A

AQA

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Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

GCSE

COMBINED SCIENCE: TRILOGY

H

Higher Tier

Physics Paper 2H

8464/P/2H

Time allowed: 1 hour 15 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

J U N 2 1 8 4 6 4 P 2 H 0 1

For this paper you must have:
- **a protractor**
- **a ruler**
- **a scientific calculator**
- **the Physics Equations Sheet (enclosed).**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Pencil should only be used for drawing.**
- **Answer ALL questions in the spaces provided.**
- **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.**
- **In all calculations, show clearly how you work out your answer.**

INFORMATION

- **The maximum mark for this paper is 70.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

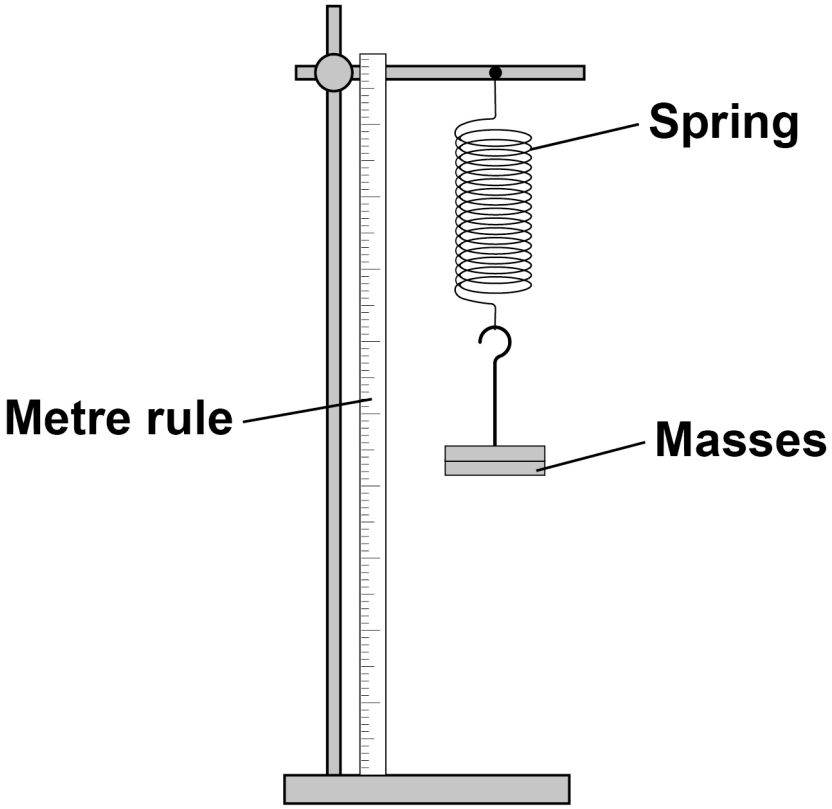
DO NOT TURN OVER UNTIL TOLD TO DO SO

0 1

FIGURE 1 shows a stretched spring.

The spring is elastically deformed.

FIGURE 1



0 1 . 1

What is meant by 'elastically deformed'? [1 mark]

Tick (✓) ONE box.

- ☐ **As the force on the spring increases the length of the spring increases.**
- ☐ **Only a very small force is needed to stretch the spring.**
- ☐ **The force on the spring causes it to change shape.**
- ☐ **The spring will return to its original length when the force is removed.**

[Turn over]

0 1 . 2

Describe a method to determine the extension of the spring. [2 marks]

0 1 . 3

The extension of the spring is 80 mm.

spring constant = 40 N/m

Calculate the elastic potential energy of the spring.

Use the Physics Equations Sheet. [3 marks]

Elastic potential energy = _____ J

[Turn over]

0 1 . 4

Write down the equation which links extension (*e*), force (*F*) and spring constant (*k*). [1 mark]

0 1 . 5

A force of 300 N acts on a different spring.

The force causes the spring to extend by 0.40 m.

Calculate the spring constant of the spring. [3 marks]

Spring constant = _____ N/m

10

0 2

Professional rugby players wear a tracking device that measures their velocity and acceleration.

FIGURE 2 shows a player wearing a tracking device.

The player is tackling another player who is running with the ball.

FIGURE 2

0 2 . 1

Velocity and acceleration are both vector quantities.

What is a vector quantity? [1 mark]

Tick (✓) ONE box.

- ☐ **A quantity with both magnitude and direction**
- ☐ **A quantity with direction only**
- ☐ **A quantity with magnitude only**

[Turn over]

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0 2 . 2

Which of the following is a vector quantity? [1 mark]

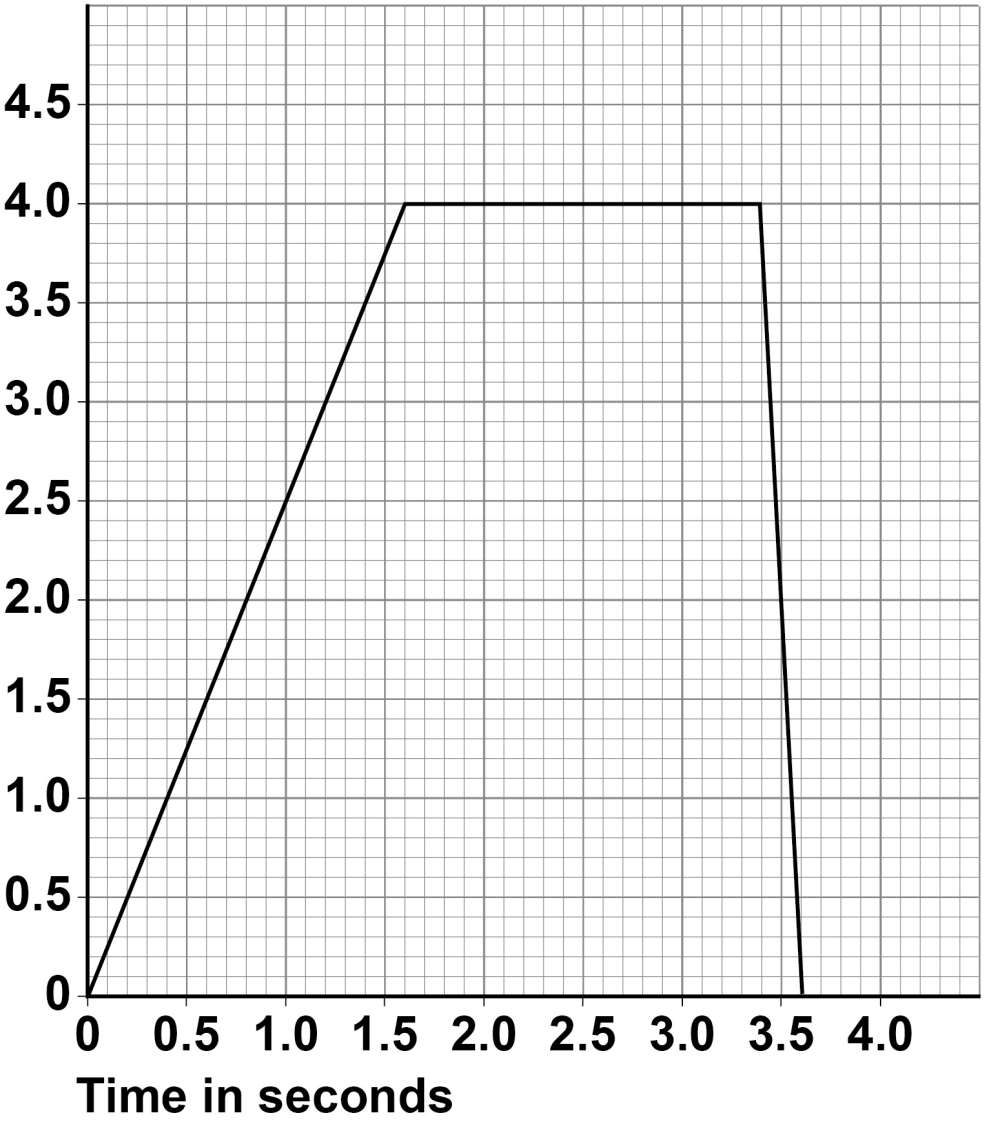
Tick (✓) ONE box.

- ☐ **Displacement**
- ☐ **Distance**
- ☐ **Time**
- ☐ **Work done**

[Turn over]

FIGURE 3 shows a velocity–time graph for the player running with the ball.

FIGURE 3



0 2 . 3

Determine the acceleration of the player between 0 and 1.6 s. [2 marks]

Acceleration = _____ m/s^2

0 2 . 4

Describe the motion of the player between 3.4 s and 3.6 s. [1 mark]

[Turn over]

The force exerted on the player when she is tackled causes her to accelerate.

0 2 . 5

Write down the equation which links acceleration (*a*), mass (*m*) and resultant force (*F*). [1 mark]

0 2 . 6

The player accelerates at 25 m/s^2 when a resultant force of 1800 N acts on her.

Calculate the mass of the player. [3 marks]

Mass = _____ kg

[Turn over]

0 2 . 7

The tracking device sends data to a computer during the game.

Suggest ONE advantage of the data being sent during the game. [1 mark]

0 3

A student made water waves in a ripple tank.

0 3 . 1

Describe how the frequency and wavelength of the water waves in the ripple tank can be measured accurately. [4 marks]

The student recorded values for the frequency and the wavelength of waves in the ripple tank.

TABLE 1 and TABLE 2 show the results.

TABLE 1

Reading	1	2	3
Frequency in hertz	9.8	9.4	9.3

TABLE 2

Reading	1	2	3
Wavelength in cm	1.7	2.2	2.1

0 3 . 2

Determine the mean wave speed. [4 marks]

Mean wave speed = _____ m/s

[Turn over]

0 3 . 3

What is the advantage of taking repeat readings and then calculating a mean? [1 mark]

0 3 . 4

The speed of the wave is affected by the depth of the water in the ripple tank.

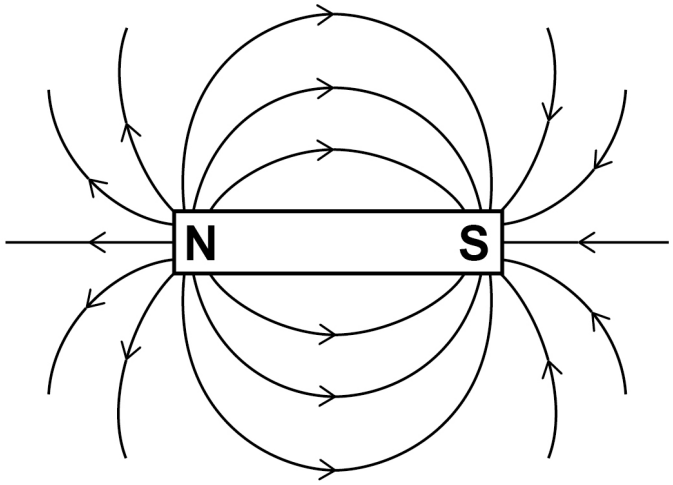
The deeper the water the faster the wave.

Explain how the depth of the water affects the wavelength of the wave if the frequency is constant.
[2 marks]

0 4

FIGURE 4 shows the magnetic field pattern around a permanent magnet.

FIGURE 4



0 4 . 1

Where is the magnetic field of the magnet the strongest? [1 mark]

0 4 . 2

How does FIGURE 4 show that the strength of the magnetic field is not the same at all places? [1 mark]

_____

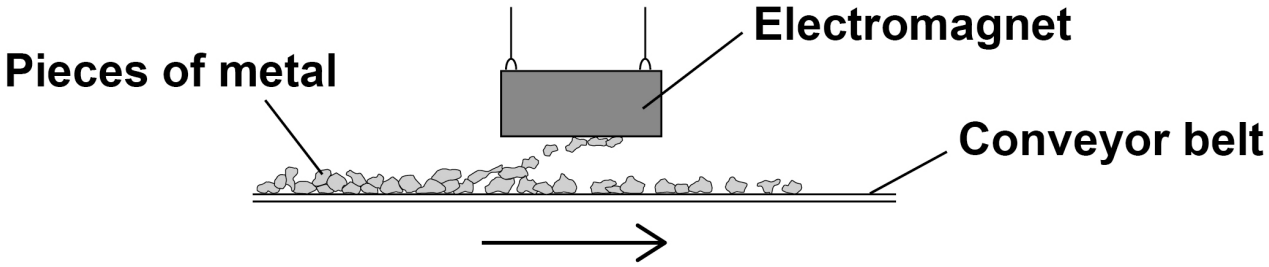
_____

_____

[Turn over]

FIGURE 5 shows an electromagnet being used to separate iron and steel from non-magnetic metals.

FIGURE 5



0 4 . 3

Explain ONE reason why an electromagnet is used instead of a permanent magnet. [2 marks]

0 4 . 4

Pieces of iron and steel are attracted to the electromagnet.

Name TWO other metals that would be attracted to the electromagnet. [2 marks]

1 _____

2 _____

0 4 . 5

The design of the electromagnet CANNOT be changed.

Give TWO ways the force exerted by the electromagnet on a piece of iron or steel could be increased. [2 marks]

1 _____

_____

_____

2 _____

_____

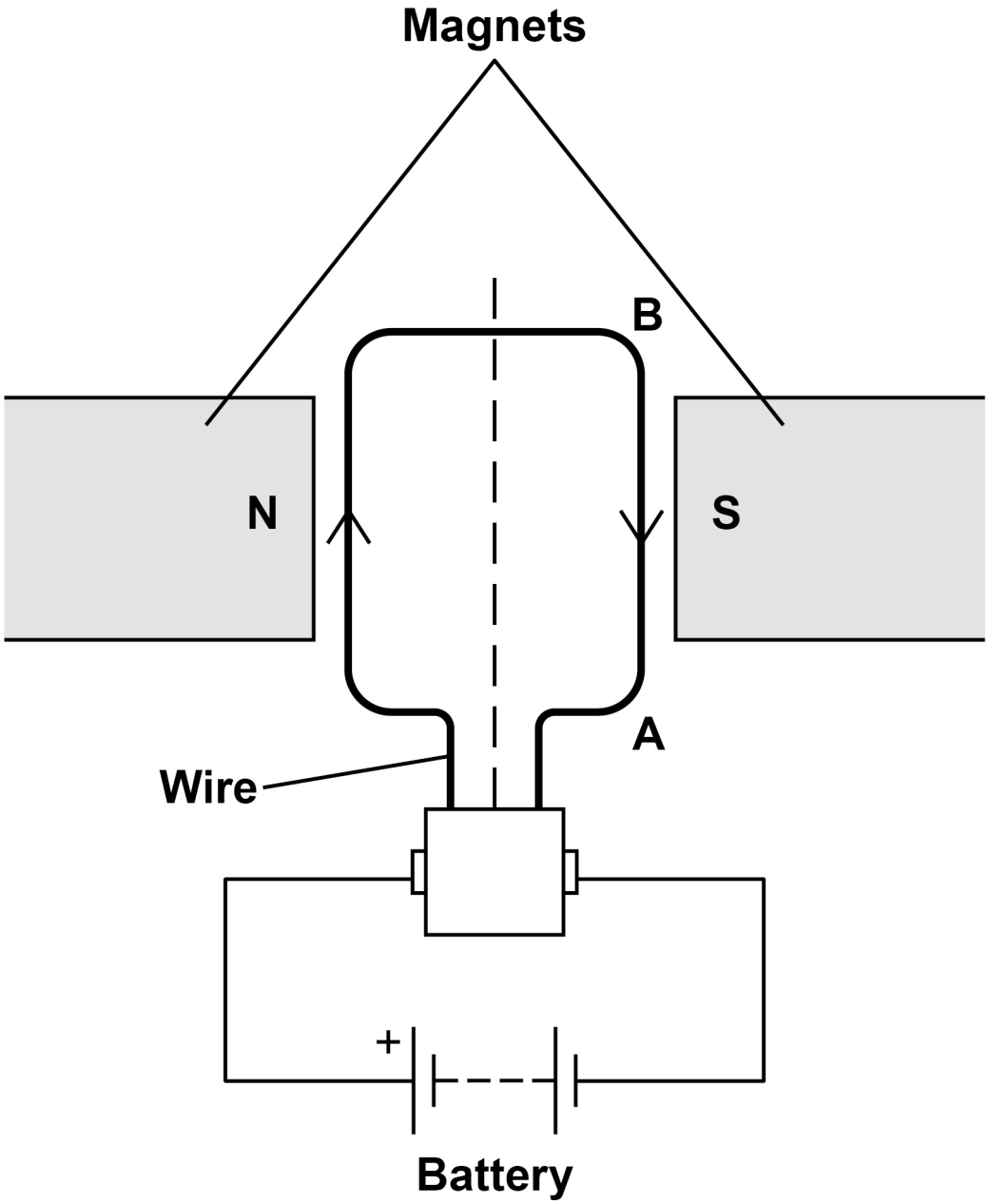
_____

[Turn over]

The conveyor belt that moves the pieces of metal is driven by an electric motor.

FIGURE 6 shows a simple electric motor.

FIGURE 6



0 4 . 6

The length of the wire AB in the magnetic field is 120 mm.

There is a current of 4.0 A in the wire. The length of wire AB experiences a force of 0.36 N.

Calculate the magnetic flux density between the magnets.

Give the unit. [5 marks]

Magnetic flux density = _____

Unit _____

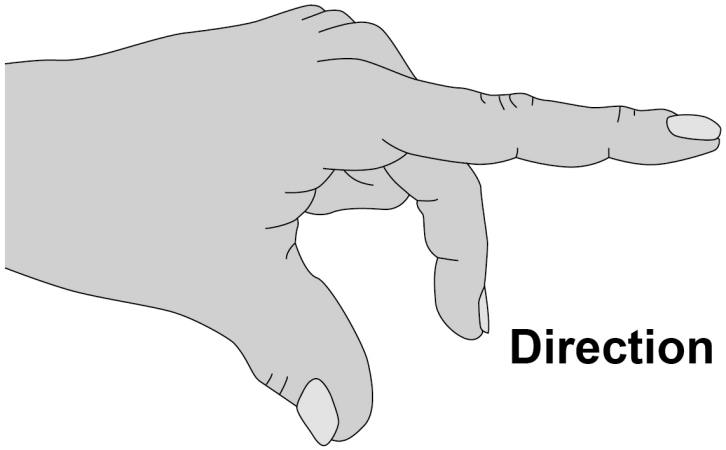
[Turn over]

0 4 . 7

Fleming's left-hand rule can be used to determine the direction of the force on wire AB.

Complete the labels on FIGURE 7 to show Fleming's left-hand rule. [2 marks]

FIGURE 7



Direction of _____

Direction of _____

Direction of _____

15

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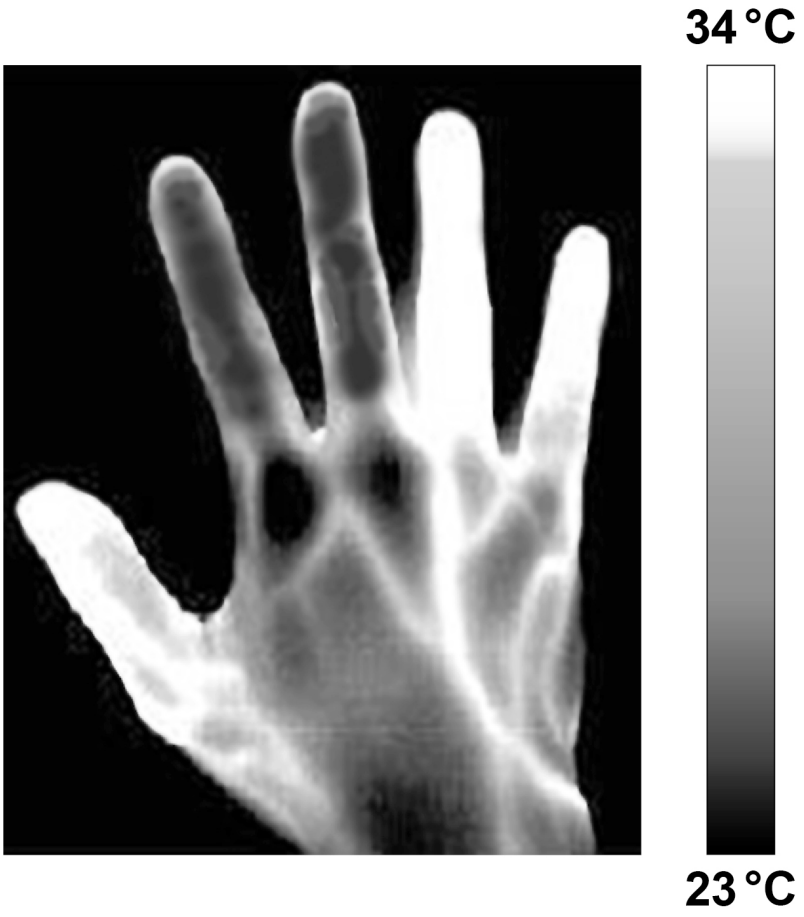
[Turn over]

0 5

Different parts of the electromagnetic spectrum are used in medical imaging.

FIGURE 8 shows an image of a person's hand taken with an infrared camera.

FIGURE 8



0 5 . 1

Explain why the infrared camera is able to show that parts of the hand are at different temperatures.
[2 marks]

0 5 . 2

Infrared has a range of wavelengths from 700 nm to 1 mm.

Which part of the electromagnetic spectrum would have waves with a wavelength of 6.5×10^{-7} m? [1 mark]

Tick (✓) ONE box.

- ☐ **Infrared**
- ☐ **Microwaves**
- ☐ **Radio waves**
- ☐ **Visible light**

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[Turn over]

0 5 . 3

FIGURE 9 shows X-rays and gamma rays being used for medical imaging.

FIGURE 9

X-rays

Gamma rays

To use X-rays for medical imaging, a machine produces a very brief burst of X-rays.

To use gamma rays for medical imaging, a radioactive isotope is injected into the patient's blood. The isotope is circulated around the body in the blood. The isotope emits gamma rays.

Compare the potential risks to a patient of using X-rays and gamma rays for medical imaging. [4 marks]

X-rays are produced by colliding high-energy electrons into a metal target.

The electrons have high energy because they are accelerated to high speeds.

Only a small proportion of the kinetic energy of an electron is converted into an X-ray when it collides with the metal target.

0 5 . 4

An electron is accelerated through a distance of 15 mm.

The work done on the electron is 1.2×10^{-13} J.

Calculate the force on the electron. [3 marks]

Force = _____ N

[Turn over]

0 5 . 5

The metal target is made from tungsten.

Tungsten has the highest melting point of any metal.

Explain why using tungsten as the metal target enables the X-ray machine to be more powerful. [3 marks]

13

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[Turn over]

0 6

Scientists are developing a hypersonic aeroplane that will travel much faster than normal aeroplanes.

0 6 . 1

An aeroplane accelerates from a low speed to a high speed with the engines at maximum power.

Explain why the acceleration is NOT constant.
[5 marks]

[Turn over]

0 6 . 2

The hypersonic aeroplane will have jet engines and a rocket engine.

The speed of aeroplanes can be measured on a uniform scale called the Mach scale.

Mach 1 = 330 m/s

The jet engines will accelerate the aeroplane to Mach 5.5.

The rocket engine will accelerate the aeroplane from Mach 5.5 to Mach 25.5 in 300 s.

The average resultant force on the aeroplane when the rocket engine is used will be 630 000 N.

Calculate the mass of the hypersonic aeroplane.

Give your answer to 2 significant figures. [6 marks]

Mass (2 significant figures) = _____ kg

END OF QUESTIONS

11

Additional page, if required.
Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
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