AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS
PHYSICS

Paper 1

Wednesday 13 May 2026 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a pencil and a ruler
- a scientific calculator
- a Data and Formulae Booklet
- a protractor.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 70.
- You are expected to use a scientific calculator where appropriate.
- A Data and Formulae Booklet is provided as a loose insert.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

for more: jadedamien673@gmail.com

Answer **all** questions in the spaces provided.

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0 1 The proton number of lead is 82

The mass of a nucleus of one isotope of lead is 3.45×10^{-25} kg.

0 1 . 1 The average mass of a nucleon in this nucleus is 1.7×10^{-27} kg.

Calculate the number of neutrons in this nucleus.

[2 marks]

number of neutrons = _____

0 1 . 2 Calculate the specific charge of this nucleus.

[1 mark]

specific charge = _____ C kg^{-1}

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0 1 . 3 This isotope of lead is unstable and undergoes a series of alpha and beta-minus decays.

The final product of this series of decays is a stable isotope of lead.

What is the number of alpha and beta-minus decays that occur?

Tick (✓) **one** box.

[1 mark]

one alpha, one beta minus ☐

one alpha, two beta minus ☐

two alpha, one beta minus ☐

two alpha, two beta minus ☐

4

Turn over for the next question

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0 2 An unidentified particle **X** interacts with a proton to produce a neutron and a positron. The equation representing the interaction is

$$\mathbf{X} + \mathrm{p} \rightarrow \mathrm{n} + \mathrm{e}^{+}$$

0 2 . 1 State the quark structure of the neutral hadron that is involved in this interaction.

[1 mark]

0 2 . 2 Identify particle **X**.
Justify your answer by referring to appropriate conservation laws.

[3 marks]

X = _____

0 2 . 3 The total energy of an interaction consists of the kinetic energy and the mass-energy of the interacting particles.

A positron is moving very slowly when it interacts with a stationary electron.

The total energy of this interaction is 1.64×10^{-13} J.

Calculate the maximum wavelength of the gamma radiation that is produced when the positron and electron annihilate.

[2 marks]

maximum wavelength = _____ m

6

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0 3 . 1 Describe **three** differences between progressive waves and stationary waves.

[3 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

3 _____

_____

_____

_____

Question 3 continues on the next page

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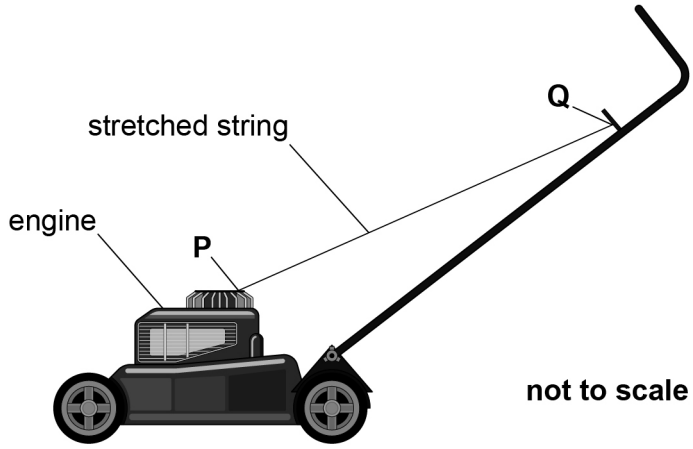
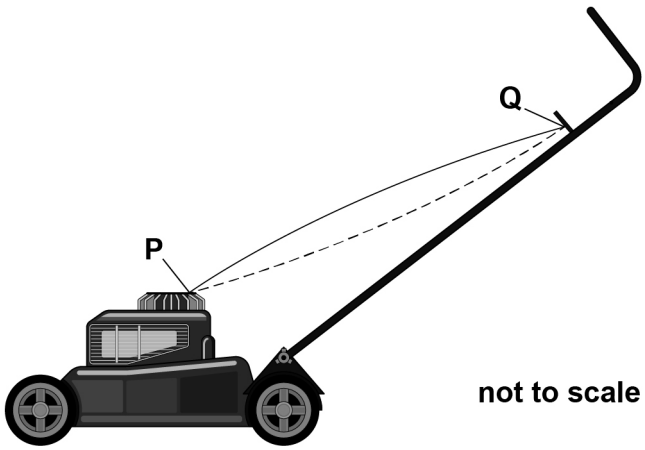
0 3 . 2 **Figure 1** shows a stretched string on a petrol lawnmower.
The string is fixed at ends **P** and **Q**.

Figure 1



When the lawnmower is on, the engine makes the string vibrate.
A first harmonic stationary wave is formed on the string.
The first harmonic stationary wave is shown in **Figure 2**.

Figure 2



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The length of the string between **P** and **Q** is $75\ \text{cm}$.
The string vibrates with a frequency of $45\ \text{Hz}$.

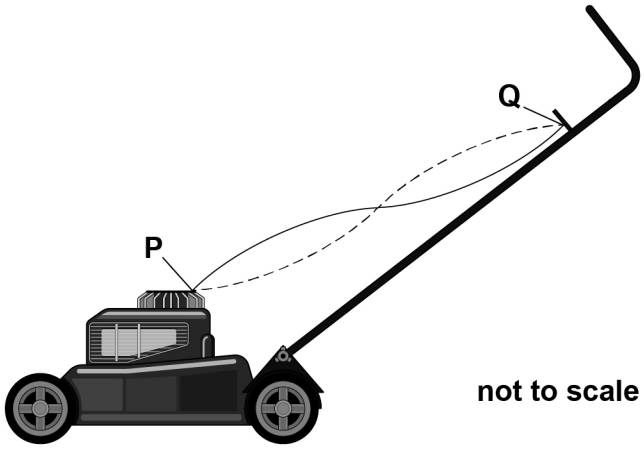
Calculate the speed of the waves in this string.

[2 marks]

speed = _____ m s^{-1}

0 3 . 3 The stretched string is replaced with a new string of the same length.
When the lawnmower is on, a second harmonic stationary wave is formed on this string.
The new string also vibrates with a frequency of $45\ \text{Hz}$.
The second harmonic stationary wave is shown in **Figure 3**.

Figure 3



not to scale

The mass per unit length of the new string is $0.028\ \text{kg m}^{-1}$.

Calculate the tension in the new string.

[2 marks]

tension = _____ N

7

Turn over ►

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0 4 This question is about diffraction gratings.

0 4 . 1 State **one** application of diffraction gratings.

[1 mark]

Question 4 continues on the next page

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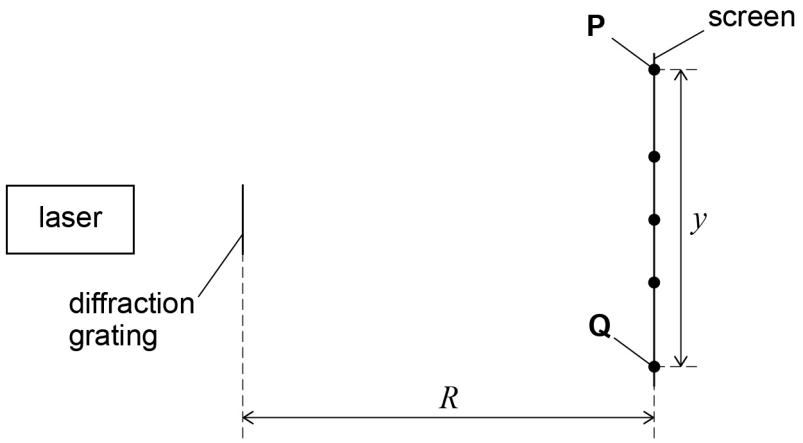
A student sets up the apparatus in **Figure 4**.

Figure 4

not to scale

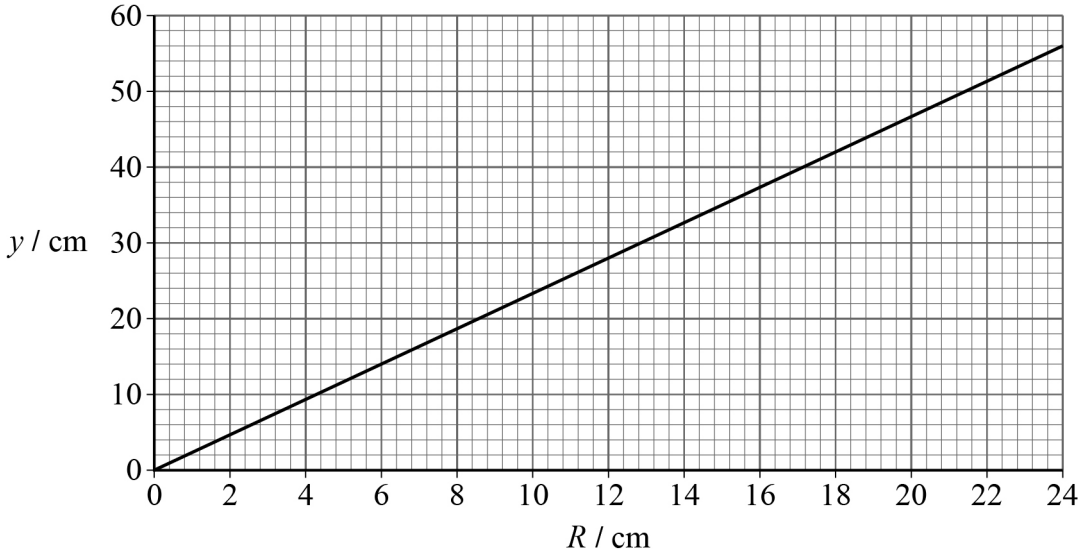


Light from a laser is incident normally on a grating. All five maxima produced by the grating are shown on the screen.

The screen and grating are parallel and separated by a perpendicular distance R.
The maxima labelled **P** and **Q** are separated by a distance y.
The student observes that when R decreases, y decreases.
The student makes measurements to test how y varies with R.

Figure 5 is a graph of the student's results.

Figure 5



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0 4 . 2 Calculate the slit spacing, in mm, of the diffraction grating.

wavelength of laser light = 6.33×10^{-7} m

[3 marks]

slit spacing = _____ mm

0 4 . 3 The student repeats the experiment using a different diffraction grating.
Five maxima are still seen on the screen.
This grating has fewer lines per mm than the grating used in **Figure 4**.

Draw a line on **Figure 5** to show how y varies with R for this grating.
Explain your reasoning.

[3 marks]

7

Turn over for the next question

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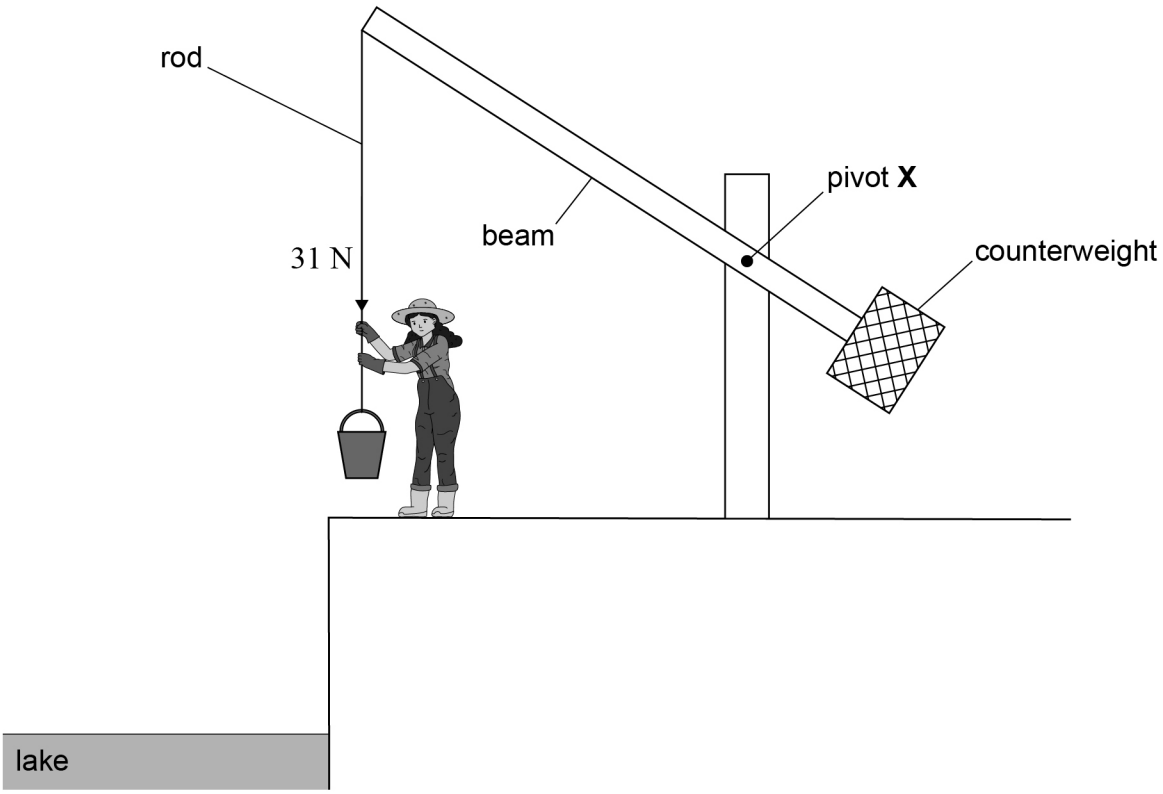
0 5 **Figure 6** shows a person using a pivoted beam to lower an empty bucket. The bucket will be used to collect water from a lake.

Figure 6



Pivot **X** shown in **Figure 6** is frictionless.

A light rod is connected to the end of the beam. The connection is frictionless and ensures that the rod is always vertical.

The person applies a downwards force on the rod of 31 N.

0 5 . 1 Describe how to determine the moment of the 31 N force about pivot **X**.

[2 marks]

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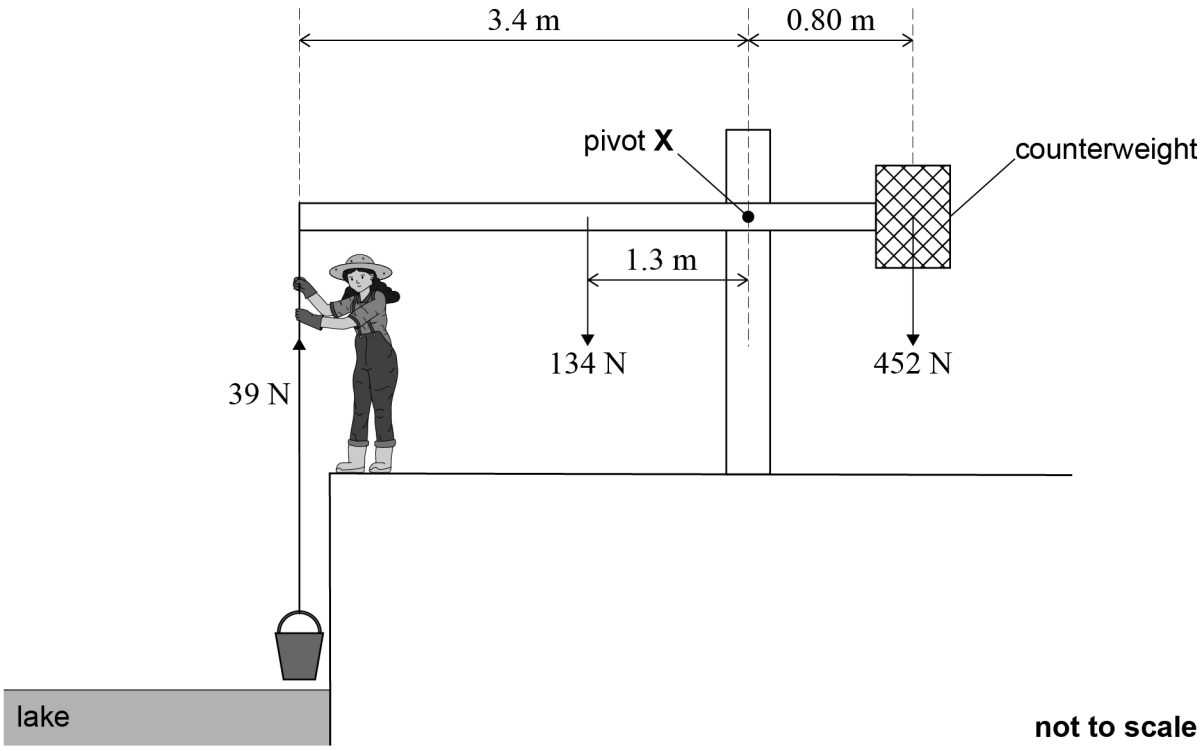
Figure 7 shows the bucket full of water just above the surface of the lake.

Figure 7



not to scale

The bucket remains stationary because the person is applying an upward force of 39 N to the rod.

The weight of the empty bucket is 24.1 N.
The counterweight has a weight of 452 N.
The beam has a weight of 134 N.

0 5 . 2 Calculate the mass of the water in the bucket.

[3 marks]

mass of water = _____ kg

Question 5 continues on the next page

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0 5 . 3 The bucket of water is now raised through a height of $1.5\ \text{m}$.

Calculate the change in the gravitational potential energy of the counterweight as the bucket is raised through this height.

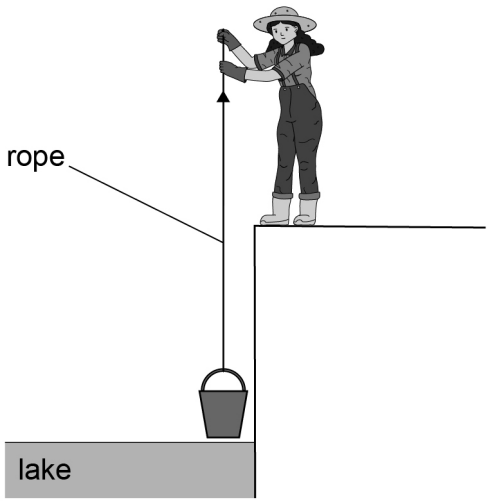
[2 marks]

change in gravitational potential energy = _____ J

0 5 . 4 On another occasion, the person **drops** the bucket into the lake and then uses a light rope to pull the bucket of water upwards by $1.5\ \text{m}$.

Figure 8 shows the person pulling the bucket of water upwards.

Figure 8



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Compare the amount of energy the person must use to collect the water using this method and when using the pivoted beam.

In your answer, consider the energy transfers that occur when:
- the empty bucket travels downwards to the lake
- the bucket of water is lifted upwards.

[4 marks]

11

Turn over for the next question

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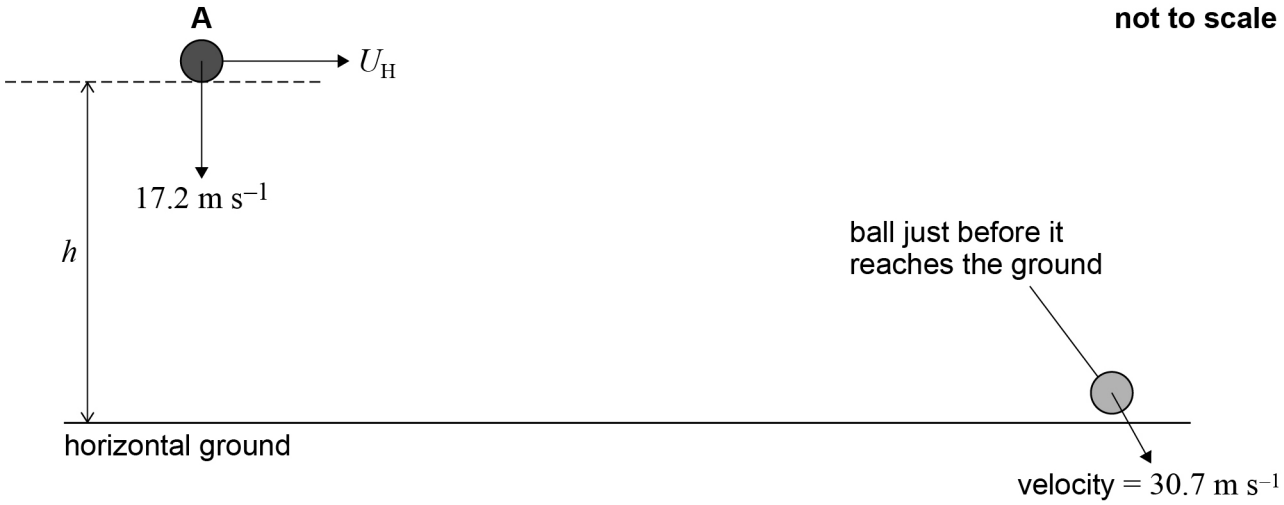
0 6 This question is about projectile motion.
Assume that air resistance is negligible in Questions **06.1** to **06.5**.

A student throws a ball towards the ground.

Figure 9 shows the ball at position **A** just after it leaves the student's hand.

Figure 9



At **A**:
- the bottom of the ball is a height h above the horizontal ground
- the vertical component of the velocity is $17.2\ \text{m s}^{-1}$ downwards
- the horizontal component of the velocity is U_H.

Just before it reaches the ground, the vertical component of the ball's velocity is $18.4\ \text{m s}^{-1}$ downwards.

0 6 . 1 Calculate h.

[2 marks]

$h =$ _____ m

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0 6 . 2 Just before the ball reaches the ground, its resultant velocity is $30.7\ \text{m s}^{-1}$.

Calculate U_H.
Give your answer to an appropriate number of significant figures.

[3 marks]

$U_H =$ _____ m s^{-1}

Question 6 continues on the next page

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At another time, the student throws the ball from a different height. The ball is thrown upwards at an angle to the vertical.

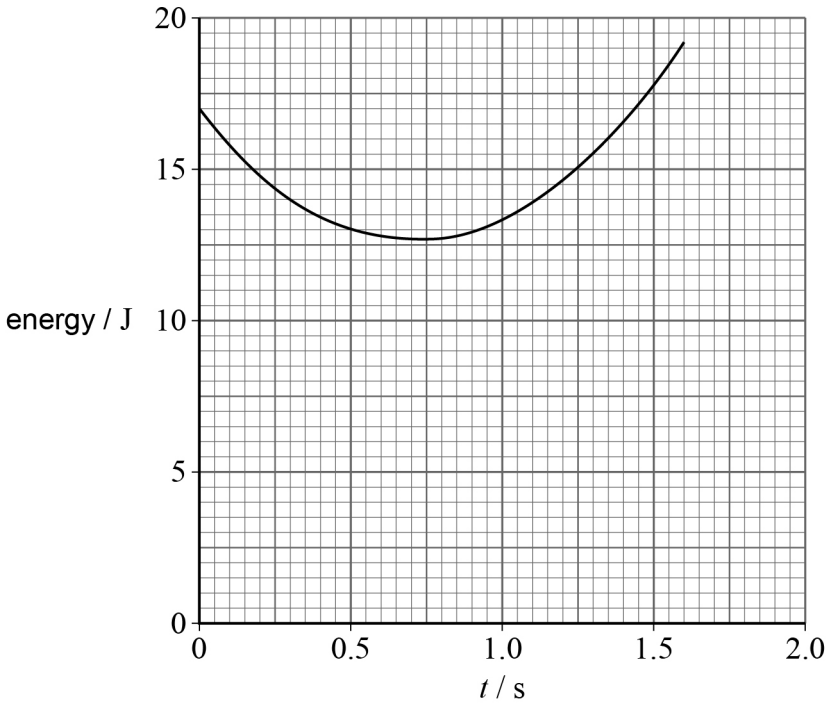
As the ball leaves the student's hand, its kinetic energy is 17.0 J.

Figure 10 shows the ball's position and velocity v as it leaves the student's hand.

Figure 10

Figure 11 shows how the kinetic energy E_k of the ball varies with time t from when the ball leaves the student's hand until it lands on the ground at $t = 1.6$ s.

Figure 11



0 6 . 3 Explain, with reference to energy transfers, why the ball has a greater kinetic energy at $t = 1.6$ s than at $t = 0$

[1 mark]

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0 6 . 4 The gravitational potential energy of the ball E_p is zero at ground level.

Sketch a graph on **Figure 11** to show how E_p varies from $t = 0$ to $t = 1.6$ s.

[3 marks]

0 6 . 5 The mass of the ball is 0.173 kg.

Determine, using **Figure 11**, the horizontal distance travelled by the ball between $t = 0$ and $t = 1.6$ s.

[3 marks]

horizontal distance = _____ m

Question 6 continues on the next page

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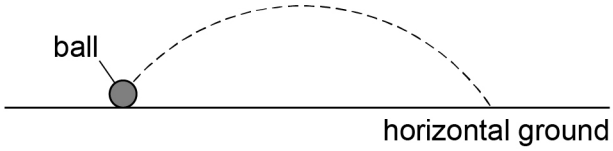
0 6 . 6 **Figure 12** shows the path that a ball takes when launched from a horizontal surface when air resistance is negligible.

Figure 12



State and explain how air resistance affects:
- the maximum height gained by the ball
- the horizontal distance travelled by the ball.

Refer to the vertical and horizontal components of the acceleration of the ball in your answer.

[4 marks]

maximum height _____

_____

_____

_____

horizontal distance _____

_____

_____

_____

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0 7 . 1 Two wires **A** and **B** are made from the same metal and are at the same temperature.

- length of **A** = 2 × length of **B**
- diameter of **A** = 2 × diameter of **B**

Compare:

- the resistivity of **A** with the resistivity of **B**
- the resistance of **A** with the resistance of **B**.

[2 marks]

resistivity _____

resistance _____

_____

Question 7 continues on the next page

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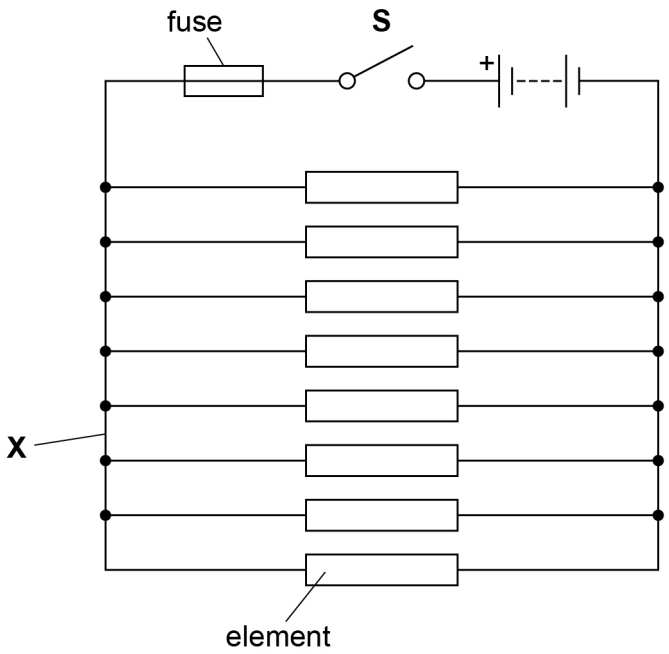
Figure 13 shows the arrangement of connecting wires and elements in the heater of a car's rear window. The heater is made from eight identical elements. Each element consists of a piece of resistance wire.

Figure 13



Assume that:

- the resistance of each element is constant at $5.4\ \Omega$
- the connecting wires and the fuse have negligible resistance.

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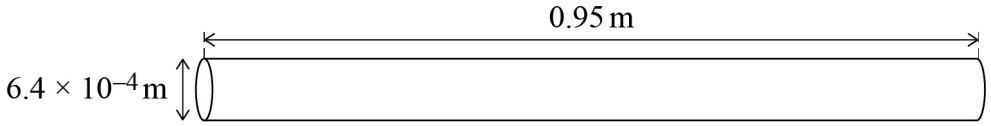
0 7 . 2 Each element is a metal wire of length $0.95\ \text{m}$ and diameter $6.4 \times 10^{-4}\ \text{m}$ as shown in **Figure 14**.

Figure 14



Calculate the resistivity of the metal.
Give an appropriate unit for your answer.

[4 marks]

resistivity = _____

unit = _____

When switch **S** is closed, the current in the battery is $15.3\ \text{A}$.
The heater then operates normally.

0 7 . 3 The battery has an emf of $12.0\ \text{V}$ and an internal resistance of $0.11\ \Omega$.

Calculate the terminal pd of the battery.

[3 marks]

terminal pd = _____ V

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0 7 . 4 Calculate the current at point **X** in **Figure 13** on page 22.

[1 mark]

current = _____ A

0 7 . 5 Calculate the energy transferred in **one** of the elements in a time of 3.0 minutes.

[3 marks]

energy transferred = _____ J

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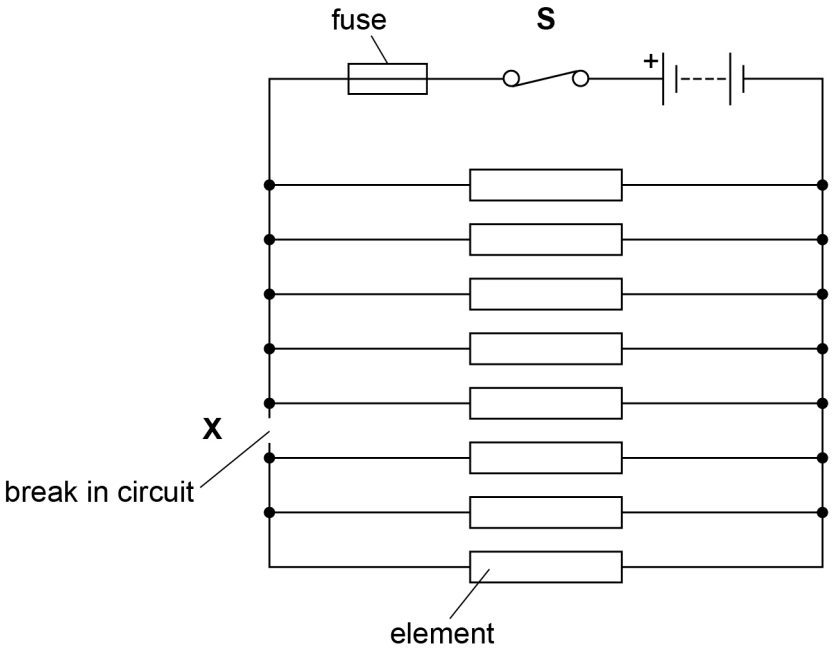
0 7 . 6 The fuse melts if the current in the fuse exceeds the normal operating value of 15.3 A. While switch **S** is closed, a break in the circuit occurs at point **X**, as shown in **Figure 15**.

A student suggests that:
- the fuse does not melt
- the power output, of each element that is still operating, increases.

Figure 15



Deduce whether the student is correct.

In your answer, explain the effect this fault will have on:
- the total resistance of the circuit
- the current in the fuse
- the pd across the elements that are still operating.

[6 marks]

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END OF QUESTIONS

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