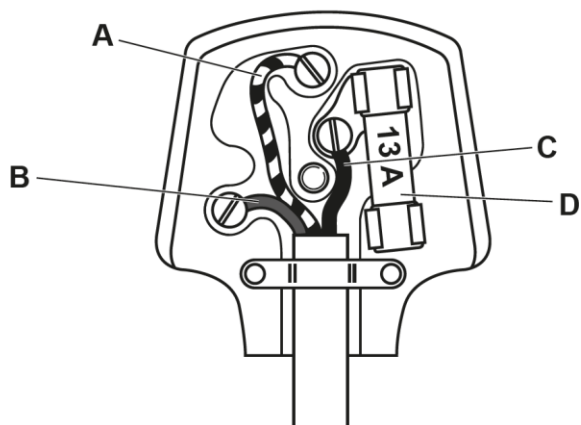
Your answer

[1]

This question was generally well answered.

## Question 2

2 Which part of the plug is connected to the metal case of an appliance?



Your answer

[1]

This question was not well answered, D was the most common incorrect response.

## Question 3

3 A student calculates the efficiency of an energy transfer.

The input energy is 1600 J.

The useful output energy is 1200 J.

Which answer shows the correct calculation?

Use the Equation Sheet.

A Efficiency =  $\frac{400}{1600}$

B Efficiency =  $\frac{1200}{1600}$

C Efficiency =  $\frac{1600}{1200}$

D Efficiency =  $\frac{1600}{400}$

Your answer

[1]

This question was generally well answered.

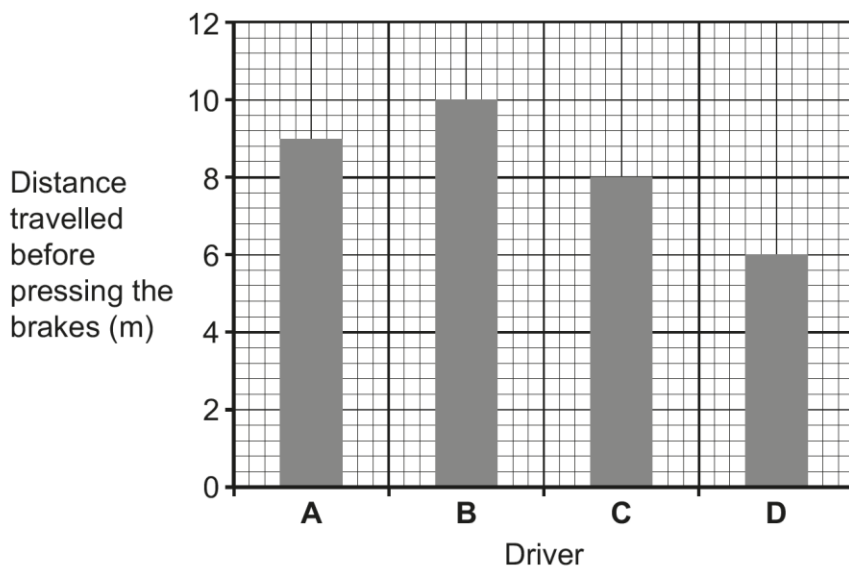
## Question 4

4 Four drivers travel along the same road at 30 mph.

Each driver sees a red traffic light.

The graph shows the distance each driver travels after seeing the red light, but before pressing the brakes.

Which driver has the **quickest** reaction time?



Your answer

[1]

Most candidates correctly answered this question.



## Question 5

5 A 200 g bar of chocolate is melted in a saucepan.

The specific latent heat of melting chocolate is 31.2 J/g.

How much energy is needed to melt the bar of chocolate?

Use the equation: thermal energy for a change in state = mass  $\times$  specific latent heat

A 0.156 J

B 6.24 J

C 156 J

D 6240 J

Your answer

[1]

Most candidates correctly answered this question.

## Question 6

6 A transformer has an output potential difference of 24 V.

The output current is 5 A.

What is the power output of the transformer?

Use the Equation Sheet.

A 0.21 W

B 4.8 W

C 120 W

D 240 W

Your answer

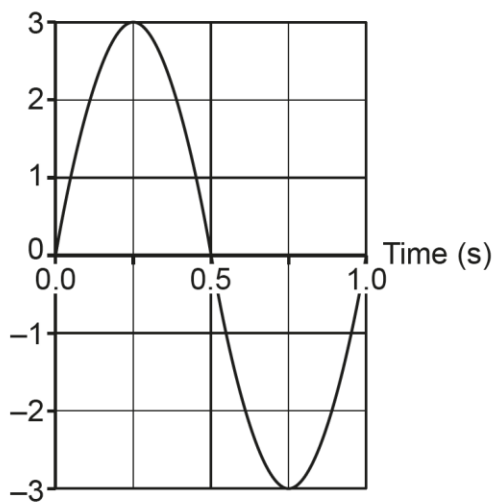
[1]

Most candidates correctly answered this question.

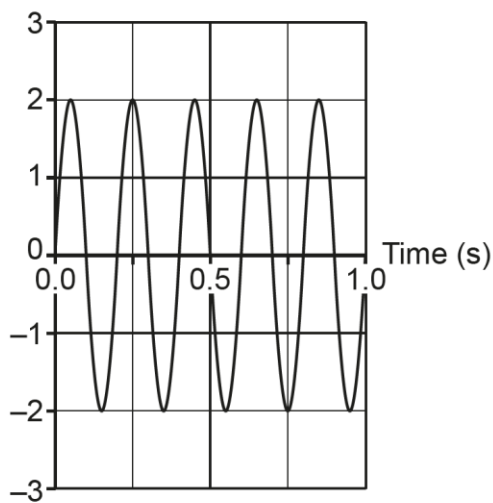
### Question 7

7 Which wave has the **highest** frequency?

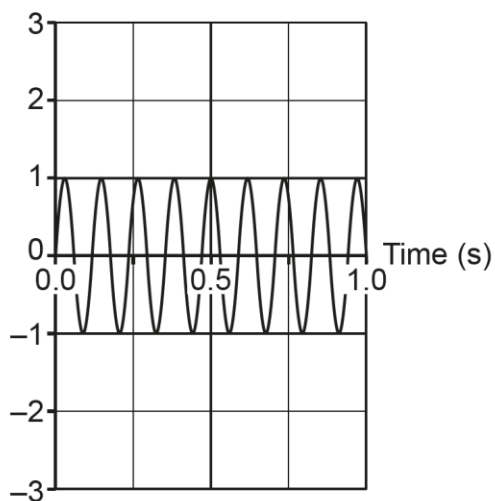
**A** Height (cm)



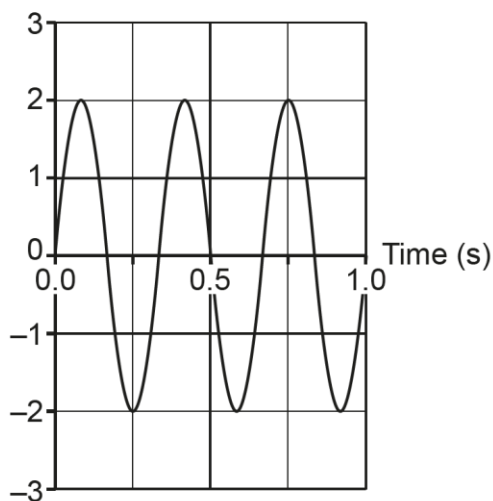
**B** Height (cm)



**C** Height (cm)



**D** Height (cm)



Your answer

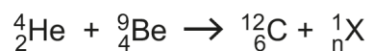
[1]

This question was generally well answered. A and B were common incorrect answers.

## Question 8

8 When an alpha particle hits a beryllium nucleus, a particle 'X' is emitted.

What is the missing number, labelled **n** in the equation?



- A -1
- B 0
- C 1
- D 2

Your answer

[1]

Candidates answered this question reasonably well. A was the most common incorrect response.

## Question 9

9 Which sentence describes the **law of conservation of energy**?

- A Energy can be created in a power station.
- B Energy can be transferred into power.
- C Energy can only be transferred between stores.
- D Energy can only be destroyed in the surroundings when it is wasted.

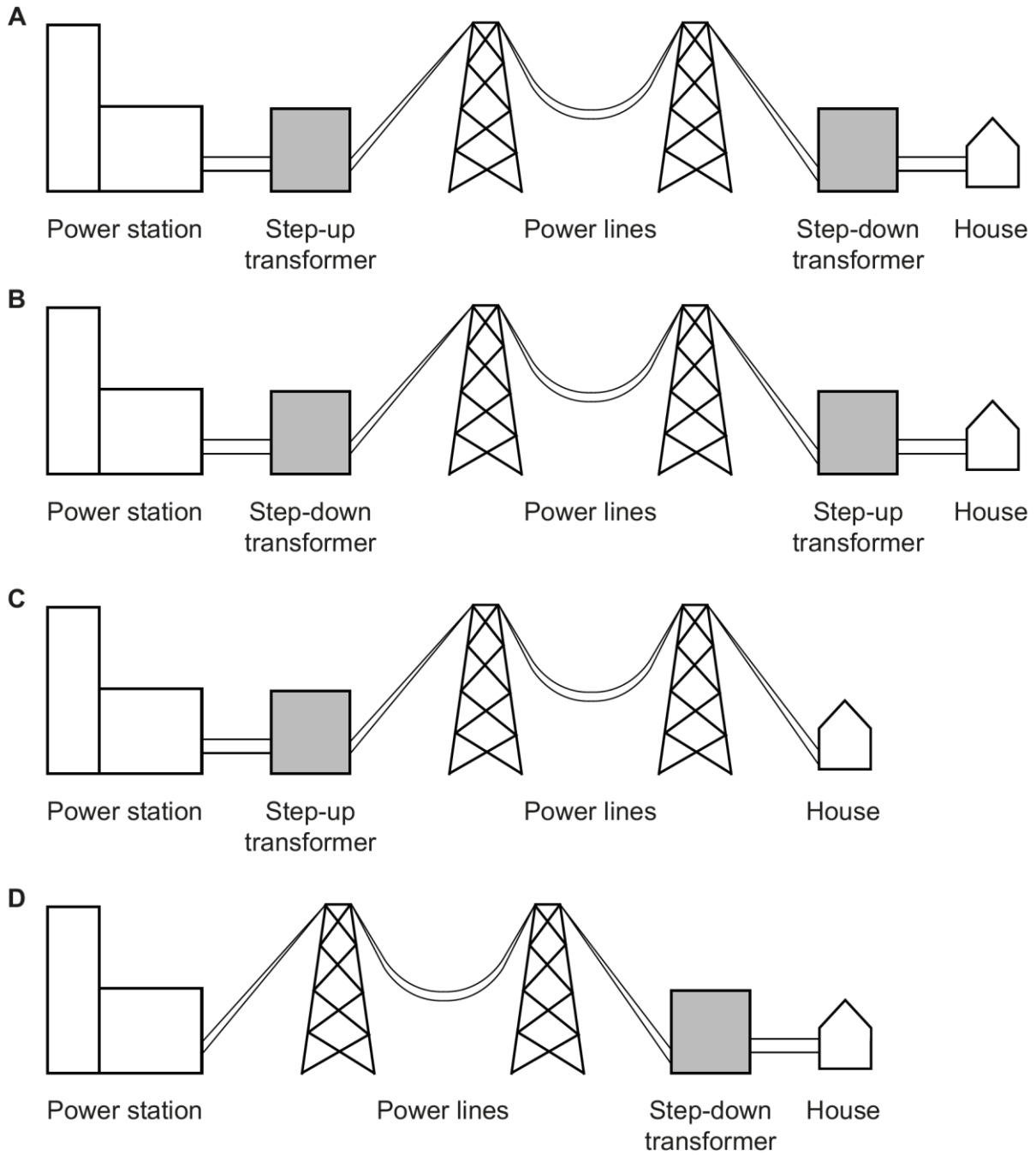
Your answer

[1]

This question was generally well answered. B was a common incorrect answer.

### Question 10

10 Which diagram shows how transformers are used in the national grid?



Your answer

[1]

Most candidates correctly answered this question.

## Section B overview

The questions in this section were mostly short, structured questions or calculations. There was one 6-mark level of response question.

### Question 11 (a)

11 (a) Which sentence is a **disadvantage** of using wind turbines?

Tick (✓) **one** box.

They are a renewable energy resource.

They make carbon dioxide.

They make dangerous waste products.

They make noise pollution.

[1]

This question was generally well answered. 'They make dangerous waste products' was a common incorrect answer.

### Question 11 (b)

(b) Which sentence is an **advantage** of using solar panels?

Tick (✓) **one** box.

They can be used in remote locations.

They generate electricity at night.

They make acid rain.

They produce harmful gases.

[1]

Most candidates correctly answered this question.

### Question 11 (c)

(c) Which energy resource produces the most energy per kilogram of fuel?

Put a **ring** around the correct answer.

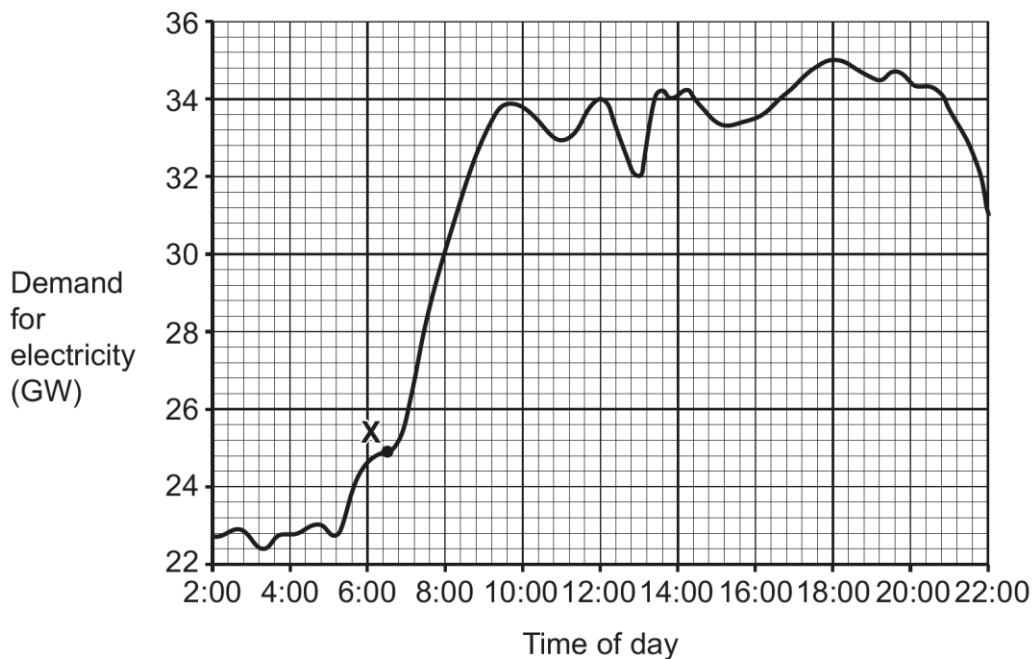
- coal**                      **gas**                      **oil**                      **nuclear**

[1]

Candidates answered this question reasonably well. 'Oil' was the most common incorrect response.

### Question 11 (d) (i)

(d) The graph shows how demand for electricity changes during a typical day.



(i) Which energy resource can be used to cope with the extra demand for electricity starting at **X**?

Put a **ring** around the correct answer.

- tidal**                      **gas**                      **wind turbines**                      **solar**

[1]

The correct option was seldom selected. Most candidates incorrectly answered 'solar'.

## Question 11 (d) (ii)

- (ii) Use the graph to estimate the **maximum** demand for electricity.

Maximum demand = ..... GW [1]

Most candidates answered this question correctly.

## Question 11 (d) (iii)

- (iii) At 12:00, the demand for electricity is 34 GW.

Calculate the percentage decrease in demand for electricity from 12:00 to 13:00.

Use the equation: percentage decrease =  $\frac{\text{decrease in demand}}{\text{demand at 12:00}} \times 100 \%$

Give your answer to 1 decimal place.

Percentage decrease = ..... % [3]

Many candidates answered this question well, but it was common to incorrectly substitute the demand at 13:00 into the equation in place of the decrease in demand; see Exemplar 1. It was common to see an incorrect value on the answer line with no working out shown. This prevented the decimal place mark being given as an error carried forward.

## Exemplar 1

Use the equation: percentage decrease =  $\frac{\text{decrease in demand}^{\overset{32}{\downarrow}}}{\text{demand at 12:00}^{\underset{34}{\downarrow}}} \times 100\%$

Give your answer to 1 decimal place.

$$32 \div 34 \times 100 = 94.11764706$$

Percentage decrease = .....  $94.1$  ..... %

The candidate in Exemplar 1 made the common mistake of using the demand at 13:00, rather than calculating the change in demand, and substituting this into the given equation. No mark was therefore given for the calculation. They rounded their answer correctly, so they picked up the mark for giving their answer to 1 decimal place.



### Question 11 (d) (iv)

(iv) Suggest a reason for the decrease in demand for electricity at 12:00.

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

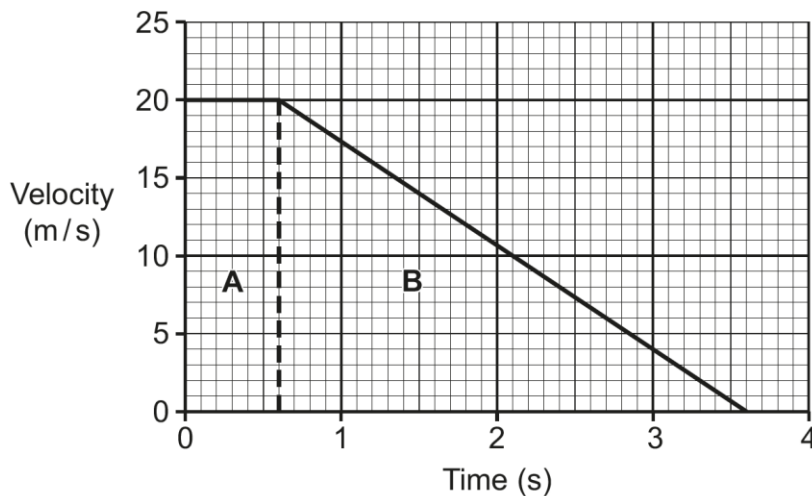
This question was not well answered, there was a lot of confusion with two main mistakes:  
'It's midday and bright outside so people don't need the lights on.'  
'It's lunchtime so people need to cook their food.' This would result in increased demand.

### Question 12 (a) (i)

12 (a) A car travels along a road at 20 m/s.

Fig. 12.1 shows how the velocity of the car changes when the driver sees a hazard in the road at time = 0 seconds.

Fig. 12.1



(i) Describe the motion of the car in part B of Fig. 12.1.

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

Many candidates answered this question well. Common errors included describing the car as braking/stopping, rather than describing motion: decelerating/slowing down.

## Question 12 (a) (ii)

- (ii) Name the distance travelled by the car in part **A** of **Fig. 12.1**.  
Tick (✓) **one** box.

Braking distance	<input type="checkbox"/>
Stopping distance	<input type="checkbox"/>
Thinking distance	<input type="checkbox"/>

[1]

Candidates answered this question well. Braking distance was the most common incorrect response.

## Question 12 (a) (iii)

- (iii) Calculate the distance travelled by the car in part **A** of **Fig. 12.1**.

Use the equation: distance travelled = speed × time

Distance travelled = ..... m [2]

Many candidates correctly answered this question scoring both marks. A common error was to multiply 20 by 3.6 (the total time for the car to come to a stop).

Question 12 (b)

(b) Draw lines to match each **situation** to its correct **speed**.

Situation	Speed (m/s)
cycling	1
an aeroplane flying	30
walking	10
car travelling on a motorway	250

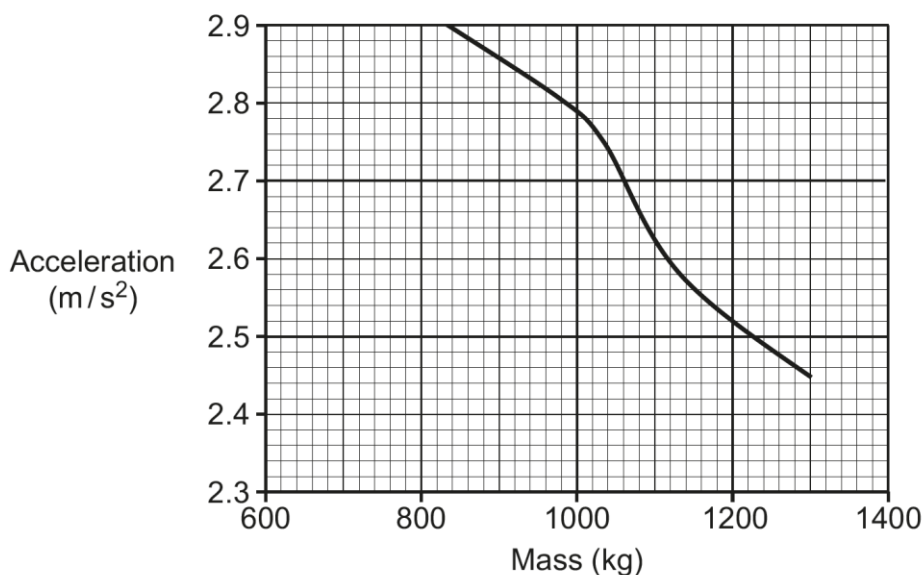
[2]

Most candidates answered this question correctly scoring both marks.

Question 12 (c) (i)

(c) Fig. 12.2 shows how acceleration changes with the mass of a car.

Fig. 12.2



(i) Use Fig. 12.2 to determine the acceleration of a car with a mass of 960 kg.

Acceleration = ..... m/s<sup>2</sup> [1]

Candidates answered this question reasonably well. A common incorrect answer was 2.8.

### Question 12 (c) (ii)

- (ii) Use **Fig. 12.2** to estimate the acceleration of a car with a mass of 1400 kg. Show your working on the graph.

Acceleration = ..... m/s<sup>2</sup> [2]

Most candidates correctly answered this question scoring both marks. Many candidates showed their extrapolation on the graph, this allowed 1 mark to be given even when their answer was out of the acceptable range.

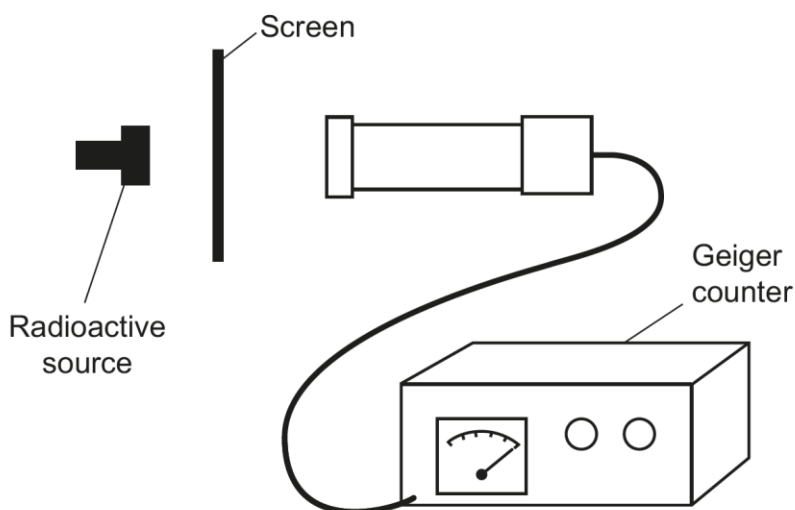
### Question 13\*

**13\*** Alpha, beta and gamma radiation have different penetrating powers.

A teacher investigates whether a radioactive source is emitting alpha, beta or gamma radiation.

They place different types of screens between the source and a Geiger-Müller tube.

The diagram shows the teacher's experiment.



The table shows the data the teacher collects.

Type of screen	Source	Count rate (counts per minute)
none	no	20
none	yes	2010
paper	yes	2000
4 mm thick aluminium sheet	yes	18

.....

.....

.....

.....

.....

.....

[6]

Many candidates attempted the question. To achieve beyond Level 1, candidates needed to use the data to identify the type of radiation and give some differences between alpha, beta, and gamma. However, most candidates found it difficult to interpret the table and so did not achieve Level 2. Several candidates thought that the materials of paper/aluminium/gamma are giving out radiation. Candidates mostly obtained Level 1 marks for knowing the penetrating abilities and other properties of the different types of radiation. Successful candidates ruled out alpha as the particles could not pass through paper, or (more rarely) ruled out gamma as the particles did not pass through the aluminium sheet. The best candidates opted for beta, as it passed through paper but not aluminium.

### Misconception

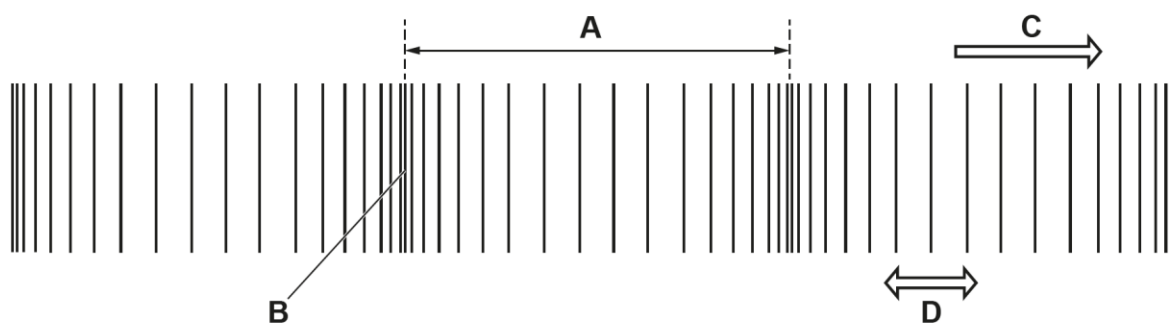


Some candidates thought the radiations were coming from the materials rather than being stopped by them.

Some candidates thought the increase in the final value of the table was due to gamma radiation rather than the randomness of count rates.

### Question 14 (a) (i)

14 (a) The diagram shows a sound wave.



(i) Write the letter **B**, **C** or **D** in the correct boxes to label the diagram.

One has been done for you.

Direction of wave travel

Direction of particle vibration

Compression

Wavelength

[2]

Most candidates correctly answered this question. It was rare for a mark of zero to be given.

## Question 14 (a) (ii)

- (ii) Which type of wave is a sound wave?  
Tick (✓) **one** box.

Amplitude wave

Longitudinal wave

Transverse wave

Water wave

[1]

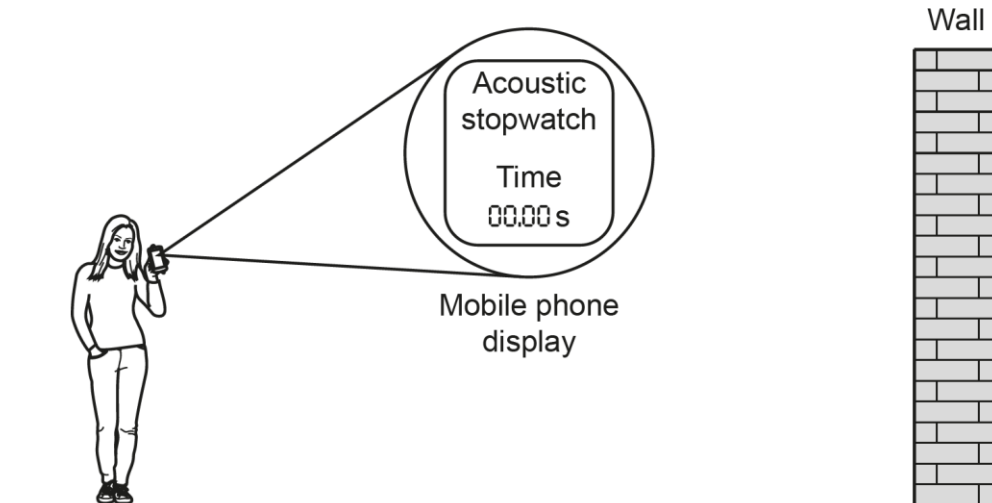
This question was not well answered with 'amplitude wave' and 'transverse wave' chosen frequently.

### Question 14 (b) (i)

- (b) A student downloads a physics app to their mobile phone. The app contains an 'acoustic stopwatch'.

The app works like this:

- When the microphone detects a loud sound, the acoustic stopwatch starts.
- When the microphone detects the next loud sound, the acoustic stopwatch stops.



- (i) Describe how the student can use the app to measure the speed of sound. Include the names of **other** equipment that the student will need to use.

.....

.....

.....

.....

.....

.....

..... [3]

Very few candidates were given full marks for this question. The most common mark was for 'making a sound', although the less successful candidates often contradicted this by adding a second sound.

Marks were given for the measuring instrument and the formula more often than for identifying that the distance between the phone and the wall should be measured.

Other common mistakes were bouncing an object off the wall and trying to use frequency and wavelength to find the speed of sound.

Question 14 (b) (ii)

(ii) Another student suggests using this stopwatch.



Suggest why the 'acoustic stopwatch' on the mobile phone app is an improvement on using this stopwatch.

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

Most candidates correctly answered this question, recognising that as there is no human reaction time, the acoustic stopwatch was more accurate.

Question 14 (c)

(c) The wavelength of a sound wave is 0.55 m.

The speed of sound in air is 330 m/s.

Calculate the frequency of the sound wave.

Use the Equation Sheet.

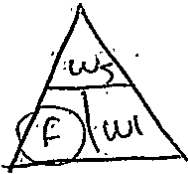
Frequency = ..... Hz [3]

Most candidates answered this question correctly. Some candidates struggled to rearrange the equation but those who showed their working gained the mark for taking the correct equation from the data sheet.



Exemplar 2

Wave Speed = Frequency x Wavelength

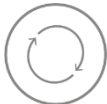


Wave speed  $\div$  Wave length  
 $330 \text{ m/s} \div 0.55 \text{ m}$   
 $= 600 \text{ Hz}$   
 $6 \times 10^2 \text{ Hz}$

Frequency = 600 ..... Hz [3]

This shows a good example of how to lay out an answer to this type of calculation. The formula taken from the data sheet is written down. It is then clearly rearranged, and numbers are substituted in before the final answer is given. The attempt to use standard form is ignored, as the correct answer scored the 3 marks.

**Assessment for learning**



When doing a calculation, working should always be shown, so credit can be given even if the final value is incorrect.

**Question 15 (a)**

**15 (a)** A car has a mass of 1100 kg.

Calculate the kinetic energy of the car when it is travelling at 10 m/s.

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

Kinetic energy = ..... J [2]

Most candidates answered this question correctly. A common error was not to square the speed.

**Question 15 (b)**

**(b)** When the car has a kinetic energy of 140 000 J, the driver presses the brakes.

Calculate the braking force if the car stops in a distance of 40 m.

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

Braking force = ..... N [2]

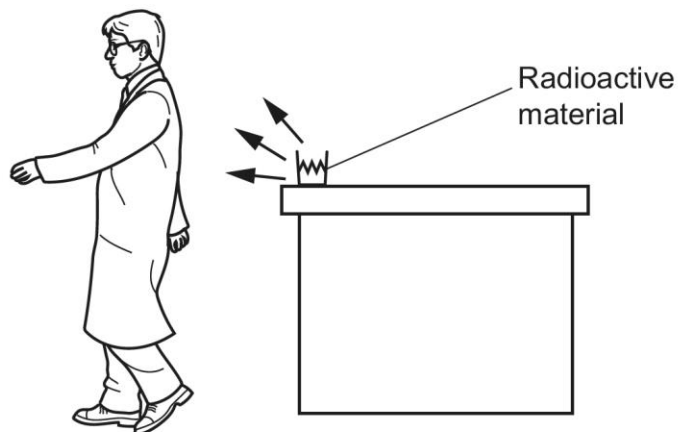
Most candidates attempted this question. The common mistake was to multiply the two numbers given in the question.

## Question 16 (a)

- 16 A scientist is working with a radioactive material.  
The radioactive material emits **beta** radiation.

(a) Fig. 16.1 shows the scientist walking very close to the radioactive material.

Fig. 16.1



Describe the effect of the radioactive material on the scientist as they walk past.

Tick (✓) **one** box.

They have been irradiated only.

They have been contaminated only.

They have been irradiated and contaminated.

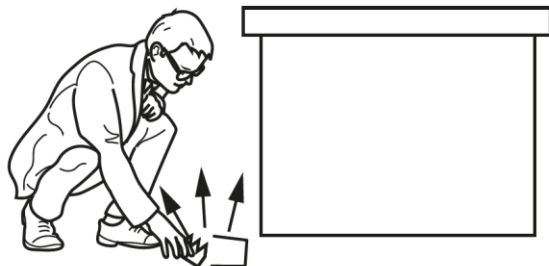
They have **not** been irradiated or contaminated.

[1]

Candidates answered this question well. 'They have been contaminated only' was the most common incorrect response.

## Question 16 (b)

- (b) In **Fig. 16.2**, the scientist knocks the radioactive material onto the floor. They pick up the radioactive material with their bare hands.

**Fig. 16.2**

Describe the effect of the radioactive material on the scientist as they pick it up.

Tick (✓) **one** box.

They have been irradiated only.

They have been contaminated only.

They have been irradiated and contaminated.

They have **not** been irradiated or contaminated.

[1]

Most candidates answered this question correctly.

## Question 16 (c)

- (c) Fig. 16.3 shows the scientist standing behind a lead screen and a lead-glass window. They use a robotic arm to handle the radioactive material.

Fig. 16.3



Describe the effect of the radioactive material on the scientist when they are behind the lead screen.

Tick (✓) **one** box.

They have been irradiated only.

They have been contaminated only.

They have been irradiated and contaminated.

They have **not** been irradiated or contaminated.

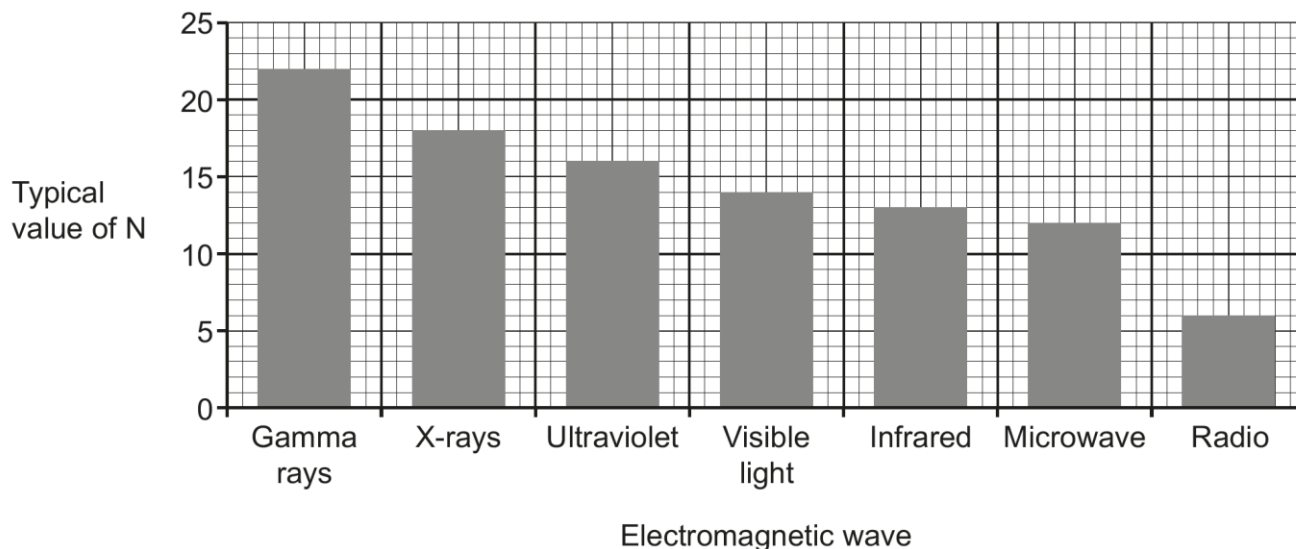
[1]

Most candidates answered this question correctly.

### Question 17 (a)

17 The frequency of electromagnetic waves can be written as  $1 \times 10^N \text{ Hz}$ .  
 N is an integer (a whole number).

The graph shows the typical values of N for different electromagnetic waves.



(a) Which electromagnetic wave has the **highest** frequency?

..... [1]

Most candidates answered this question correctly.

### Question 17 (b)

(b) Which electromagnetic wave is the **most** dangerous?

..... [1]

Most candidates answered this question correctly.

### Question 17 (c)

(c) Ultraviolet waves have a greater frequency than visible waves.

How many times greater?

Put a ring around the correct answer.

$10^2$        $10^3$        $10^{13}$        $10^{14}$        $10^{16}$       [1]

About half the candidates identified the correct answer. It was common to see  $10^3$  as an incorrect answer.

## Question 17 (d)

(d) What is the frequency of a typical radio wave on the graph?

Write your answer as an ordinary number without standard form.

Frequency = ..... Hz [2]

Many candidates took 6 from the chart and gave this as an answer but could not relate this to standard form.

## Question 17 (e)

(e) Which sentence is true about electromagnetic waves?

Tick (✓) **one** box.

Infrared waves do not have any harmful effects on human body tissue.

Only microwaves transfer energy.

Our eyes can detect all electromagnetic waves.

They are transverse waves.

[1]

A small majority of candidates scored this mark. It was common to see 'Our eyes can detect all electromagnetic waves.'

## Question 17 (f)

- (f) A 0.8 kW microwave oven is used to cook food.  
The microwave oven transfers 0.56 kWh when it is used to cook food.

Calculate the time the microwave oven is used for.

Use the equation: energy transferred = power  $\times$  time

Time = ..... h [3]

Many of the candidates obtained marks on this question. It was generally well answered by the more successful candidates. Of the rest, those who included working often managed to gain a mark or two. A common error was that candidates thought they needed to convert one or both of the units. See Exemplar 3.

## Exemplar 3

Calculate the time the microwave oven is used for.

$$0.8 \div 10 = 0.08$$

Use the equation: energy transferred = power  $\times$  time

$$\text{time} = \frac{\text{energy transferred}}{\text{power}}$$

$$\text{time} = \frac{0.56}{0.08}$$

$$\text{time} = 7$$

Time = ..... 7 ..... h [3]

The candidate tries to convert the power, albeit incorrectly, but they still scored 2 marks for rearranging the equation and substituting correctly.



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## 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**

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Please [get in touch](#) if you want to discuss the accessibility of resources we offer to support you in delivering our qualifications.