Surname

Other Names

Candidate Signature

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science
Unit Physics P2

PH2HP

H

Physics
Unit Physics P2

Wednesday 20 May 2015   1.30 pm to 2.30 pm

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

A

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Advice
- In all calculations, show clearly how you work out your answer.

Answer **all** questions in the spaces provided.

1 (a) **Figure 1** shows the current–potential difference graph for three wires, **A**, **B** and **C**.
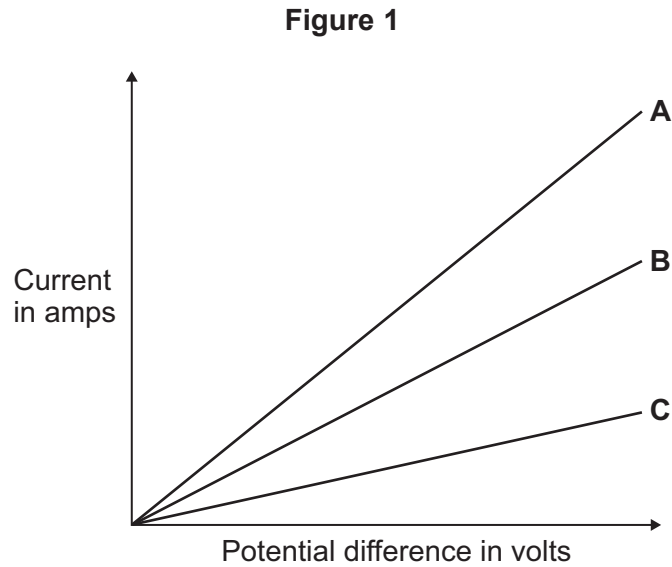
Figure 1

1 (a) (i) Using **Figure 1**, how can you tell that the temperature of each wire is constant?

[1 mark]

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1 (a) (ii) Which **one** of the wires, **A**, **B** or **C**, has the greatest resistance?

[2 marks]

Write the correct answer in the box.

Give a reason for your answer.

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1 (b) A student measured the resistance of four wires.

Table 1 shows the resistance of, and other data about, each of the four wires, **J**, **K**, **L** and **M**.

Table 1

Wire	Type of metal	Length in cm	Diameter in mm	Resistance in …….
J	copper	50	0.17	0.36
K	copper	50	0.30	0.12
L	copper	100	0.30	0.24
M	constantan	100	0.30	7.00

1 (b) (i) The last column of **Table 1** should include the unit of resistance.

[1 mark]

What is the unit of resistance?

....

1 (b) (ii) The resistance of a wire depends on many factors.

Look at **Table 1**. Which **two** wires from **J**, **K**, **L** and **M** show that the resistance of a wire depends on the **length** of the wire?

[2 marks]

Wire ☐ and wire ☐

Give a reason for your answer.

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Question 1 continues on the next page

Turn over ▶

1 (b) (iii) A student looked at the data in **Table 1** and wrote this conclusion:

'The resistance of a wire depends on the type of metal from which the wire is made.'

The student could **not** be certain that her conclusion is true for **all** types of metal.

Suggest what extra data is needed for the student to be more certain that the conclusion is correct.

[1 mark]

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1 (c) The resistance of a wire can be calculated using the readings from an ammeter and a voltmeter.

1 (c) (i) Complete **Figure 2** by drawing a voltmeter in the correct position in the circuit.
Use the correct circuit symbol for a voltmeter.

[1 mark]

Figure 2
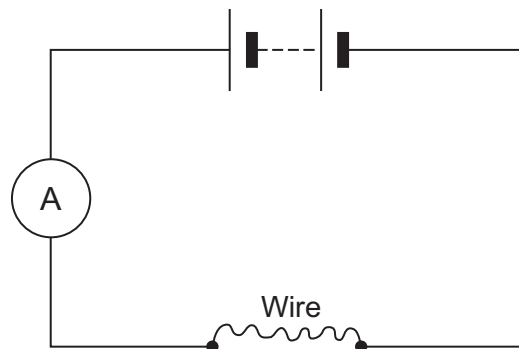
1 (c) (ii) In a circuit diagram, a wire can be represented by the symbol for a resistor.

In the box below, draw the circuit symbol for a resistor.

[1 mark]

Turn over for the next question

9
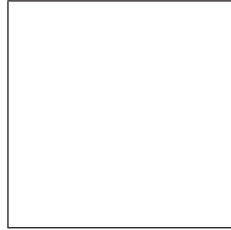
Turn over ▶

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ANSWER IN THE SPACES PROVIDED

2 (a) Over 100 years ago, scientists thought the atom was like a 'plum pudding'.
Figure 3 shows the plum pudding model of the atom.

Figure 3
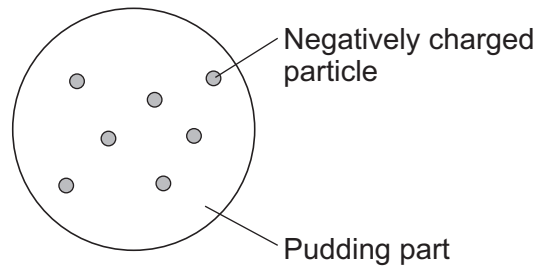
The scientists knew that an atom has negatively charged particles. They also knew that an atom has no overall charge.

What did the scientists conclude about the **charge** on the 'pudding part' of the atom?

[1 mark]

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Question 2 continues on the next page

Turn over ▶

2 (b) Two scientists named Rutherford and Marsden devised an experiment to investigate the plum pudding model of the atom. The experiment involved firing alpha particles at a thin sheet of gold. The scientists measured how many of the alpha particles were scattered.

Using the plum pudding model, the scientists predicted that only a few of the alpha particles would be scattered by more than 4°.

Over several months, more than 100 000 measurements were made.

2 (b) (i) The results from this experiment caused the plum pudding model to be replaced by a new model of the atom.

Explain why.

[2 marks]

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2 (b) (ii) Suggest **one** reason why other scientists thought this experiment provided valid evidence for a new model of the atom.

[1 mark]

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2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe the model now used for the structure of an atom.

In your answer you should:
- give details of the individual particles that make up an atom
- include the relative masses and relative charges of these particles.

Do **not** include a diagram in your answer.

[6 marks]

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Extra space ....

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Turn over ▶

3   Many countries use nuclear power stations to generate electricity.
Nuclear power stations use the process of nuclear fission to release energy.

3 (a) (i)   What is nuclear fission?

[1 mark]

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3 (a) (ii)   Plutonium-239 is one substance used as a fuel in a nuclear reactor. For nuclear fission
to happen, the nucleus must absorb a particle.

What type of particle must be absorbed?

[1 mark]

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3 (b)   Nuclear **fusion** also releases energy.
Nuclear fusion happens at very high temperatures. A high temperature is needed to
overcome the repulsion force between the nuclei.

3 (b) (i)   Why is there a repulsion force between the nuclei of atoms?

[1 mark]

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3 (b) (ii)   Where does nuclear fusion happen naturally?

[1 mark]

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3 (c) In 1991, scientists produced the first controlled release of energy from an experimental nuclear **fusion** reactor. This was achieved by fusing the hydrogen isotopes, deuterium and tritium.

Deuterium is naturally occurring and can easily be extracted from seawater. Tritium can be produced from lithium. Lithium is also found in seawater.

Table 2 gives the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Table 2

Type of fuel	Energy released from 1 kg of fuel in joules
Fusion fuel	3.4×10^{14}
Fission fuel	8.8×10^{13}

3 (c) (i) Suggest **two** advantages of the fuel used in a fusion reactor compared with plutonium and the other substances used as fuel in a fission reactor.

[2 marks]

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2 ....

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3 (c) (ii) Some scientists think that by the year 2050 a nuclear fusion power station capable of generating electricity on a large scale will have been developed.

Suggest **one** important consequence of developing nuclear fusion power stations to generate electricity.

[1 mark]

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Question 3 continues on the next page

Turn over ▶

3 (d) Tritium is radioactive.

After 36 years, only 10 g of tritium remains from an original sample of 80 g.

Calculate the half-life of tritium.

Show clearly how you work out your answer.

[2 marks]

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Half-life = ... years

9

4 (a) A car driver sees the traffic in front is not moving and brakes to stop his car.

The stopping distance of a car is the thinking distance plus the braking distance.

4 (a) (i) What is meant by the 'braking distance'?

[1 mark]

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4 (a) (ii) The braking distance of a car depends on the speed of the car and the braking force.

State **one** other factor that affects braking distance.

[1 mark]

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4 (a) (iii) How does the braking force needed to stop a car in a particular distance depend on the speed of the car?

[1 mark]

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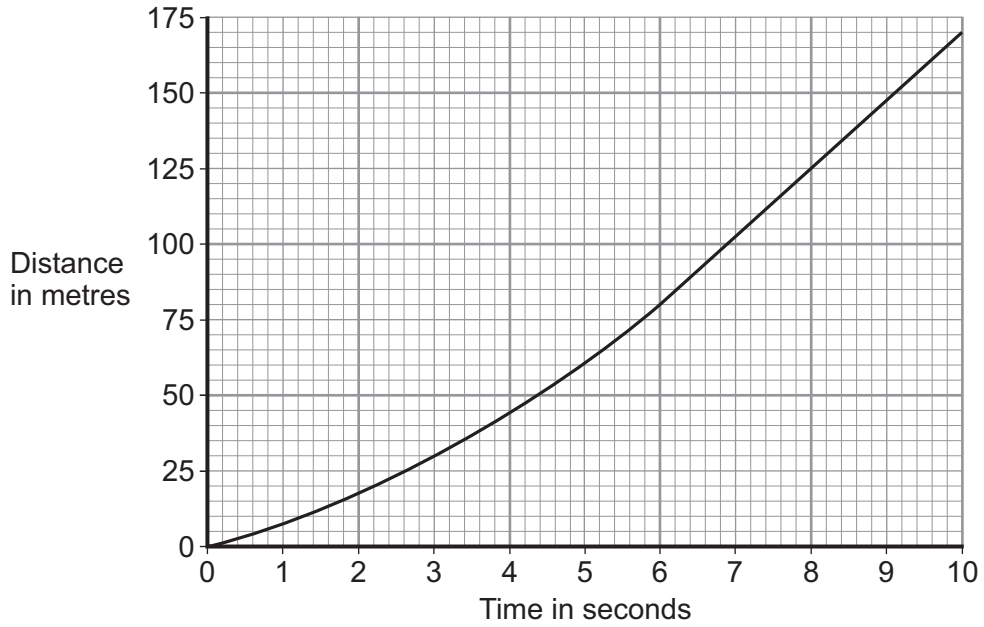
Question 4 continues on the next page

Turn over ▶

4 (b) **Figure 4** shows the distance–time graph for the car in the 10 seconds before the driver applied the brakes.

Figure 4

Distance in metres

Time in seconds

Use **Figure 4** to calculate the maximum speed the car was travelling at.
Show clearly how you work out your answer.

[2 marks]

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Maximum speed = ... m/s
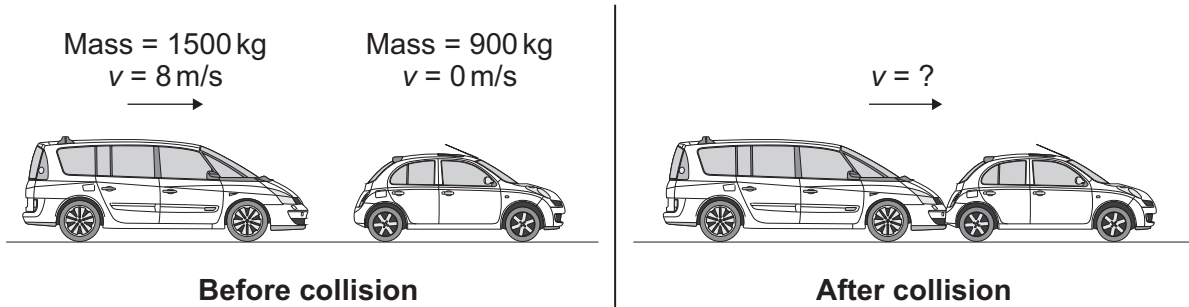
4 (c) The car did not stop in time. It collided with the stationary car in front, joining the two cars together.

Figure 5 shows both cars, just before and just after the collision.

Figure 5

Mass = 1500 kg
v = 8 m/s

Mass = 900 kg
v = 0 m/s

v = ?

Before collision

After collision

4 (c) (i) The momentum of the two cars was conserved.

What is meant by the statement 'momentum is conserved'?

[1 mark]

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4 (c) (ii) Calculate the velocity of the two joined cars immediately after the collision.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Velocity = ... m/s

Question 4 continues on the next page

Turn over ▶

4 (d) Since 1965, all cars manufactured for use in the UK must have seat belts.

It is safer for a car driver to be wearing a seat belt, compared with not wearing a seat belt, if the car is involved in a collision.

Explain why.

[4 marks]

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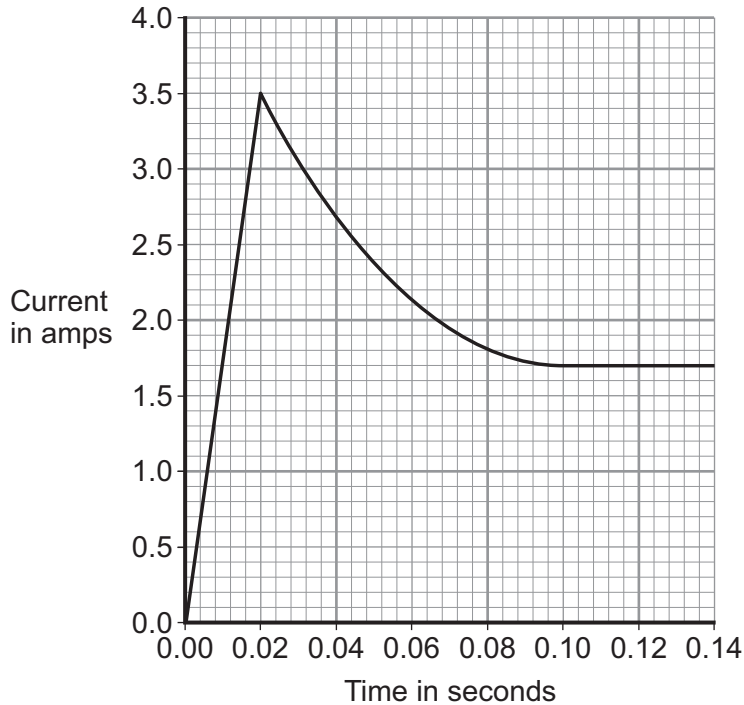
13

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Turn over ▶

5 A 12 V filament bulb is connected to a 12 V power supply.
Figure 6 shows how the current changes after the bulb is switched on.

Figure 6

5 (a) (i) After 0.10 seconds, the bulb works at its normal brightness.

What is the current through the bulb when it is working at normal brightness?

[1 mark]

Current = ... A

5 (a) (ii) The bulb works at normal brightness for 30 seconds before it is switched off.

Calculate the charge that flows through the bulb in the 30 seconds before it is switched off. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Charge = ... unit ....

5 (a) (iii) Calculate the energy transferred by the 12 V bulb when it is working at normal brightness for 30 seconds.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Energy transferred = ... J

5 (b) Between 0.02 seconds and 0.08 seconds, there is an increase in both the resistance and the temperature of the metal filament inside the bulb.

Explain, in terms of the electrons and ions inside the filament, why both the temperature and the resistance increase.

[2 marks]

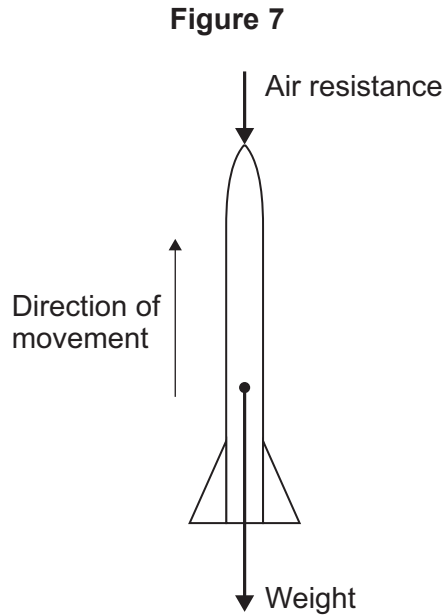...

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8

Turn over for the next question

Turn over ▶

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7

6 (a) (i) How does the velocity of the rocket change as the rocket moves **upwards**?

[2 marks]

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Give a reason for your answer.

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6 (a) (ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

[1 mark]

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6 (b)   The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i)   Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Kinetic energy = ... J

6 (b) (ii)   As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii)   Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.
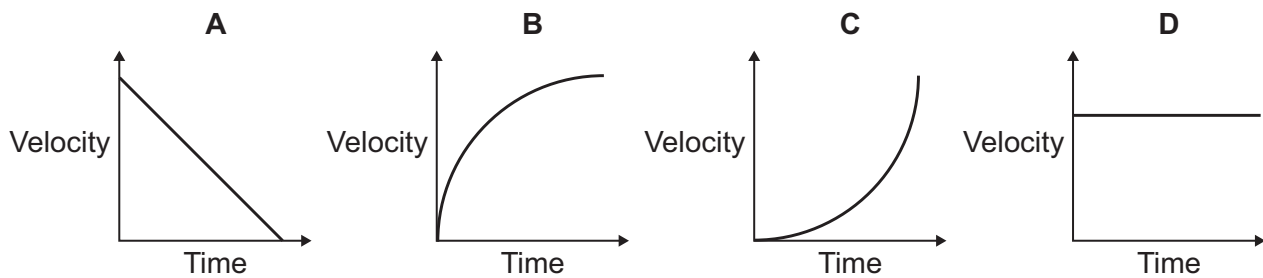
[2 marks]

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Maximum height = ... m

Question 6 continues on the next page

Turn over ▶

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8

Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?
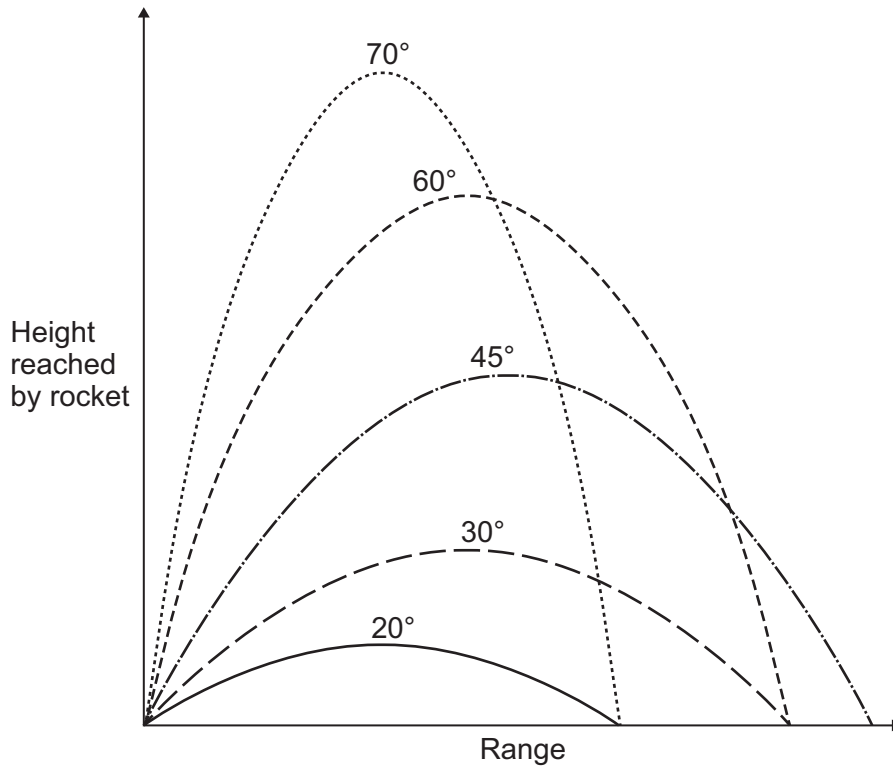
[1 mark]

Write the correct answer in the box.

6 (c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9

What pattern links the angle at which the rocket is launched and the range of the rocket?

[2 marks]

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11

END OF QUESTIONS

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