OCR
Oxford Cambridge and RSA

Friday 16 June 2023 – Morning

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

J250/06 Paper 6 (Foundation Tier)

Time allowed: 1 hour 10 minutes

F

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

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

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

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

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **24** pages.

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

Section A

You should spend a **maximum** of **20 minutes** on this section.

Write your answer to each question in the box provided.

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

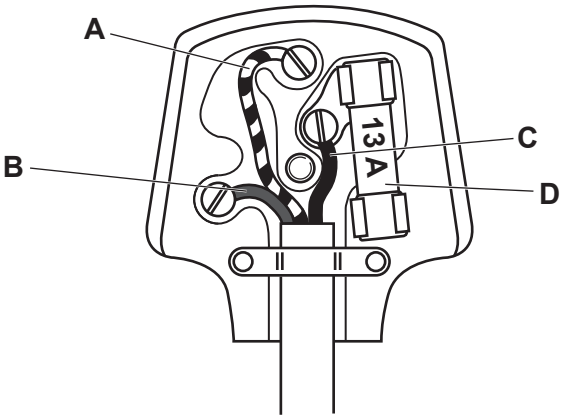
B 313 m/s – 330 m/s

C 320 m/s – 330 m/s

D 321 m/s – 330 m/s

Your answer ☐ **[1]**

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



Your answer ☐ **[1]**

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 = $\frac{1600}{400}$

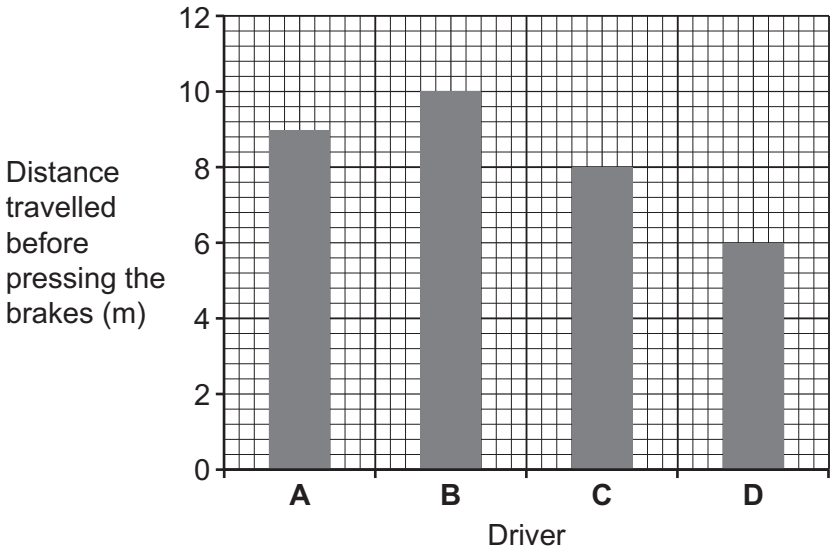
Your answer ☐ **[1]**

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]**

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 × specific latent heat

A 0.156 J

B 6.24 J

C 156 J

D 6240 J

Your answer ☐ **[1]**

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

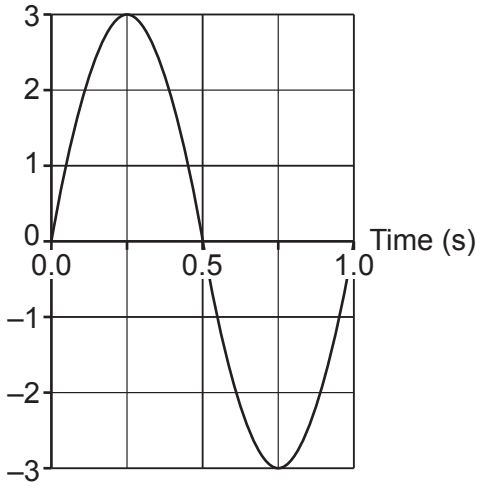
C 120 W

D 240 W

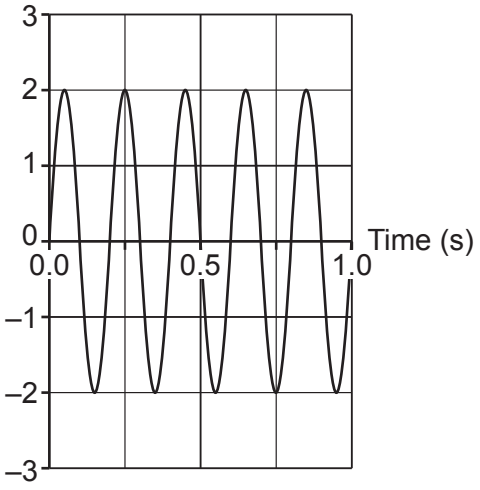
Your answer ☐ **[1]**

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

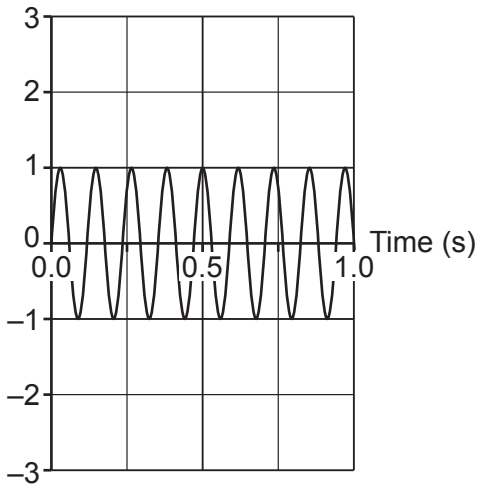
A Height (cm)



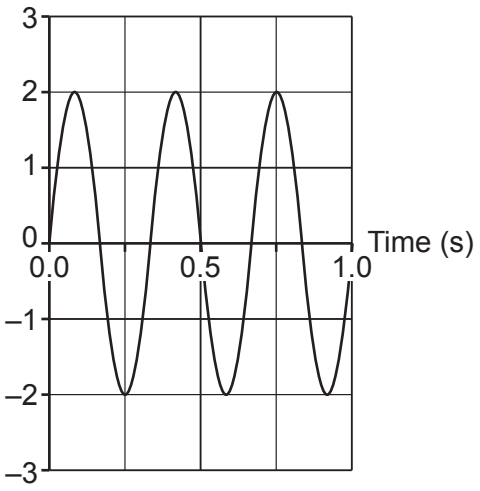
B Height (cm)



C Height (cm)



D Height (cm)



Your answer ☐ **[1]**

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

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

$^{4}_{2}He + {}^{9}_{4}Be \longrightarrow {}^{12}_{6}C + {}^{1}_{n}X$

A –1

B 0

C 1

D 2

Your answer ☐ **[1]**

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.

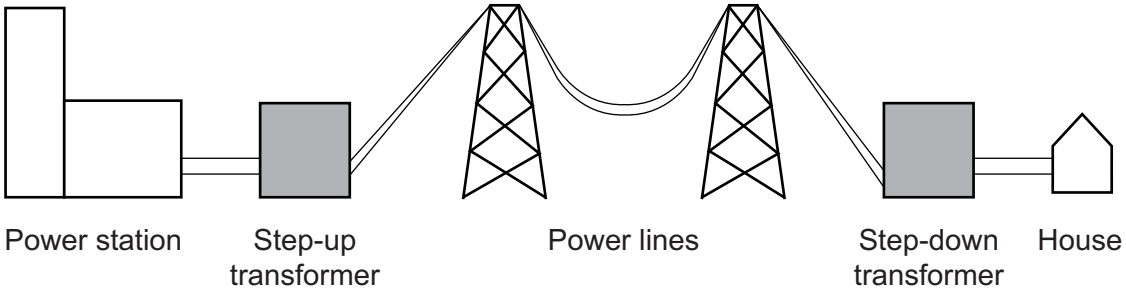
C Energy can only be transferred between stores.

D Energy can only be destroyed in the surroundings when it is wasted.

Your answer ☐ **[1]**

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

A



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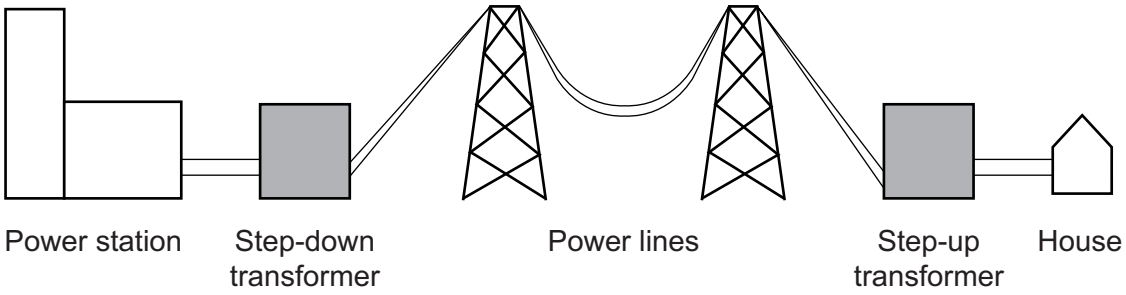

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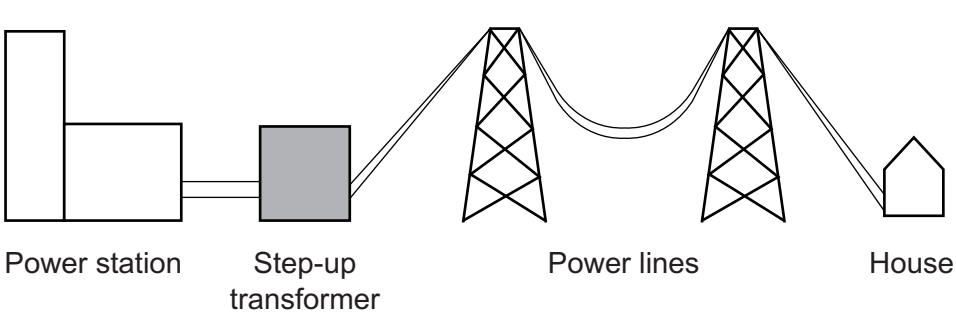
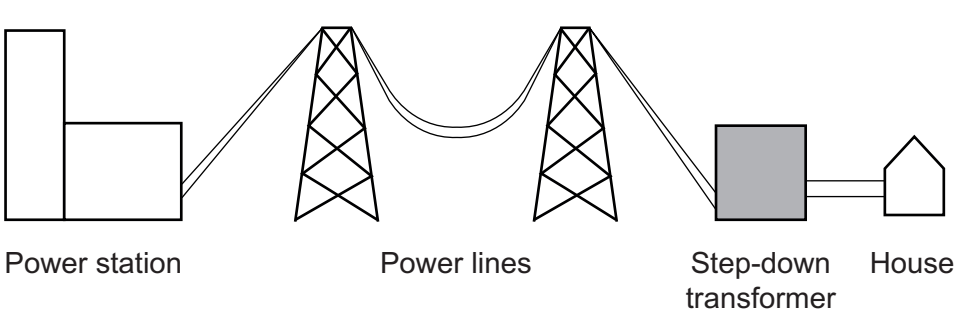


D



Your answer ☐ **[1]**

Section B

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]

(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]

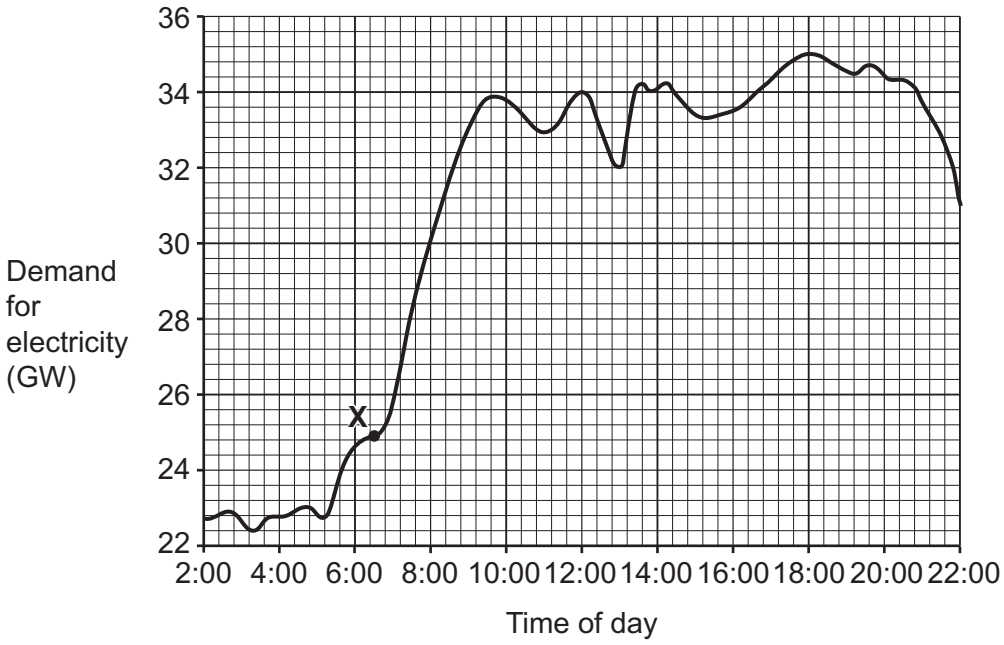
(c) Which energy resource produces the most energy per kilogram of fuel?

Put a (ring) around the correct answer.

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

[1]

(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]

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

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

(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]**

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

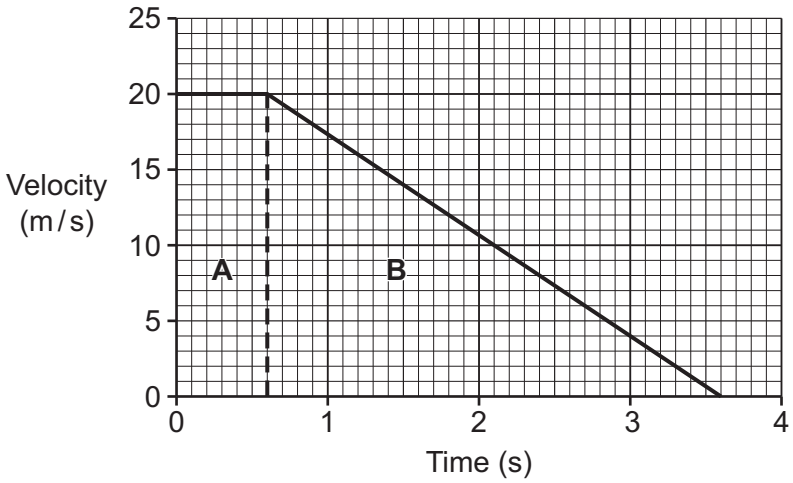
.....

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

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]**

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

Braking distance ☐

Stopping distance ☐

Thinking distance ☐

[1]

(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]**

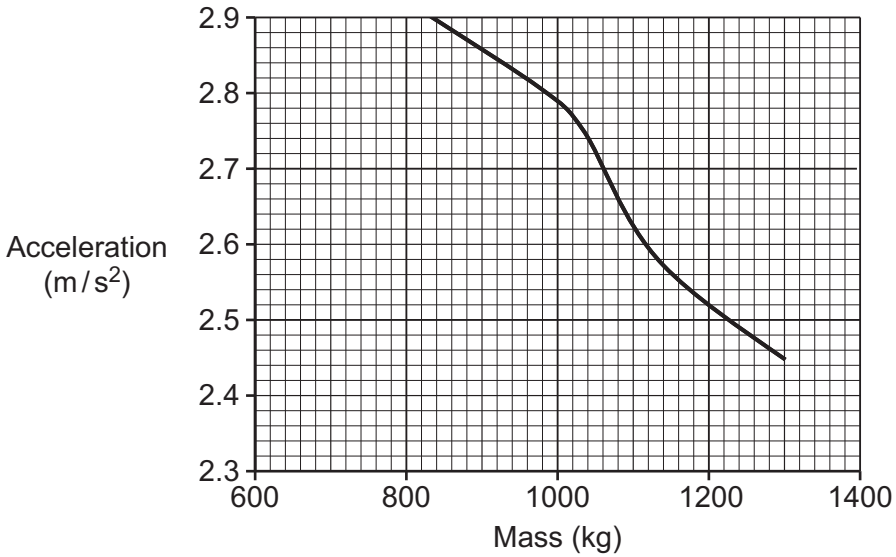
(b) Draw lines to match each **situation** to its correct **speed**.

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

[2]

(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^2 **[1]**

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

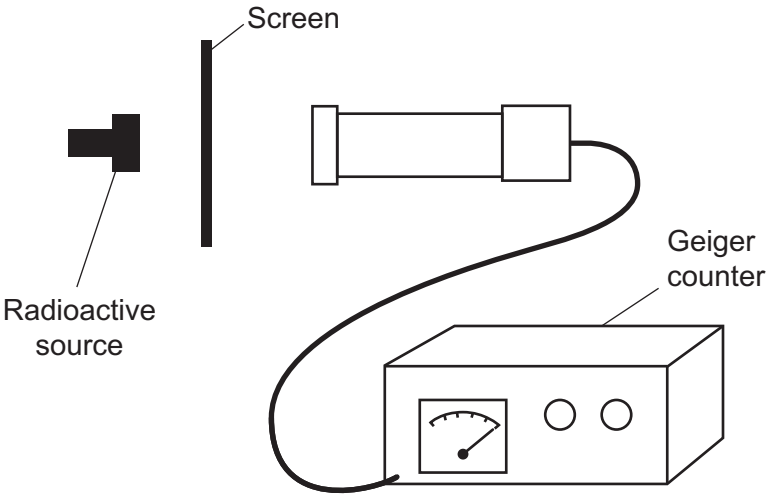
Acceleration = ... m/s^2 **[2]**

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
1 cm thick lead sheet	yes	21

Use the table to explain which type of nuclear radiation is emitted by the source.

Describe some other differences between alpha, beta and gamma radiation.

.....

.....

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

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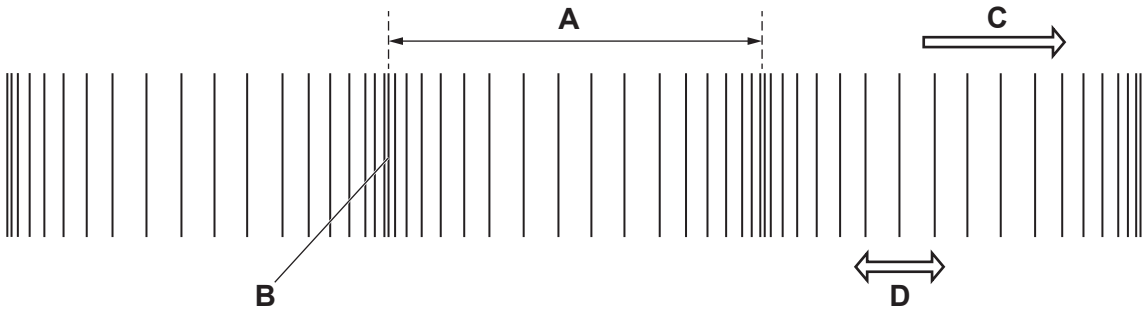
14 **(a)** The diagram shows a sound wave.



(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	**A**

[2]

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

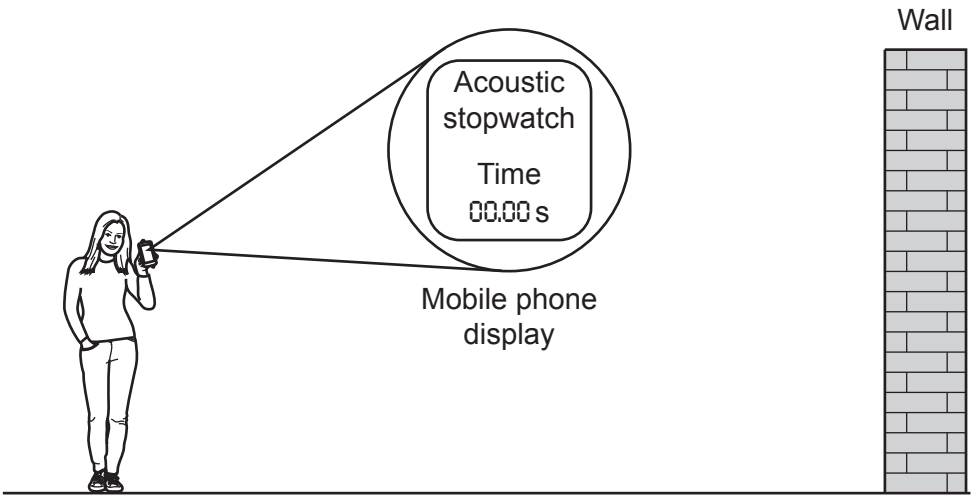
Amplitude wave	
Longitudinal wave	
Transverse wave	
Water wave	

[1]

(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]**

(ii) Another student suggests using this stopwatch.

Stopwatch

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

.....

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

(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]**

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 = $\frac{1}{2}$ × mass × (speed)^2

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

(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.

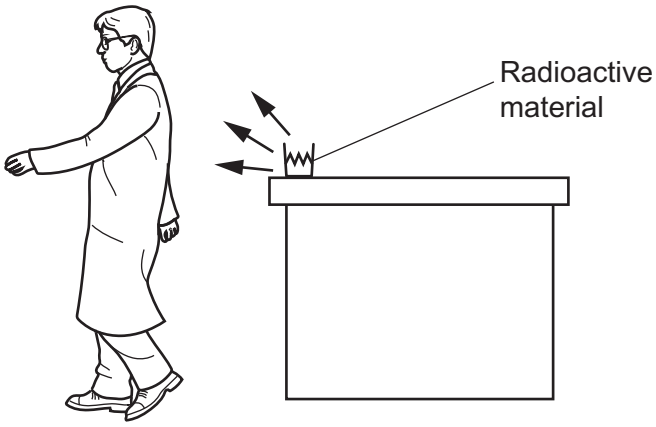
Use the equation: work done = force × distance

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

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. ☐

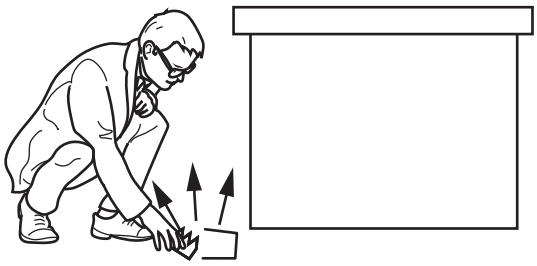
They have been irradiated and contaminated. ☐

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

[1]

(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. ☐

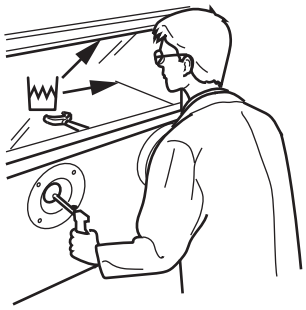
They have been irradiated and contaminated. ☐

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

[1]

(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. ☐

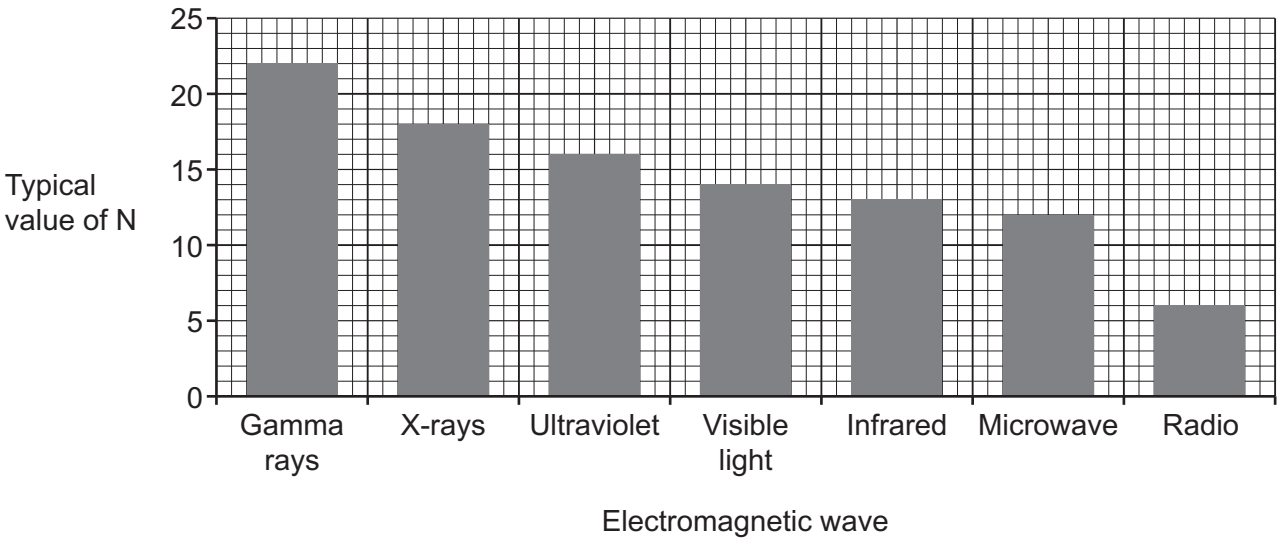
They have been irradiated and contaminated. ☐

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

[1]

17 The frequency of electromagnetic waves can be written as 1×10^{N} 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]**

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

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

(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]**

(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]**

(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]

(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 × time

Time = ... h **[3]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).