Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						7	5	4	0	/	0	2	Signature	

Paper Reference(s)

7540/02

London Examinations GCE

Physics

Ordinary Level

Paper 2

Friday 9 May 2008 – Afternoon

Time: 2 hours

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Some questions must be answered with a cross in a box (☒). If you change your mind about an answer, put a line through the box (~~☒~~) and then mark your new answer with a cross (☒).

Information for Candidates

Calculators may be used.
Where necessary, assume the acceleration of free fall, $g = 10\ m/s^2$.
The total mark for this paper is 100. The marks for parts of questions are shown in round brackets: e.g. **(2)**.
This paper has 5 questions. All blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.
In calculations, show **all** the steps in your working.

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Answer ALL the questions.

1. This question is about force and acceleration.

(a) The picture shows a small jet plane which can carry six people.

When taking off fully loaded the mass of the plane is 2560 kg. The two jet engines can exert a total thrust force of 8000 N and the friction force between the wheels and the ground is 340 N. Both forces remain constant at these values during take off.

(i) Calculate the acceleration of the plane as it starts to move.

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(3)

(ii) Explain why the acceleration gets smaller as the plane speeds up.

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(2)

(iii) The average acceleration during take off is 2.2 m/s^2. Calculate the time the plane will take to reach its take off speed of 55 m/s.

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(2)

Leave blank

(iv) Show that the plane could just take off using a runway 700 m long.

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(2)

(v) State and explain why the wheels of the plane are folded into the body of the plane after take off.

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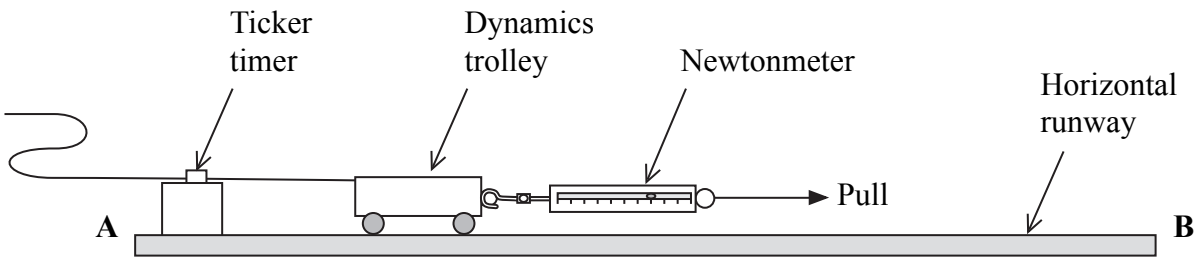
(2)

(b) The diagram shows an arrangement which is used to show how the acceleration of a dynamics trolley depends on the unbalanced force.



(i) Name two other items of apparatus which are needed.

1 .....

2 .....

(2)

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(ii) The runway, **AB**, is kept horizontal as shown. Describe how you would use this arrangement to obtain a set of results.

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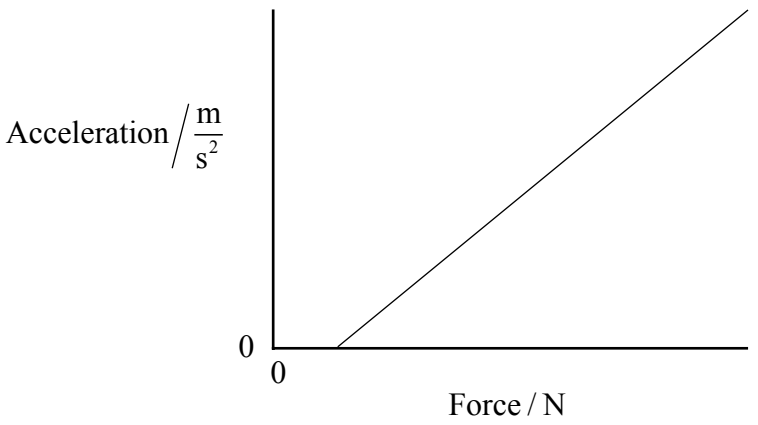
(4)

(iii) When this arrangement is used, the graph obtained is shown below.



Give a reason why the graph does not pass through the origin.

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(1)

Leave blank

(iv) Describe how you could adjust the arrangement so that the graph produced from the new results would pass through the origin.

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(2)

Q1

(Total 20 marks)

N 2 9 6 5 4 A 0 5 2 4

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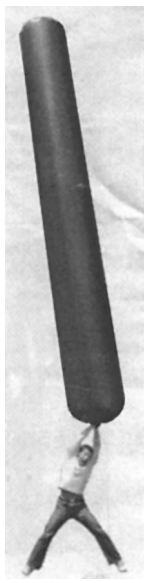
2. This question is about thermal (heat) energy, density and the expansion of gases.

The picture shows a cylindrical balloon made from very thin black plastic.



(a) (i) The volume of air trapped in this balloon at 15 °C is 7.0 m^3. Calculate the weight of air trapped inside the balloon.
[Density of air at 15 °C = 1.2 kg/m^3]

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(3)

(ii) If the temperature of the air trapped in the balloon is increased from 15 °C to 54 °C, show that the new volume of the air trapped in the balloon will be about 8 m^3. (Assume that the pressure and the mass of the trapped air remain constant.)

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(3)

Leave blank

(iii) What effect, if any, will this expansion have on the density and weight of the air trapped in the balloon?

Density .....

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Weight .....

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.....

(2)

(b) When placed in sunlight the air trapped in the balloon heats up and the balloon expands.

(i) Name the process by which the Sun transfers heat energy to the outside surface of the balloon.

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(1)

(ii) Name a process by which heat energy is transferred from the outside surface of the balloon to the air trapped inside the balloon.

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(1)

(iii) Explain in terms of air molecules why the balloon expands when the air trapped inside is heated.

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(2)

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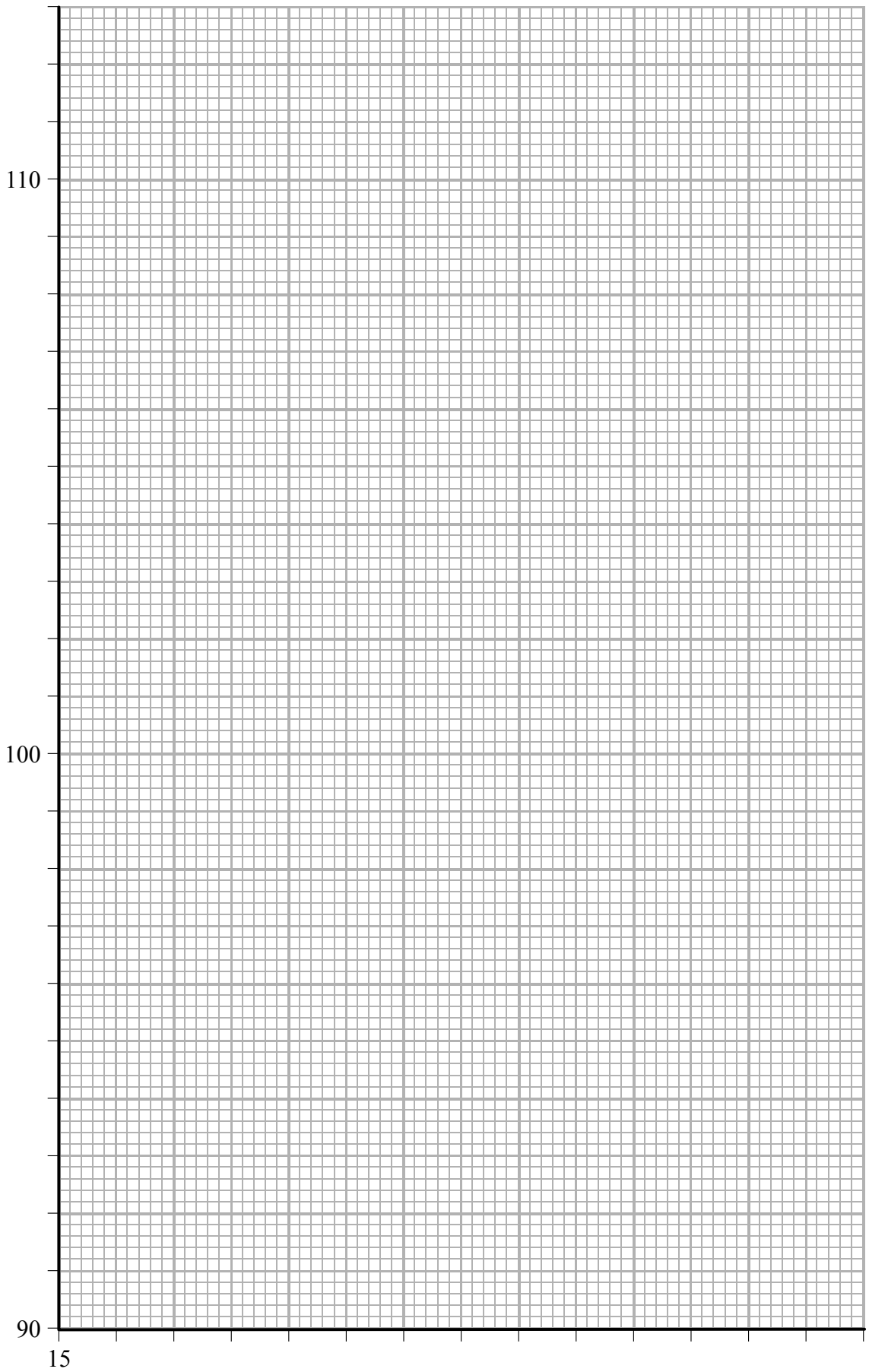

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(c) The air-filled balloon experiences a vertical upward force called upthrust. The table below shows how the upthrust on the balloon varies with temperature.

Upthrust on balloon / N	95.2	96.8	98.5	100.1	101.8	103.4	105.1	106.7
Temperature of trapped air / °C	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0

(i) On the grid opposite, plot a graph of Upthrust on balloon (*y*-axis) against Temperature of trapped air (*x*-axis). The scale for the Upthrust axis has been drawn for you and the Temperature axis has been started at 15 °C. Choose a sensible scale for the temperature axis that makes full use of the grid. Draw a straight line through the points.

(5)

(ii) Use your graph to find the temperature at which the upthrust equals 101 N.

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(1)

(iii) On the grid show clearly how you used the graph to obtain your answer.

(1)

(iv) The total weight of the balloon and the trapped air is 101 N. State why the balloon will accelerate upwards when the temperature of the trapped air is 50 °C.

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(1)

Q2

(Total 20 marks)

N 2 9 6 5 4 A 0 9 2 4

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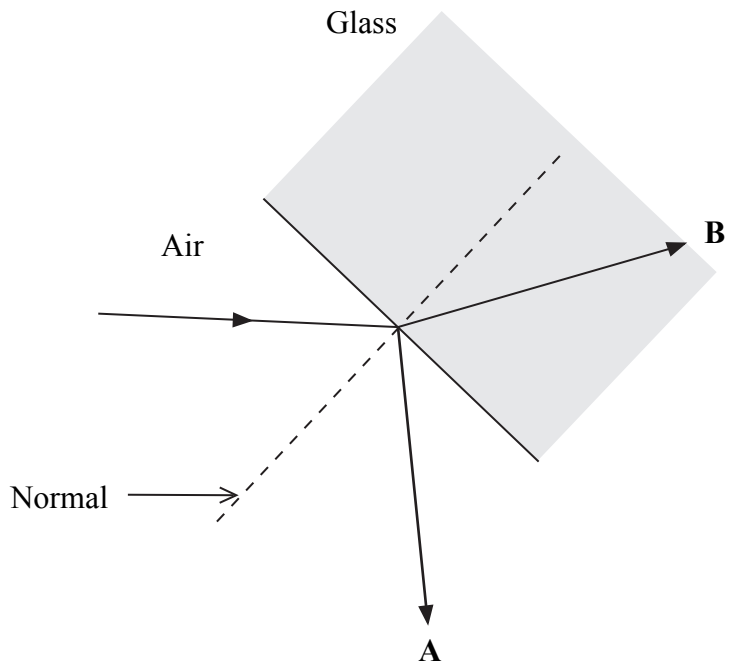
3. This question is about light.

(a) The diagram shows a ray of light in air going towards glass. The normal at the point of incidence is drawn as a dotted line. Two resulting rays **A** and **B** are shown.



(i) Explain the direction of ray **A**.

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(2)

(ii) Explain the direction of ray **B**.

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(2)

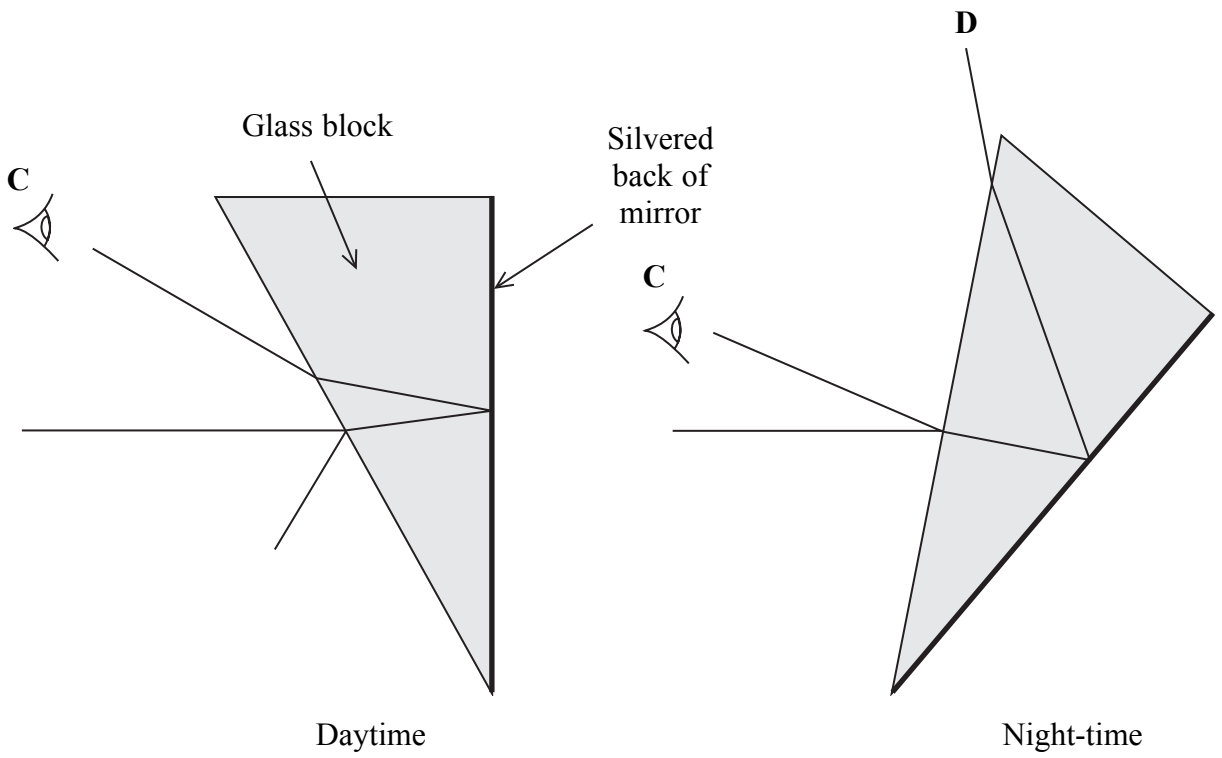
(iii) Which is brighter, ray **A** or ray **B**? Put a cross (☒) in the correct box.

A ☒ **B** ☒

(1)

Leave blank

(b) The diagram shows a mirror in a car set for daytime and for night-time driving.



For both settings, light from a car behind the driver strikes the mirror and goes towards the driver's eye at **C**.

(i) Add arrows to both diagrams to show the directions of all the rays of light.

(1)

(ii) Explain why the back of the mirror is silvered.

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(1)

(iii) Give two reasons why it would not be a good idea for the driver's eye to be placed at **D** for night-time driving.

1 .....

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2 .....

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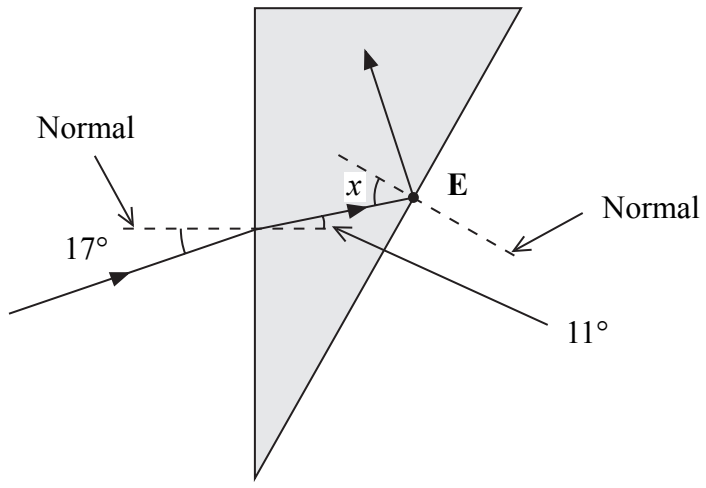
(2)

N 2 9 6 5 4 A 0 1 1 2 4

Leave blank

(c) A student experimented with a glass block of similar shape to the mirror. The block was not silvered. The rays are shown.



(i) Calculate the refractive index of the glass.

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(2)

(ii) State what is happening at **E**.

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(1)

(iii) Calculate the least possible value for angle *x*.

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(2)

(iv) Explain your answer to part (iii).

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(1)

Leave blank

(d) Describe an experiment to find the refractive index of glass using a rectangular glass block. Your answer should include a labelled diagram and the method used for this experiment.

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(5)

Q3

(Total 20 marks)

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N29654A01424

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4. This question is about electricity and radioactivity.

(a) A battery has an energy density of 0.10 kWh/kg which means that it holds 0.10 kWh of energy for every kg of its mass.

(i) Show that 0.10 kWh is 360 kJ.

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(2)

(ii) The mass of the battery is 0.025 kg. Use the value from (i) to calculate how much energy the battery holds.

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(2)

(iii) Use your answer from (ii) to calculate the time for which the battery can supply energy to a 5.0 W lamp.

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(2)

Leave blank

(b) A Radioactive Thermoelectric Generator (RTG) is a device in which heat is released by the radioactive decay of plutonium (Pu-238). The RTG can be used as a power source in satellites and space probes. Plutonium-238 decays by emitting an alpha particle to form an isotope of uranium. The half-life of plutonium-238 is 88 years.

(i) Complete the decay equation shown below.

$$\overset{238}{\underset{\ldots\ldots}{\ldots\ldots}}\mathrm{Pu} \rightarrow \underset{\ldots\ldots}{\overset{\ldots\ldots}{\ldots\ldots}}\alpha + \overset{\ldots\ldots}{\underset{92}{\ldots\ldots}}\mathrm{U}$$

(4)

(ii) How long does it take for the amount of plutonium-238 in a material to reduce to one-quarter?

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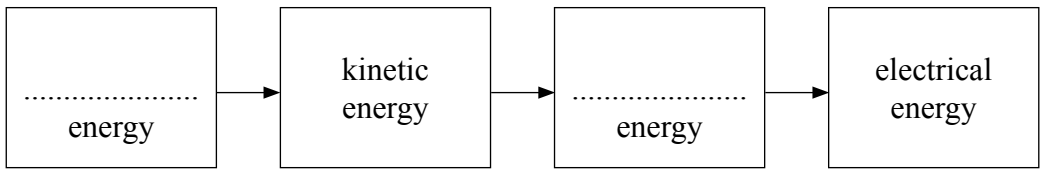
(2)

(iii) State the energy conversions that take place in the RTG by completing the boxes.



(1)

(c) The RTG has an outer casing of aluminium.

Explain why aluminium is a suitable material to use from a safety point of view.

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(2)

Leave blank

(d) An RTG battery has an energy density of 200 kWh/kg but is only 5% efficient.

(i) Show that the RTG battery with a mass of 0.0020 kg has sufficient energy to supply a 5.0 W lamp for 4 hours.

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(3)

(ii) Why will the RTG battery be able to supply energy to the lamp for longer than 4 hours?

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(2)

(Total 20 marks)

Q4

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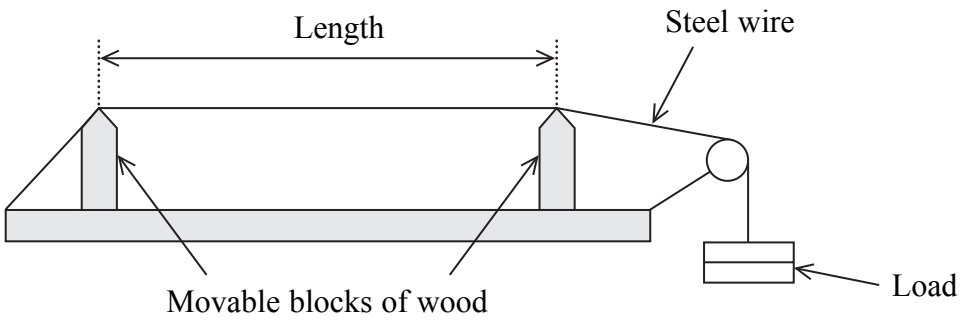
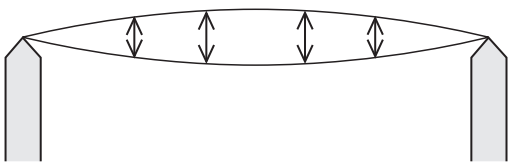
5. This question is about the vibration of wires and the design of an experiment.

The diagram shows an arrangement for investigating the vibrations of a stretched steel wire.

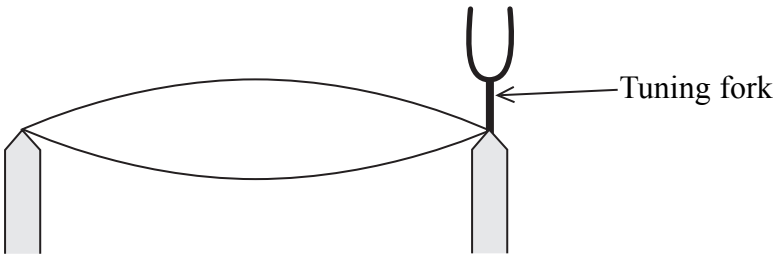


When the wire is plucked at its centre it moves rapidly as shown below. The length of the wire represents half the **wavelength** of the vibration.



A vibrating tuning fork is placed on the wire as shown below. The wire vibrates with an **amplitude** which is too small to see. A small piece of paper is placed on the centre of the wire.

With a tuning fork of a certain **frequency** the wire vibrates with a larger **amplitude** and the paper falls off. This is called **resonance**.



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(a) What is meant by the terms:

(i) amplitude

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(1)

(ii) frequency

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(1)

(iii) wavelength

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(1)

(iv) resonance?

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(2)

Leave blank

(b) A student decides to investigate how the length of the wire at resonance depends on the frequency of the tuning fork.

Describe how she would investigate the relationship between the length of the wire and the frequency of the tuning fork.

Your account should include the following.

(i) A factor that needs to remain constant throughout the investigation.

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(1)

(ii) A list of three items of equipment needed to carry out the investigation.

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3 .....

(3)

(iii) A description of the method she would use.
(Include any measurements she would make and say how she would ensure that the results are as accurate as possible.)

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(6)

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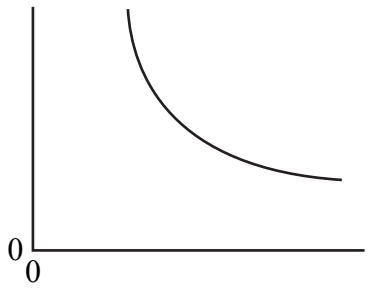
(iv) A table for recording results, showing the column headings.

(2)

(c) Below is a sketch of the results of the investigation. Label the axes.



Describe the effect of frequency on length.

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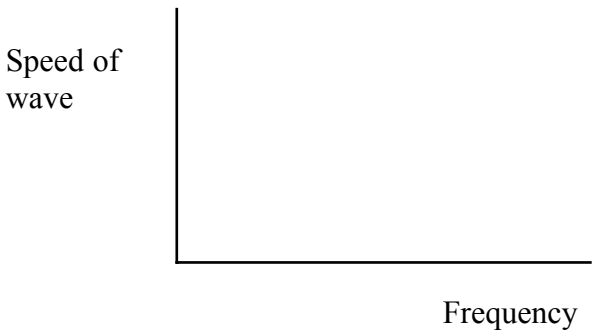
(1)

(d) (i) On the axis below sketch how the speed of the wave in the wire depends on the frequency.



(1)

(ii) Explain your sketch.

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(1)

Q5

(Total 20 marks)

TOTAL FOR PAPER: 100 MARKS

END

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N 2 9 6 5 4 A 0 2 3 2 4

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