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

Paper Reference(s)

**7540/02**

Examiner's use only

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Team Leader's use only

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# London Examinations GCE

## Physics

## Ordinary Level

Paper 2

Wednesday 13 May 2009 – Afternoon

Time: 2 hours

**Materials required for examination**
Nil

**Items included with question papers**
Nil

| Question Number | Leave Blank |
|---|---|
| 1 | |
| 2 | |
| 3 | |
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| Total | |

### 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 momentum.**

The drawing shows a golfer about to hit a golf ball.


(a) The golf club hits the stationary ball of mass 0.045 kg and applies an average force of 2700 N.

(i) Calculate the acceleration of the golf ball due to this force.

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.....

.....

**(2)**

(ii) The golf club applies the force for 0.0012 s.
Show that the velocity of the ball as it leaves the club is about 70 m/s.

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**(2)**

Leave blank

(iii) Calculate the change of momentum of the ball during this 0.0012 s.

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.....

**(2)**

(iv) List **two** forces which act on the ball after it leaves the club.

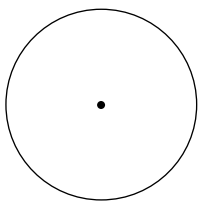
1 .....

2 .....

**(2)**

(v) Add two arrows to the diagram below to show the direction and line of action of each of the forces named above. Label the arrows 1 and 2.

Direction of travel of the golf ball



**(2)**

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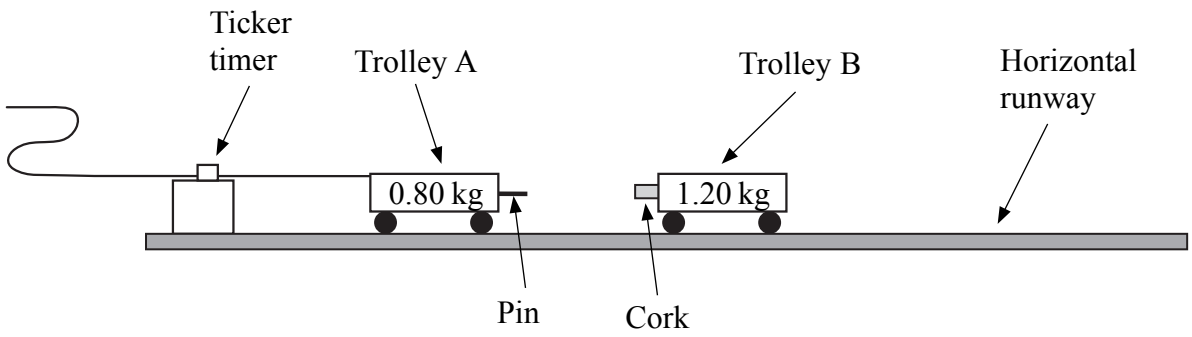
(b) The diagram shows an arrangement which can be used to investigate the momentum before and after a collision. Moving trolley A collides with stationary trolley B. After the collision the two trolleys stick and move together.




(i) The momentum of trolley A before the collision is 0.50 kg m/s. What is the *expected* momentum of the combined trolleys after the collision? Give a reason for your answer.

Momentum after collision .....

Reason .....

.....

.....

**(2)**

(ii) The *actual* momentum measured after the collision using the arrangement shown was 0.40 kg m/s. What force is responsible for the difference from your answer to (i)?

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.....

**(1)**

(iii) Using the *actual* momentum, calculate the velocity of the trolleys after the collision.

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**(3)**

Leave blank

(iv) What name is given to the adjustment that is normally made to the arrangement shown before carrying out the experiment?

.....

**(1)**

(v) Describe how you would carry out this adjustment. Explain how you would check that it had been carried out correctly.

Adjustment:

.....

.....

Explanation:

.....

.....

.....

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**(3)**

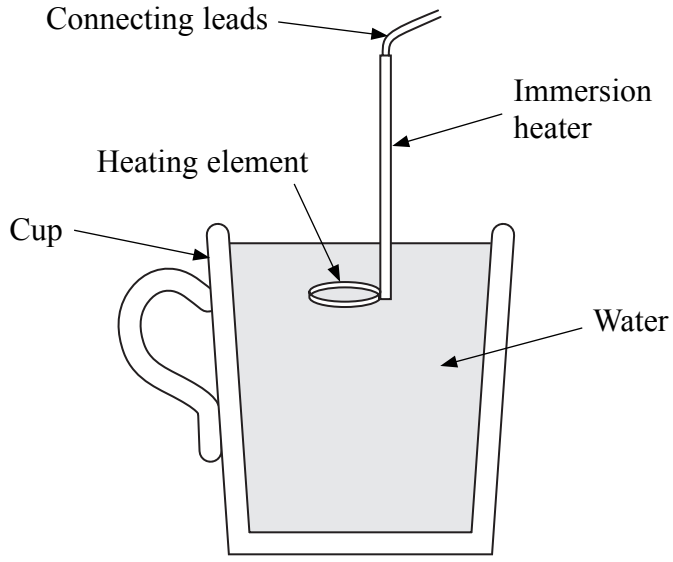
**Q1**

**(Total 20 marks)**

Leave blank

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

The diagram shows an electric immersion heater being used to heat a cupful of water.




(a) (i) Name the **two** main processes by which heat energy is transferred from the heating element to the water in the cup.

1 .....

2 .....

**(2)**

(ii) With the heater in the position shown, the water at the bottom of the cup remains cold.
State a better position for the heating element.

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**(1)**

Leave blank

(iii) Explain how all the water in the cup is heated with the heater in this new position.

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**(3)**

(iv) The cup contains 0.45 kg of water at 20 °C. Calculate the heat energy needed to raise the temperature of the water in the cup to 90 °C.
[Specific heat capacity of water = 4200 J/(kg K)]

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.....

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.....

**(3)**

Leave blank

(b) The heater is correctly placed in a different cup. The heat energy needed to raise the temperature of the water in this cup from 20 °C to 90 °C is 144 000 J.
The power of the heater is 360 W.

(i) How much heat energy does the heater transfer in one second?

.....

**(1)**

(ii) Calculate the least time taken for the heater to raise the temperature of the water in this second cup from 20 °C to 90 °C.

.....

.....

.....

**(2)**

(iii) Give **two** reasons why the actual time taken to raise the temperature of the water from 20 °C to 90 °C will be greater than that calculated in (ii).

1 .....

.....

2 .....

.....

**(2)**

(iv) The heater is switched off when the temperature reaches 90 °C. Give **two** ways in which the rate at which the water in the cup cools could be reduced.

1 .....

.....

2 .....

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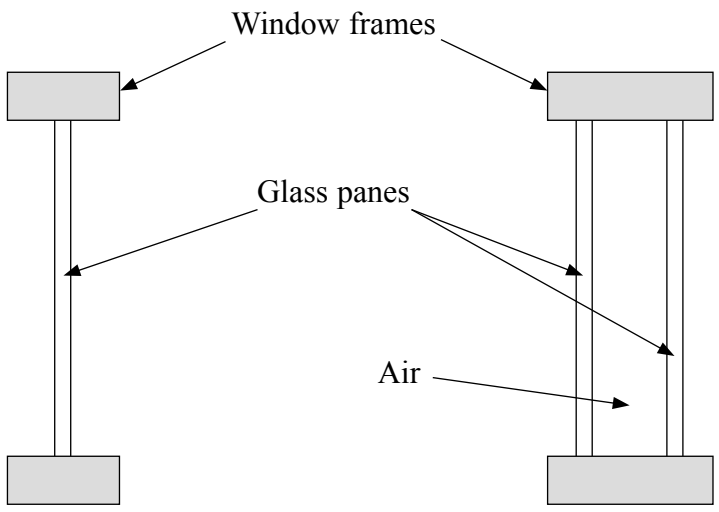
**(2)**

Leave blank

(c) The diagram below shows a section through a single-glazed window and a section through a double-glazed window.




Single-glazed window

Double-glazed window

(i) Explain why a house with double-glazed windows will be cheaper to heat in cold weather than one with single-glazed windows.

.....

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.....

**(2)**

(ii) Explain why it would be better to make the window frames from wood rather than from metal.

.....

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.....

.....

**(2)**

**Q2**

**(Total 20 marks)**



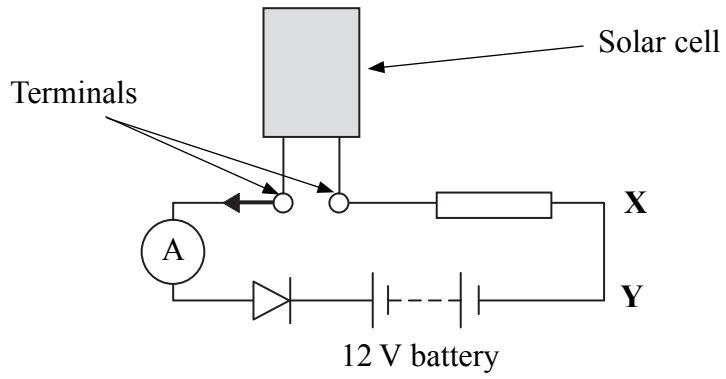


**Turn over**

Leave blank

**3. This question is about solar energy and current electricity.**

The diagram shows a solar cell connected in a circuit used for charging a 12 V battery.




(a) The energy transfer process in the solar cell is ..... energy to ..... energy.

**(1)**

(b) During the charging process, charge from the solar cell passes through the battery.

The direction of the conventional current in the circuit is shown by the arrow.

←

(i) Label each terminal of the solar cell with either + or −.

**(1)**

(ii) The circuit includes a diode. State the action of a diode.

.....

.....

**(1)**

(iii) Why is the diode connected as shown in the circuit diagram?

.....

.....

**(1)**

Leave blank

(c) The e.m.f. of the solar cell is 18 V.

The current from the solar cell is 70 mA (0.070 A).

(i) Calculate the power output of the solar cell.

.....

.....

.....

**(2)**

(ii) How much charge flows from the solar cell in 4 hours?

.....

.....

.....

**(2)**

(iii) Show that the resistance of the resistor in the circuit is about 86 Ω.

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.....

**(3)**

(d) (i) Refer to the wire **XY** in the circuit diagram. When the solar cell is charging the battery, is the direction of the electron flow from **X to Y** or from **Y to X**?
Put a cross (☒) in the correct box.

**X to Y** ☐ **Y to X** ☐

**(1)**

(ii) Explain your answer in (i).

.....

.....

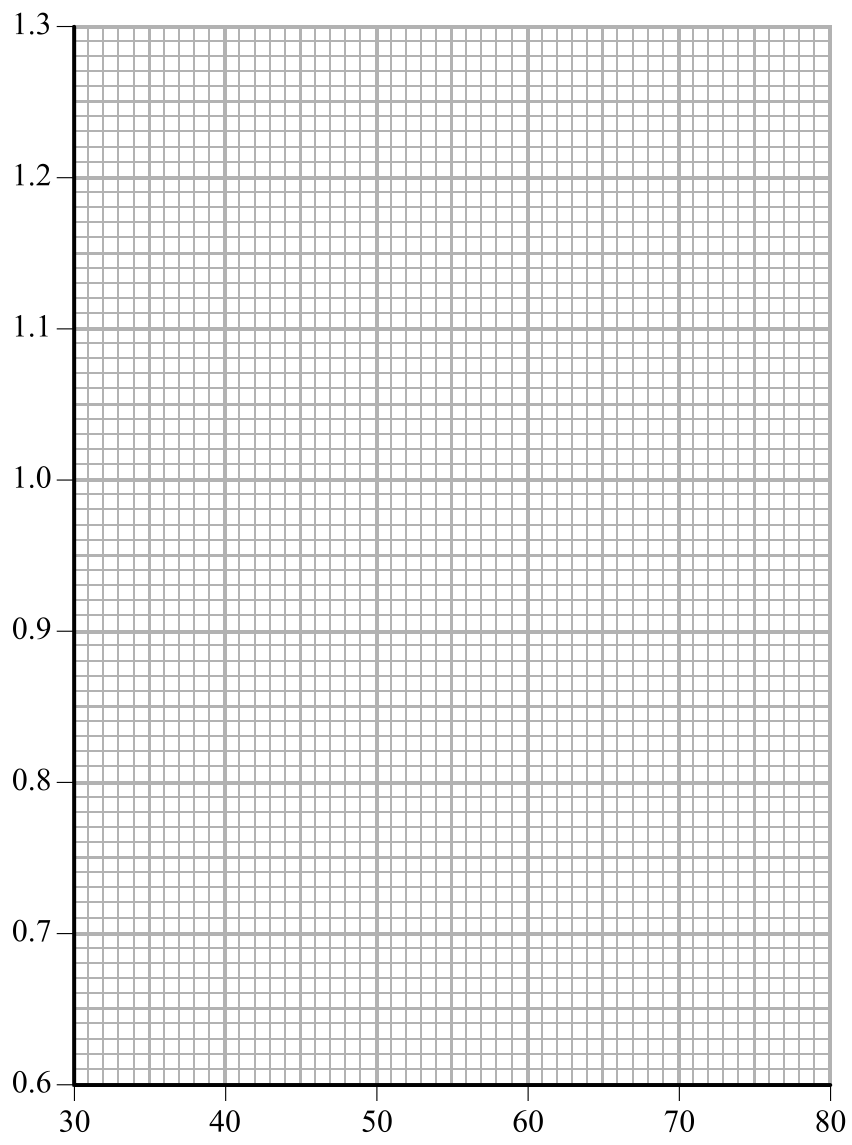
**(2)**

Leave blank

(e) The power output of the solar cell depends on the angle of the incoming radiation. A student recorded the following results.

| Power output / W | 0.63 | 0.81 | 0.97 | 1.09 | 1.18 | 1.24 |
|---|---|---|---|---|---|---|
| Angle / ° | 30 | 40 | 50 | 60 | 70 | 80 |

(i) On the grid below, plot a graph of power output (*y*-axis) against angle (*x*-axis). Label the axes. Draw the best-fit curve through the points.




**(4)**

(ii) Use the graph to find the angle that gives a power output of 0.90 W. Show on the graph how you obtained your value.

.....

**(2)**

Q3

**(Total 20 marks)**

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**4. This question is about reflection and refraction of light.**

(a) **Diagram 1** shows a sheet of glass, with one side coated with a metal, acting as a mirror reflecting a ray of light.

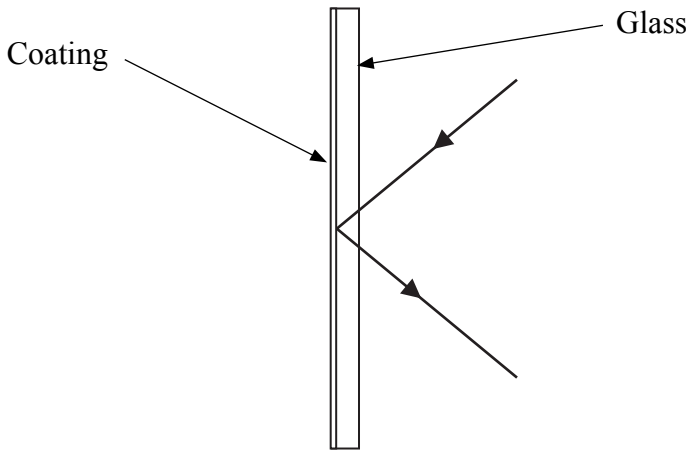


**Diagram 1**

The percentage of light reflected by the coating depends on the metal and the wavelength of the light being used.

**Diagram 2** shows the effect of coating the glass with aluminium (Al), gold (Au) or silver (Ag).
The dotted lines at **E** and **F** represent the two ends of the visible region of the electromagnetic spectrum.

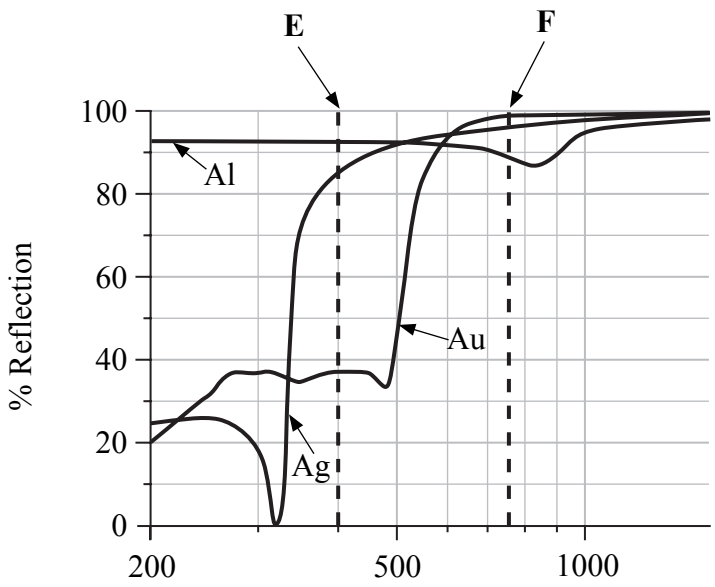


**Diagram 2**

Leave blank

(i) What do all electromagnetic waves have in common?

.....

**(1)**

(ii) State which colour is represented by **E** – red or blue.

.....

**(1)**

(iii) Give a reason for your answer in (ii).

.....

**(1)**

(iv) State which of the three coatings you would **not** use for the mirror – aluminium, gold or silver.

.....

**(1)**

(v) Explain your answer in (iv).

.....

.....

.....

**(2)**

(vi) State which part of the electromagnetic spectrum **E** or **F** has the greater frequency and explain your answer.

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.....

**(2)**

Leave blank

(b) **Diagram 3** shows a sheet of glass which is 'thin-coated'. The glass forms a window between a bright room and a dark room. Some of the incident light is reflected and some is refracted.

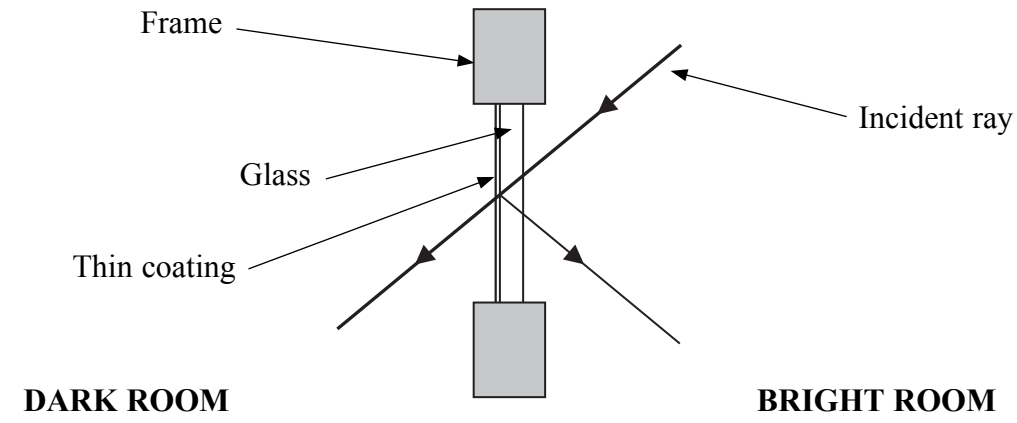


**Diagram 3**

(i) State what is meant by **refraction**.

.....

.....

**(1)**

(ii) Under what circumstances does light refract away from the normal?

.....

.....

.....

**(2)**

(iii) Explain why a person in the dark room **can** see what is going on in the bright room.

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**(1)**

Leave blank

(iv) Explain why a person in the bright room **cannot** see what is going on in the dark room.

.....

.....

.....

**(1)**

(v) Suggest a use for this thin-coated glass.

.....

**(1)**

(c) **Diagram 4** shows, in more detail, the path of a ray of light through the thin-coated glass sheet.

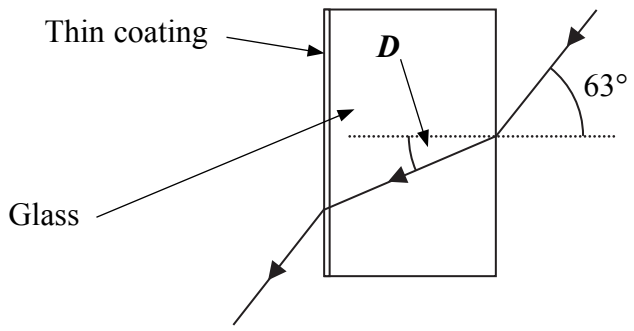


**Diagram 4**

(i) The refractive index of this glass is 1.65. Calculate the angle ***D***.

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.....

.....

**(2)**

(ii) Calculate the critical angle for this glass.

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**(2)**

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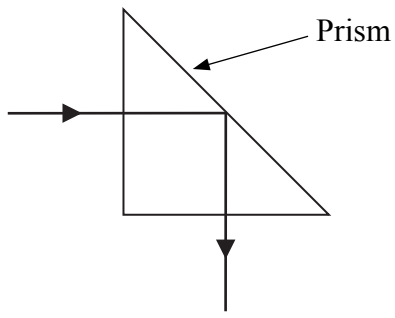
(d) When the same glass is used to make a prism it acts like a mirror, as shown below.




Describe why reflection takes place within the prism even though it is not coated.

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**(2)**

**Q4**

**(Total 20 marks)**

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

(a) In **Diagram 1** the dotted line shows the shape and clockwise direction of a magnetic line of force when a straight wire passes a direct current (d.c.) in the direction shown.

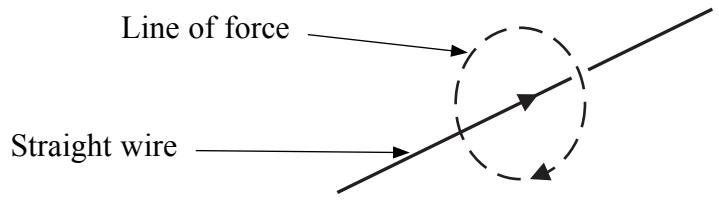


**Diagram 1**

(i) State what is meant by **alternating current (a.c.)**.

.....

.....

**(1)**

(ii) What effect will there be on the direction of the magnetic line of force in **Diagram 1** when there is an alternating current in the wire?

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**(1)**

(iii) An alternating current power supply is labelled 240 V 50 Hz. Explain the meaning of *50 Hz*.

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**(1)**

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(iv) **Diagram 2** shows a metal ring placed around a wire which carries an alternating current.

Explain why there is a current in the metal ring.

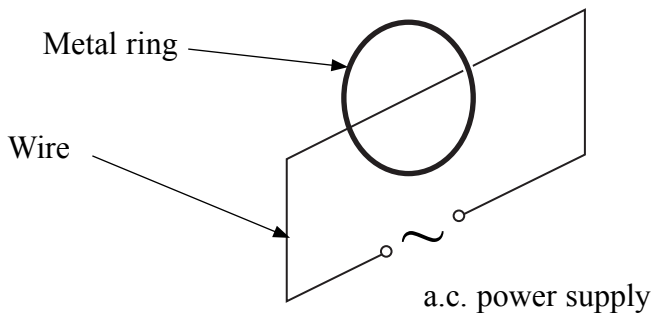


**Diagram 2**

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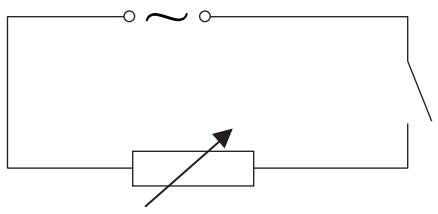
**(2)**

(b) The photograph shows a clamp ammeter which can be used to measure alternating current in a wire.


The jaws are clamped around the wire and the value of the current is read from the scale.

A student decides to use the clamp ammeter to investigate how the size of the current in a wire depends on the frequency of the power supply. She sets up the circuit shown.

(Variable frequency a.c. supply)



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Describe how the student would carry out this investigation using the apparatus shown.
Your account should include:

(i) An additional item of apparatus that could be connected to the supply to determine the frequency of the supply.

.....

**(1)**

(ii) Two essential measurements that must be taken.

1 .....

2 .....

**(2)**

(iii) Two factors that must remain constant throughout the investigation.

1 .....

2 .....

**(2)**

(iv) A description of how the apparatus would be used.

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**(4)**

(v) The headings of a table suitable for recording measurements.

**(2)**

Leave blank

(c) State **one** advantage and **one** disadvantage of a clamp ammeter compared to a traditional ammeter.

Advantage:

.....

.....

.....

Disadvantage:

.....

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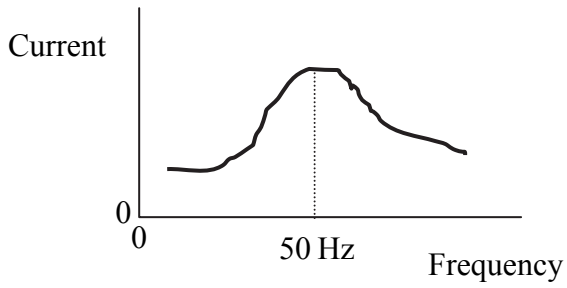
.....

**(2)**

(d) The results of the investigation are shown below:




Briefly describe the relationship between current and frequency.

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**(2)**

**Q5**

**(Total 20 marks)**

**TOTAL FOR PAPER: 100 MARKS**

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