| 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 11 May 2007 – Afternoon

Time: 2 hours

**Materials required for examination**
Nil

**Items included with question papers**
Nil

Examiner's use only

| | | |
|---|---|---|
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Team Leader's use only

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| Question Number | Leave Blank |
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| 1 | |
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### 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.

### 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 five 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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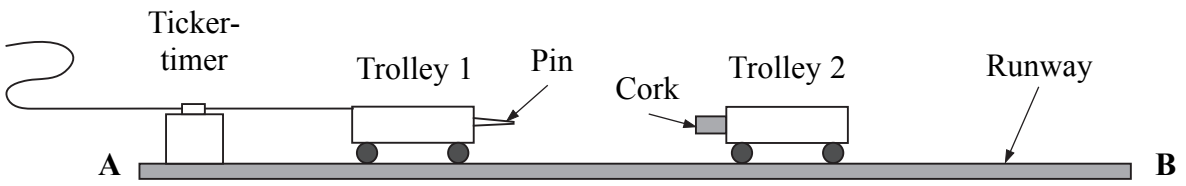
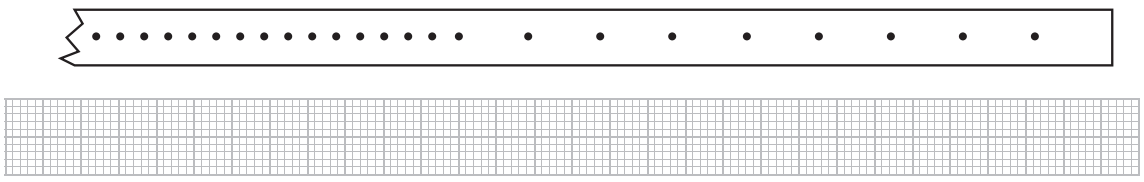
**Answer all the questions.**

**1. This question is about momentum and the conservation of energy.**




The diagram shows apparatus that can be used to investigate a collision between a moving dynamics trolley and a stationary dynamics trolley using a ticker-timer. Trolley 1 is given a short push, moves towards and collides with trolley 2. The pin on trolley 1 penetrates the cork on trolley 2 so that they move together after the collision. The tape produced is shown, full size, above a millimetre grid.



(a) End **A** of the runway is usually raised slightly before carrying out the experiment.

(i) What is the purpose of this adjustment and why is it necessary?

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**(2)**

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(ii) Has this adjustment been made correctly before producing the tape shown? Explain your answer.

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**(3)**

(b) The ticker-timer produces one dot every 0.020 s. Using the tape and the millimetre grid shown:

(i) calculate the velocity of trolley 1 before the collision;

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**(3)**

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(ii) calculate the momentum of trolley 1 before the collision. (Mass of trolley 1 is 0.80 kg.)

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**(2)**

(iii) The momentum of the two trolleys combined after the collision is 0.384 kg m/s. The mass of trolley 2 is 2.40 kg. Calculate the velocity of the trolleys after the collision.

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**(3)**

(iv) How does the value of momentum calculated in (ii) compare with the value of momentum given in (iii)? Give a reason for your answer.

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**(2)**

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(c) In a further experiment the following results were obtained:

Mass of trolley 1 = 0.80 kg
Velocity of trolley 1 before the collision = 0.40 m/s
Kinetic energy of the combined trolleys after the collision = 0.016 J

(i) Calculate the kinetic energy of trolley 1 before the collision.

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**(2)**

(ii) How does the value of kinetic energy before the collision calculated in (i) compare with 0.016 J?

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**(1)**

(iii) Give two other types of energy that could account for this difference.

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**(2)**

**Q1**

**(Total 20 marks)**

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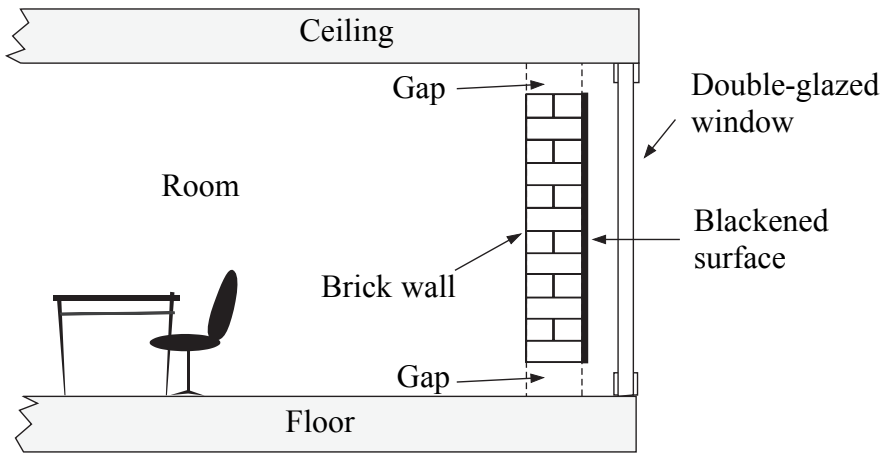
**2. This question is about thermal (heat) energy.**

The diagram shows a method of heating a room using solar energy instead of conventional sources of energy. A brick wall with a blackened surface is placed behind a double-glazed window facing the Sun. During the day the wall stores energy received from the Sun as heat energy.




(a) (i) Name the only method by which energy from the Sun is transferred to the Earth.
Give a reason for your answer.

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**(2)**

(ii) Why is the surface of the wall blackened?

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**(2)**

Leave blank

(iii) Name the method by which heat energy from the blackened surface is transferred to the air next to it.

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**(1)**

(iv) Describe how this heated air is transferred throughout the room.

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**(3)**

(v) The double-glazed window consists of two sheets of glass which trap a layer of air between them. Explain how using a double-glazed window increases the rate at which the temperature of the room rises.

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**(2)**

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(b) On a sunny day the wall absorbs energy at a rate of 300 W/m$^2$. The wall has an area of 6.0 m$^2$ and a thickness of 0.15 m.

(i) Calculate the energy absorbed by the wall in 30 minutes.

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**(2)**

(ii) Calculate the mass of the brick wall.
(Density of brick = 2100 kg/m$^3$)

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**(2)**

(iii) Calculate the temperature rise of the wall during these 30 minutes.
[Specific heat capacity of brick = 750 J/(kg K)]

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**(2)**

(iv) Give two reasons why the actual temperature rise is less than that calculated.

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**(2)**

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(v) Give one advantage and one disadvantage of this method of heating the room.

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**(2)**

**Q2**

**(Total 20 marks)**

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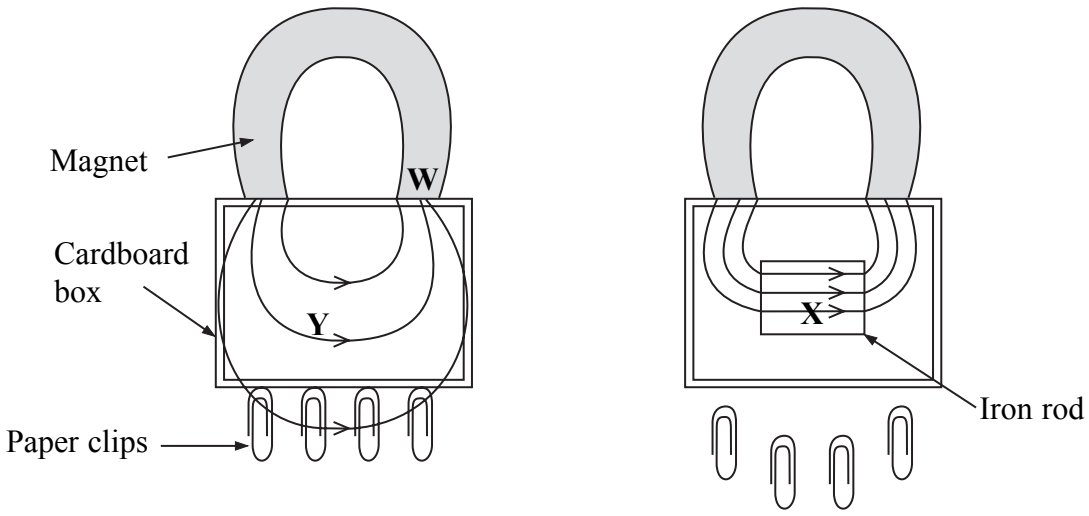
**3. This question is about electromagnetism.**

(a) The diagrams show how a region containing no magnetic field lines can be created. This is a form of magnetic shielding.




(i) Is **W** a N-pole or a S-pole?

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**(1)**

(ii) What does the magnetic flux pattern tell us about the magnetic field in region **X**?

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**(1)**

(iii) What does the magnetic flux pattern tell us about the magnetic field in region **X** compared with that in region **Y**?

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**(1)**

(iv) Explain how the introduction of the iron rod causes the paper clips to fall from the cardboard box.

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**(2)**

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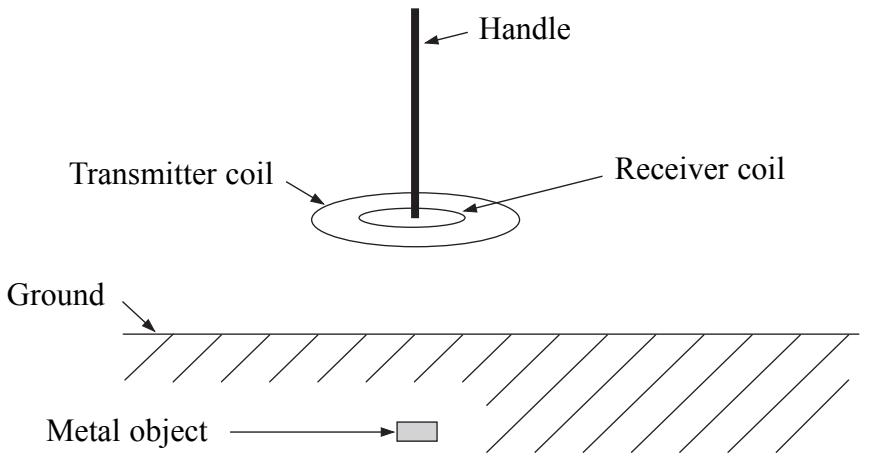
(b) The diagram shows some components of a metal detector held above a metal object buried in the ground.




The transmitter coil has an alternating current in it that produces an alternating magnetic field. This induces an alternating current in a metal object in the ground. This current produces an alternating magnetic field which in turn induces a current in the receiver coil.

(i) Sketch the magnetic flux pattern for a flat circular coil. Show the direction of the current in the coil and the direction of the magnetic field lines.

**(3)**

(ii) Explain why the receiver coil must be shielded from the transmitter coil.

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**(1)**

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(iii) Explain the difference between an alternating current and a direct current.

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**(2)**

(iv) Explain why it is necessary to use an alternating current and not a direct current in the transmitter coil.

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**(2)**

(c) In an experiment using a metal detector the current in the receiver coil is measured for a metal object placed at different depths below the ground. The table shows the values recorded.

| Current / mA | 9.3 | 8.0 | 6.7 | 5.4 | 4.1 | 2.8 | 1.5 |
|---|---|---|---|---|---|---|---|
| Depth / cm | 0 | 5 | 10 | 15 | 20 | 25 | 30 |

(i) On the grid opposite, plot a graph of current (*y*-axis) against depth (*x*-axis). Choose a sensible scale that makes full use of the grid.
Draw the best-fit straight line through the points.

**(5)**

(ii) Use the graph to find the depth of object that will produce a current of 2.0 mA in the receiver coil. Show on the graph how you obtained your value.

**(2)**

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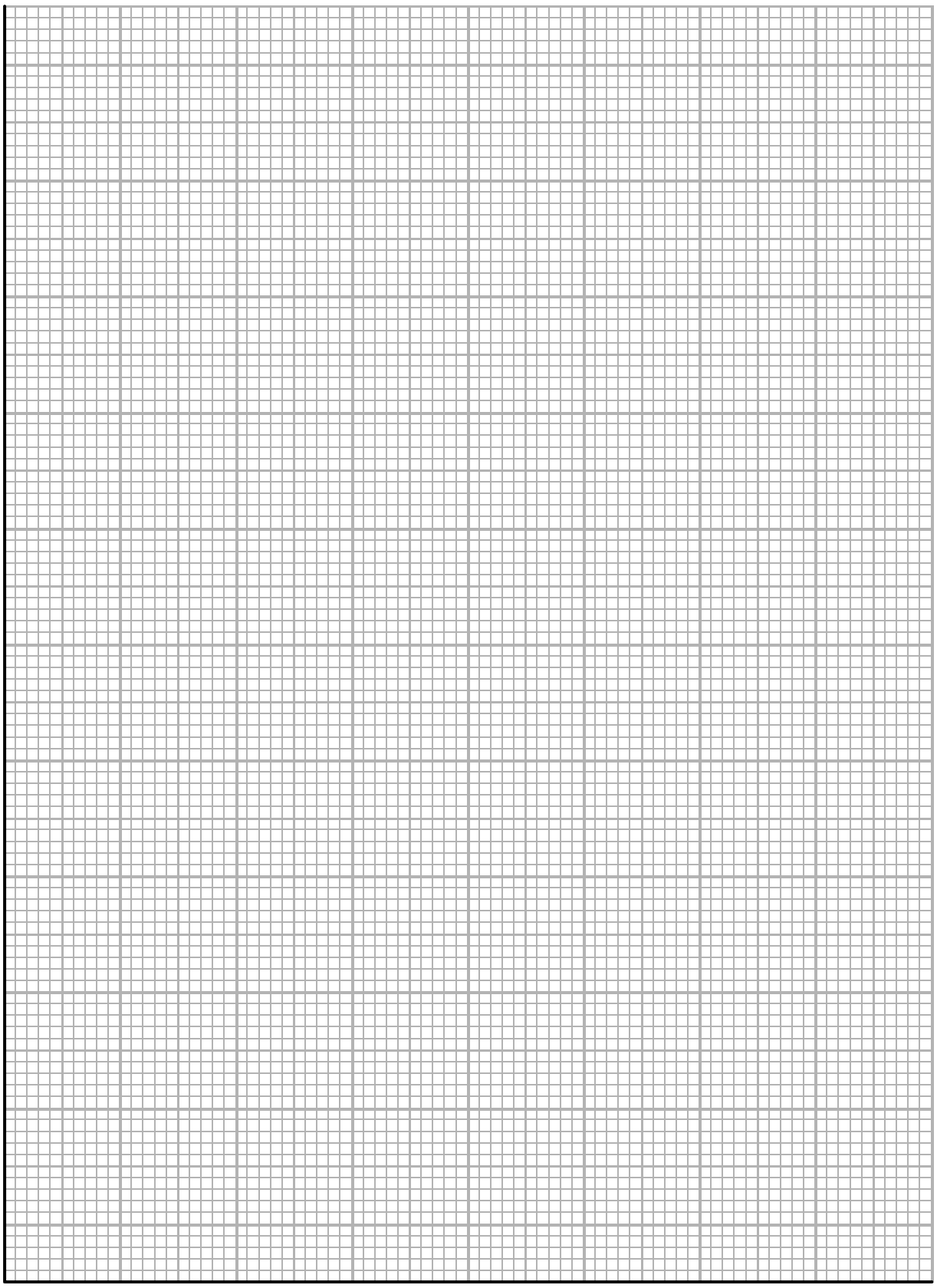

**Q3**

**(Total 20 marks)**

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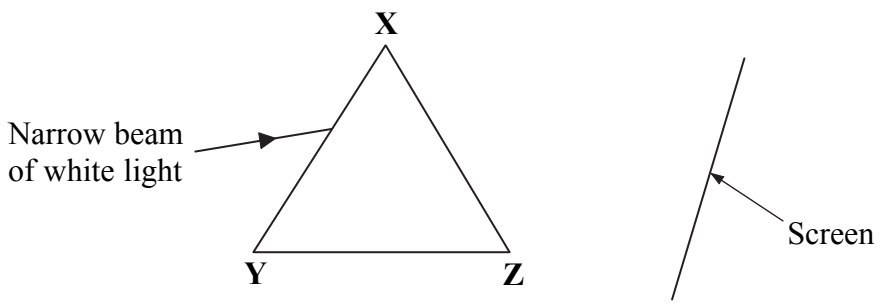
**4. This question is about refraction.**

(a) Diagram 1 shows a glass prism **XYZ** with a narrow beam of white light incident on the face **XY**.

**Diagram 1**

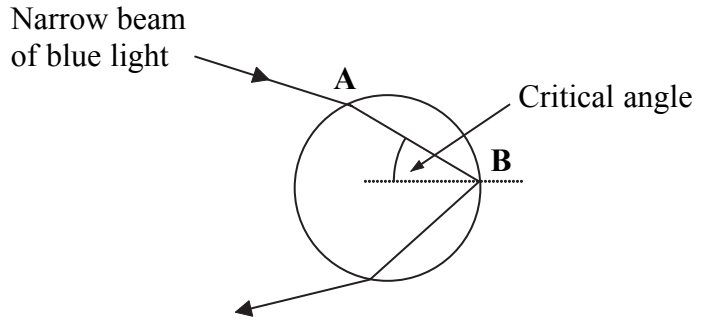



Use diagram 1 to show how a glass prism is used to produce a visible spectrum on a screen.

**(4)**

(b) Diagram 2 shows a narrow beam of blue light being deviated by a water droplet.

**Diagram 2**




(i) State and explain what is happening at **A**.

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**(2)**

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(ii) State and explain what is happening at **B**.

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**(2)**

(iii) Describe and explain the path taken by a narrow beam of **red** light incident on the water droplet at the same point, and with the same angle of incidence, as the narrow beam of blue light.

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**(5)**

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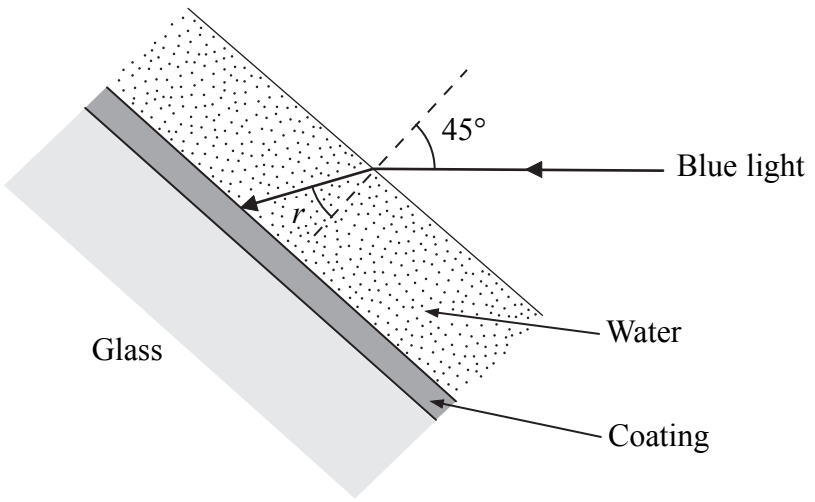
(c) Water droplets on the glass windscreen of a car make it difficult to see because of the deviation of light.
A thin transparent coating applied to the glass causes the water droplets to flatten over the surface of the glass.
Diagram 3 shows a narrow beam of blue light incident on water of refractive index 1.33.
The coating and the glass each have a refractive index of 1.52 for blue light.

**Diagram 3**




(i) Calculate the angle of refraction *r* within the water.

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**(2)**

(ii) Describe and explain what happens to the direction of the blue light after leaving the water and entering the coating and the glass.

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**(3)**

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(iii) Calculate the critical angle in water for blue light.

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**(2)**

**Q4**

**(Total 20 marks)**

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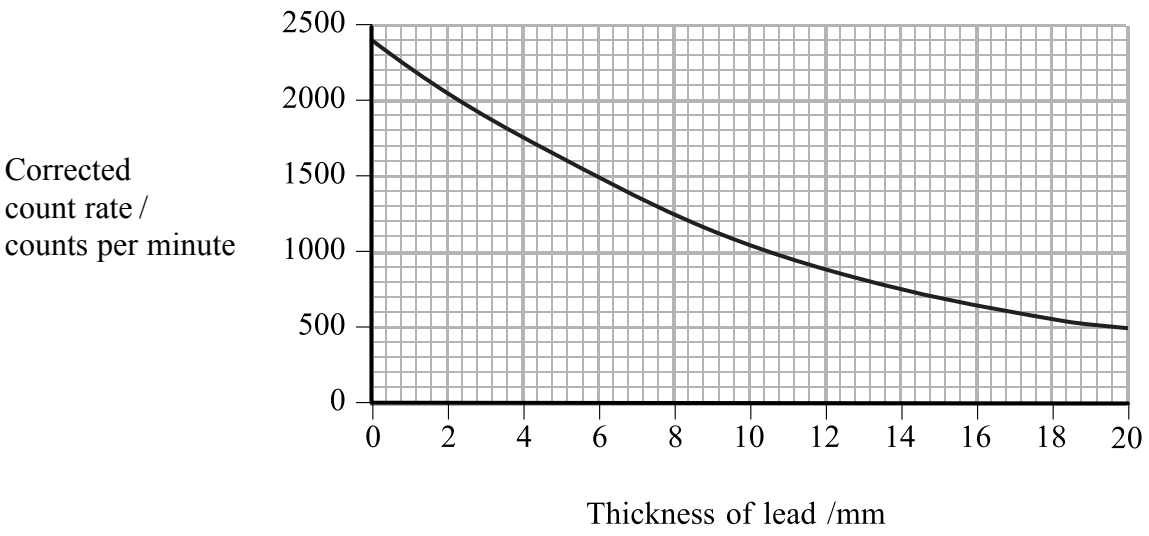
**5. This question is about radioactivity and the design of an experiment.**

When material is placed between a radioactive source and a detector the count rate depends on the thickness of the material.
The graph shows count rate against thickness of lead for a gamma ray source. The count rate values have been corrected for background radiation.




(a) The thickness of lead required to reduce the count rate to half is known as the **half-value thickness**.

(i) Explain how count rate values are corrected for background radiation.

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**(2)**

(ii) Use the graph to determine the half-value thickness of lead.

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(iii) Explain why the gamma ray source used in this investigation should have a long half-life.

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**(1)**

(iv) Explain why all readings should be repeated in this investigation.

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**(1)**

(b) A teacher is to show her class how to determine the half-value thickness of lead for gamma rays.
Describe how she would perform this investigation.
Your account should include the following:

(i) A list of four essential items of apparatus (apart from the radioactive source). One of your items should improve safety.

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**(4)**

(ii) A list of measurements to be taken.

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**(3)**

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(iii) A description of how the apparatus is used.

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**(4)**

(iv) A table for recording results.

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**(2)**

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(c) In a further investigation the teacher shows how the half-value thickness of a range of materials varies with density.
She finds that the denser the material the lower is its half-value thickness.
Sketch a labelled graph to show this effect.

**(2)** **Q5**

**(Total 20 marks)**

**TOTAL FOR PAPER: 100 MARKS**

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