OCR
Oxford Cambridge and RSA

Thursday 25 May 2023 – Morning

GCSE (9–1) in Combined Science B (Twenty First Century Science)

J260/07 Physics (Higher Tier)

Time allowed: 1 hour 45 minutes

H

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

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

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 **95**.
- 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.

1 **(a)** Which **two** statements about electromagnetic radiation are true?

Tick (✓) **two** boxes.

All electromagnetic radiation is ionising. ☐

All electromagnetic radiation travels through space at the same speed. ☐

Only very hot bodies emit electromagnetic radiation. ☐

Our eyes can only detect a limited range of electromagnetic frequencies. ☐

Gamma rays are used for satellite communications. ☐

[2]

(b) **(i)** Complete the table by showing the main groups of the electromagnetic spectrum from long to short wavelengths.

Use words from the list.

Gamma rays	**Microwave**	**Radio**	**Visible**	**X-rays**	**Ultraviolet**

Electromagnetic radiation spectrum						
Long wavelength →						**Short wavelength**
		Infrared				

[3]

(ii) Complete the sentence about electromagnetic radiation.

Put a (ring) around each correct option.

When the wavelength of electromagnetic radiation gets shorter

the frequency **increases / decreases / stays the same**

and the energy **increases / decreases / stays the same**.

[2]

(c) A new telescope in space called the JWST uses electromagnetic radiation to produce images of very distant galaxies.

(i) Suggest **one** benefit of seeing images of very distant galaxies.

.....

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

(ii) Suggest **one** reason why scientists looking at images from the JWST should tell everyone about their discoveries.

.....

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

2 The UK uses a number of different energy resources including wind and nuclear fuel to generate electricity.

(a) Give **one other** example of a renewable energy resource and a non-renewable energy resource.

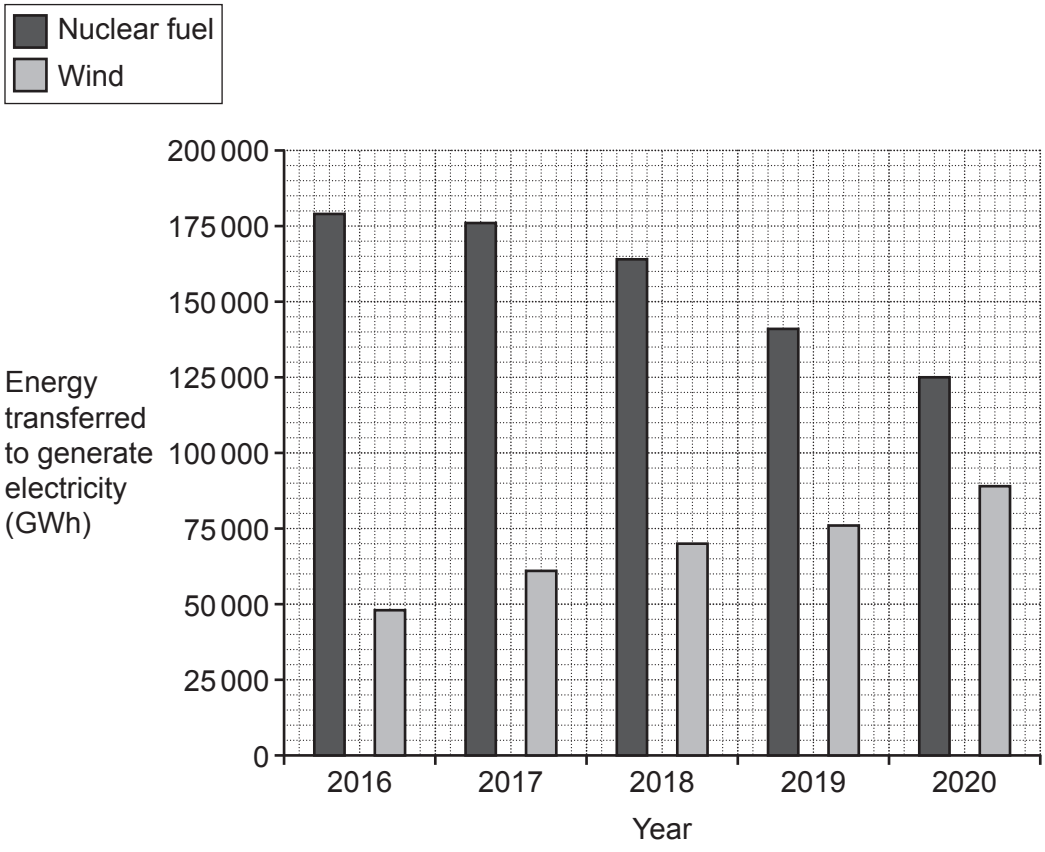
Renewable: .....

Non-renewable: .....

[2]

(b)* Nuclear fuel and wind are used to generate electricity in the UK.

The graph shows the energy transferred to generate electricity from these resources between 2016 and 2020.



5

Describe how nuclear fuel and wind are used to generate electricity.

Include in your answer how the use of these energy resources has changed in the UK since 2016.

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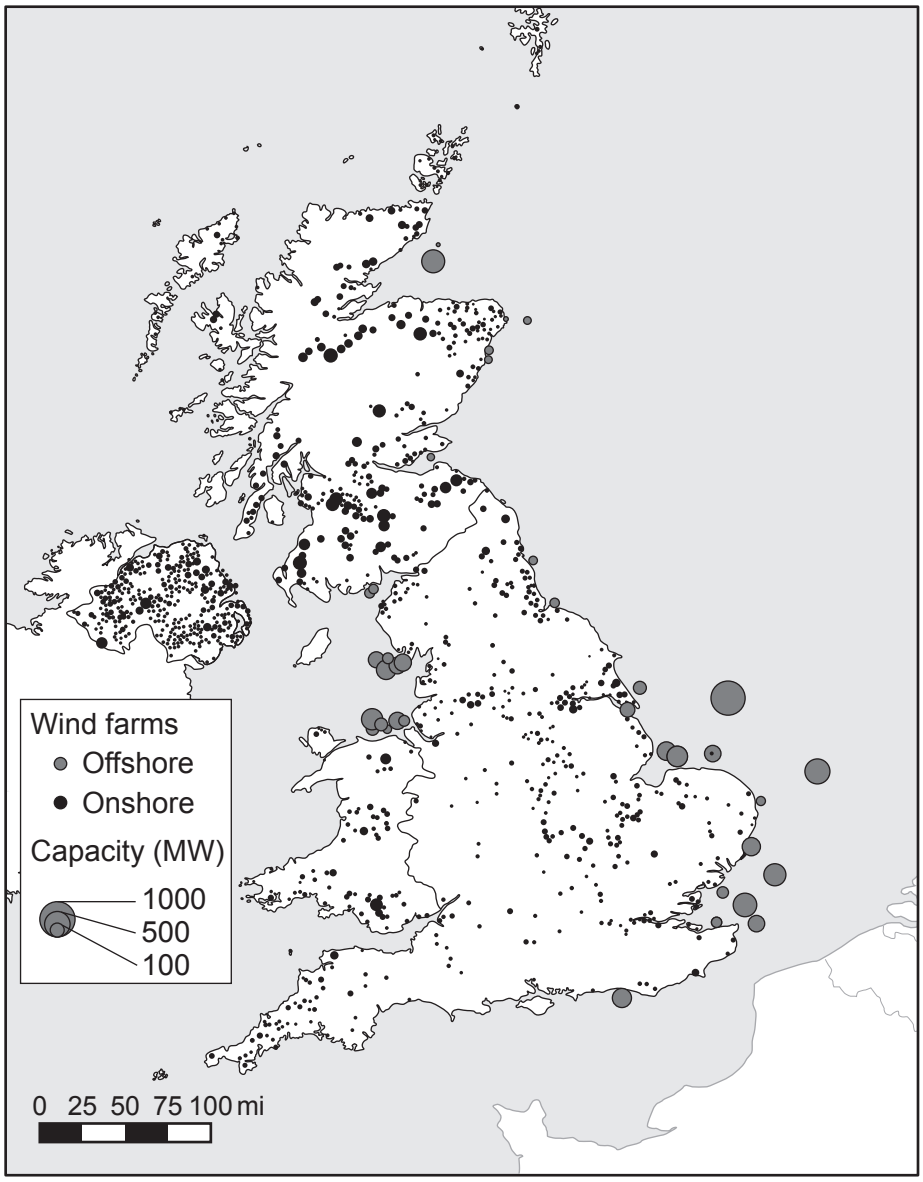
..... **[6]**

(c) This map shows wind farm sites in the UK in 2021.



Wind turbines can be built on land or in the sea.

Suggest **two** reasons why some land areas may **not** be suitable for wind turbines.

1 .....

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2 .....

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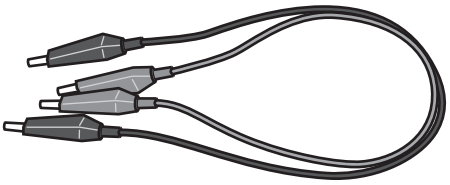
[2]

3 Ben wants to compare the brightness of filament lamps connected in a parallel circuit.

He can use as many of the components shown as he needs.



Connecting wires

Cells

Identical filament lamps

(a) (i) Draw a circuit diagram using circuit symbols to show **two** filament lamps connected in a parallel circuit with a cell.

[2]

(ii) Describe how Ben can find out how the brightness of the filament lamps connected in parallel change as more lamps are added in parallel.

.....

.....

.....

..... **[2]**

(b) Suggest how Ben could find out how the current in a filament lamp affects the brightness of a filament lamp.

.....

.....

.....

..... **[2]**

4 A neon lamp has a tube containing neon gas. Energy is transferred to the atoms of the gas. The atoms emit this energy as red light.

(a) Which statement describes what happens to a neon atom when it emits red light?

Tick (✓) **one** box.

An alpha particle is emitted from the nucleus. ☐

An electron in the atom moves closer to the nucleus. ☐

A neutron in the nucleus decays to a proton and an electron. ☐

An outer electron is removed from the atom. ☐

[1]

(b) The lamp is connected to an electricity supply. The potential difference across the tube is 60 V.

(i) Calculate the charge that flows through the tube when 7500 J of energy is transferred.

Use the Equation Sheet.

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

(ii) To supply the power to the neon lamp, a transformer uses a 240 V input power supply. The current in the primary coil is 0.2 A. The output potential difference is 60 V.

Calculate the current in the secondary coil of the transformer.

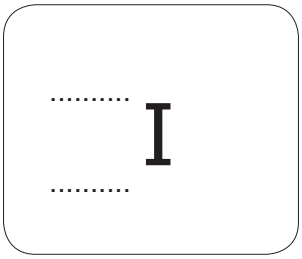
Use the Equation Sheet.

Current in secondary coil = ... A **[3]**

5 This table lists some data about an iodine radioactive isotope used to diagnose and treat cancer.

	Iodine
Chemical symbol	I
Number of protons	53
Number of neutrons	78

(a) Complete the label, using data from the table.



[2]

(b) The iodine is used as a tracer to image cancer cells. Gamma rays are emitted when the iodine decays.

Explain how the gamma rays can have hazardous effects.

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..... **[2]**

(c) (i) Gamma rays can be emitted when radioactive nuclei decay.

State **two** other possible emissions from radioactive nuclei when they decay.

1 .....

2 .....

[1]

(ii) Why do radioactive nuclei decay?

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

(iii) Complete the sentences to describe what can change when the nucleus of an atom decays radioactively.

Put a (ring) around each correct option.

The charge of the nucleus **can / cannot** change, and the mass of the nucleus

can / cannot change.

[1]

(d) In 2010 a new element was discovered. In 2015 the element was recognised officially. It is called tennessine.

Between 2010 and 2015 publications about tennessine went through the process of peer review.

Define **peer review**.

.....

.....

.....

..... **[2]**

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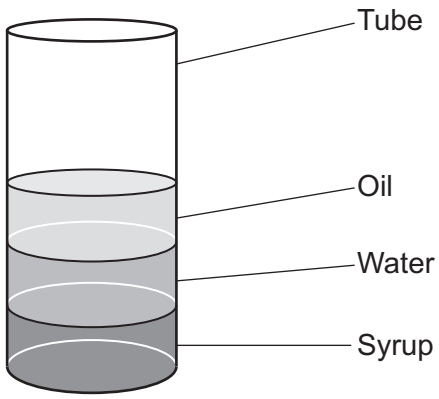
6 **Fig. 6.1** shows that liquids separate. The liquid that settles at the bottom has the greatest density.

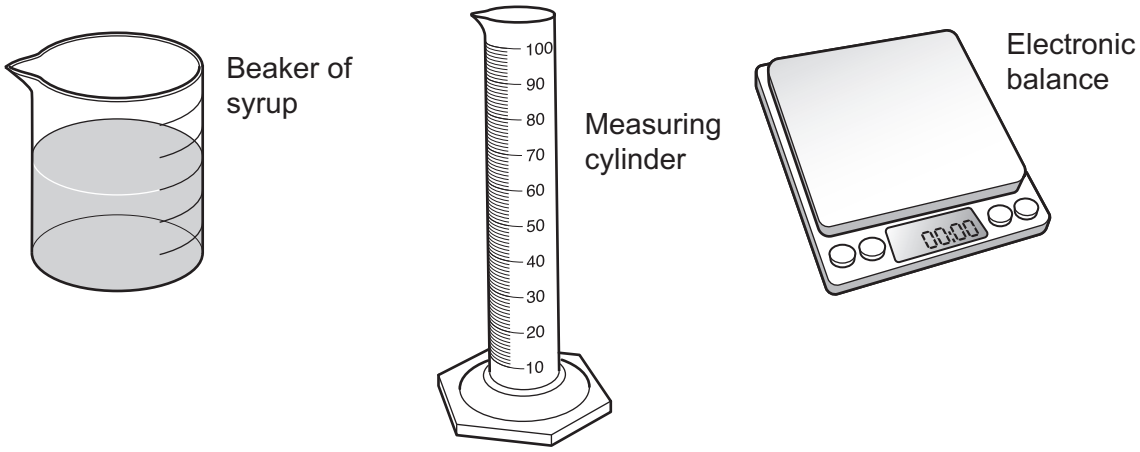
Fig. 6.1



(a) Mia has a sample of the syrup from **Fig. 6.1**.

She needs to determine the density of the syrup. She collects the equipment shown in **Fig. 6.2**.

Fig. 6.2



Describe how Mia can use this equipment to accurately determine the density of the syrup.

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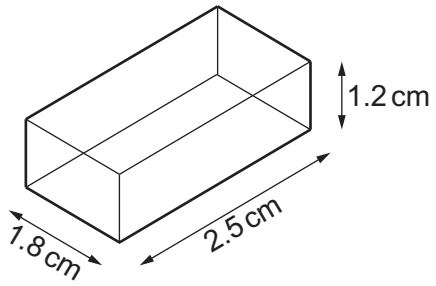
..... **[4]**

(b) **Fig. 6.3** shows a small plastic block.

Fig. 6.3



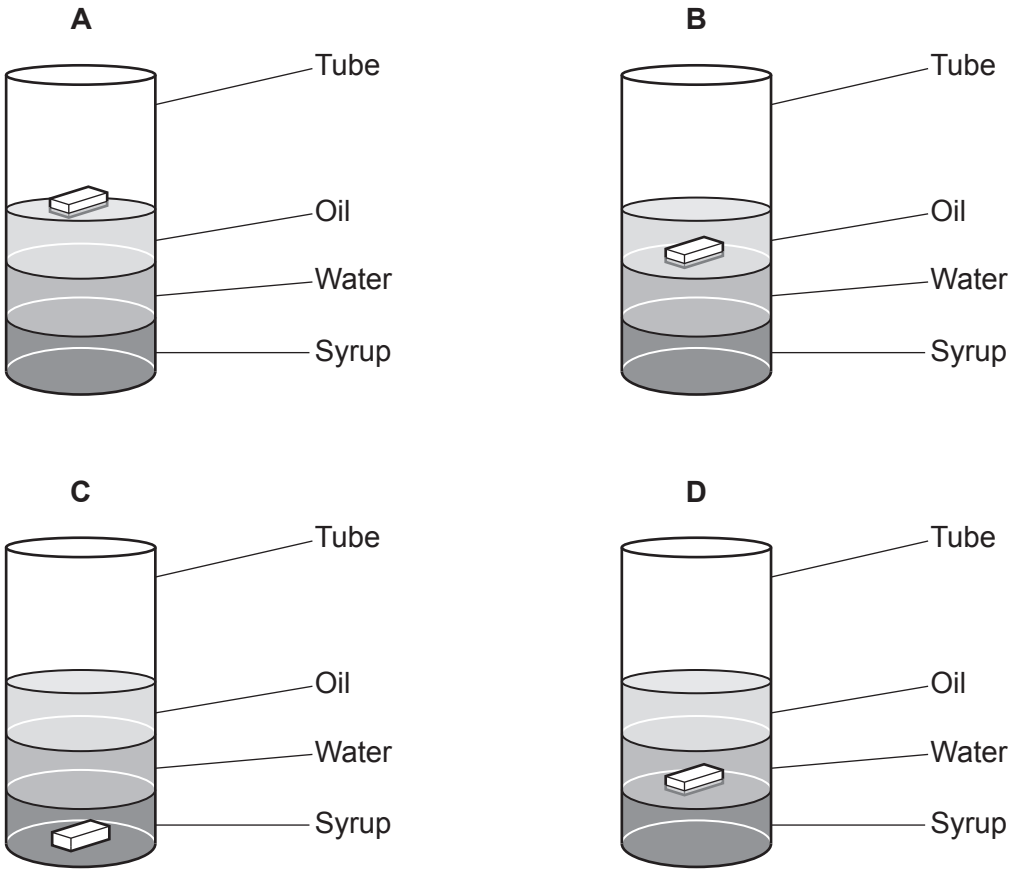
The mass of the block is 7.02 g.

(i) Calculate the density of the block.

Density = ... g / cm^3 **[4]**

(ii) **Fig. 6.4** shows 4 diagrams, **A**, **B**, **C**, and **D**. These diagrams show what happens to blocks of different densities that are dropped into the tube.

Fig. 6.4



The table shows the densities of the liquids in the tube.

Material	Density (g/cm^3)
Oil	0.85
Water	1.00
Syrup	1.45

Which diagram **A**, **B**, **C**, or **D**, shows what happens to a plastic block with a density of $1.15\,g/cm^3$ when it is dropped into the tube?

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

(iii) Suggest why the block moves to this position.

.....

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

7 An electric fan has a fast and slow setting.

(a) On the slow setting the current is 50 mA.

(i) Calculate the time for 30 C of charge to flow through the fan motor.

Use the Equation Sheet.

Time = ... s **[4]**

(ii) Define current.

.....

.....

.....

..... **[2]**

(b) On the fast setting the power transfer in the fan is 46 W. The current is 0.2 A.

Calculate the resistance of the fan.

Use the Equation Sheet.

Resistance = ... Ω **[3]**

(c) On the slow setting the power rating is 11.5 W.

Calculate the energy transferred by the fan in 240 s.

Use the equation: power = $\frac{\text{energy transferred}}{\text{time}}$

Energy transferred = ... J **[2]**

8 The table shows the typical speed of some activities.

Activity	Speed (m/s)	Speed (km/h)
Walking	1 to 1.5	3.6 – 5.4
Running	3	10.8
Cycling	7	……..
Driving a car at 30 mph	13	46.8

(a) Complete the table. **[2]**

(b) Leo is riding his bike along a flat road.

It takes Leo 17 s to accelerate from 3 m/s to 7 m/s.

Calculate the acceleration of the bike.

Give your answer to **2** decimal places.

Use the Equation Sheet.

Acceleration = ... m/s^2 **[4]**

(c) Leo increases his speed by peddling harder. The bike accelerates because of forces between the wheel and the road.

(i) Draw **two** arrows on the picture to represent the interaction pair of forces between the **back wheel** and the road.

Label the force on the road: **X**
Label the force on the bike: **Y**

[2]

(ii) Later on in the journey, Leo travels at a constant speed.

Identify **three** forces acting on the **bike**.

1 .....

2 .....

3 .....

[3]

(d) Leo is carrying a heavy rucksack.

Which statement defines the weight of Leo's rucksack?

Tick (✓) **one** box.

The weight of the rucksack is the downward force on the rucksack due to the gravitational attraction of the Earth. ☐

The weight of the rucksack is the mass of the rucksack due to the downward force on the Earth. ☐

The weight of the rucksack is the pressure on the rucksack due to the gravitational attraction of the Earth. ☐

The weight of the rucksack is the pressure on the Earth due to the mass of the rucksack. ☐

[1]

9 Hiro has a laser pointer which emits visible light.

The table shows the wavelength range for each colour in the visible light spectrum:

Colour of laser	Wavelength range ($\times 10^{-7}$ m)
Red	6.20 – 7.40
Orange	5.85 – 6.20
Yellow	5.75 – 5.85
Green	5.00 – 5.75
Blue	4.45 – 5.00
Indigo	4.25 – 4.45
Violet	3.90 – 4.25

(a) The frequency of the light from the laser pointer is 7.40×10^{14} Hz.

(i) Calculate the wavelength of the light.

Use the equation: wave speed = frequency × wavelength

The speed of light is 3.00×10^{8} m/s

Give your answer to **3** significant figures.

Wavelength = ... m **[3]**

(ii) The manufacturer claims that the laser pointer emits violet light.

Is the manufacturer correct?

Explain your answer.

.....

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

(b) Which **two** statements about waves are correct?

Tick (✓) **two** boxes.

Electromagnetic waves are transverse waves. ☐

Electromagnetic waves do not affect electric circuits. ☐

Infra-red waves are emitted by molecules. ☐

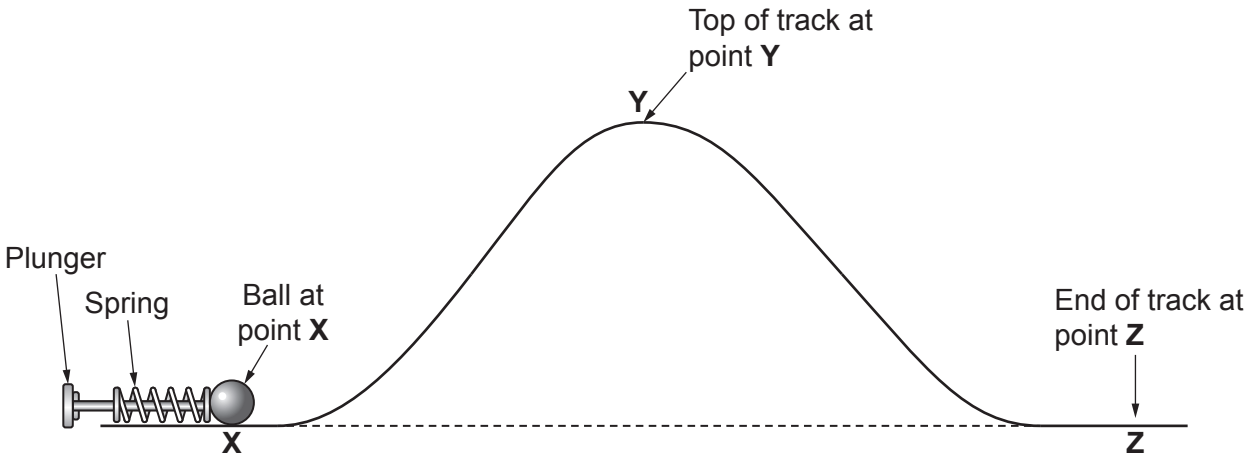
Sound waves are transverse waves. ☐

The amplitude of a wave decreases as the wavelength increases. ☐

[2]

10 Gabi has a toy which uses a spring to fire a ball along a track as shown in **Fig. 10.1**.

Fig. 10.1



Gabi pulls back the plunger to compress the spring. When released, the spring sends the ball along the track to the top of the track at point **Y**.

(a) The initial length of the spring is 0.17 m. It is compressed to a length of 0.05 m.

Calculate the energy stored in the spring when it is compressed.

Assume the energy stored when compressing the spring is the same as the energy stored when extending it the same distance.

Spring constant of the spring = 11 N / m
Use the Equation Sheet.

Energy stored = ... J **[4]**

(b) The ball continues to the end of the track at point **Z**.

Assume that no energy is transferred to any thermal stores.

(i) Complete this table to show the energy store that **increases** at each stage.

Action	Energy store that increases
Ball travelling up the track to **Y**.	
Ball travelling down the track to **Z**.	

[2]

(ii) Describe what happens to the total energy of the ball as it moves from **X** to **Z**.

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

(c) **(i)** Explain how changing the compressed length of the spring affects the speed of the ball at point **Z**.

.....

.....

.....

.....

..... **[3]**

(ii) Explain how changing the height of the track at point **Y** affects the speed of the ball at point **Z**.

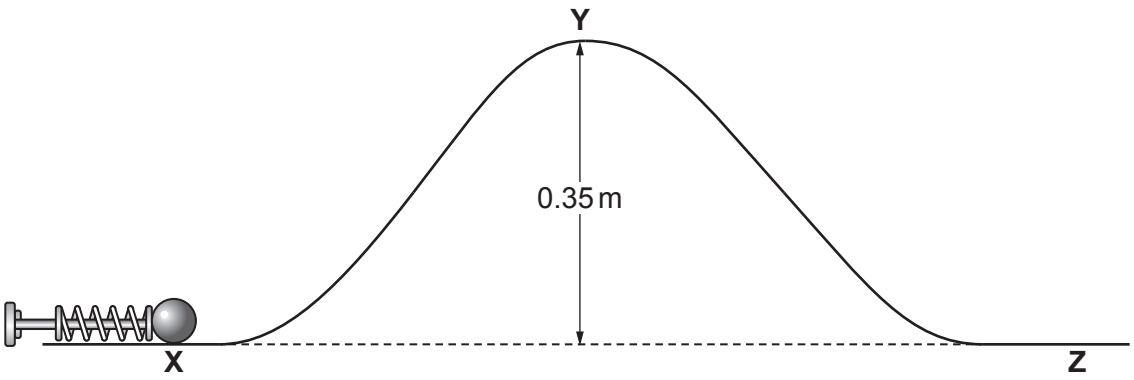
.....

.....

..... **[2]**

(d) The height between **X** and **Y** is 0.35 m as shown in **Fig. 10.2**.

Fig. 10.2



Gabi pulls the plunger so that the energy stored in the spring is 0.06 J. The plunger is released.

Calculate the maximum height the ball can travel up the slope.

Mass of the ball = 0.02 kg
Gravitational field strength = 10 N / kg

Use the Equation Sheet.

Maximum height = ... m **[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).