

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 3 Physics Core

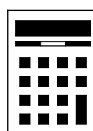
C

Wednesday 8 November 2023 07:00 GMT Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a protractor
- a scientific calculator
- the Physics Equations Sheet (enclosed).



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.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- 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 100.
- You are expected to use a scientific calculator where appropriate.
- The Physics Equations Sheet is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



N 0 V 2 3 9 2 0 4 P C 0 1

IB/G/Nov23/E7

9204/PC

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

0 1

The stopping distance of a car depends on the thinking distance and the braking distance.

0 1 . 1

Complete the sentence.

Choose the answer from the box.

[1 mark]

distance

force

speed

time

Thinking distance is the distance a car travels during the driver's reaction _____.

0 1 . 2

Which **two** factors affect the thinking distance of a car?

[2 marks]

Tick (✓) **two** boxes.

Condition of the road

☐

Distraction of the driver

☐

Mass of the car

☐

Quality of the brakes

☐

Tiredness of the driver

☐


The driver of a moving car applies the brakes and the car decelerates to a stop.

0 1 . 3

Describe the energy changes for the car when the brakes are applied.

[2 marks]

0 1 . 4

The change in velocity of the car is 18 m/s.

The time taken for the car to stop is 4.0 s.

Calculate the deceleration of the car.

Use the equation:

$$\text{deceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

[2 marks]

Deceleration = _____ m/s²

Question 1 continues on the next page

Turn over ►



0 1 . 5

The average braking force is 4500 N.

The car travels a distance of 36 m while braking.

Calculate the work done by the brakes.

Use the Physics Equations Sheet.

Choose the unit from the box.

[3 marks]

J	kg m/s	N/m	Pa
---	--------	-----	----

Work done = _____ Unit _____

0 1 . 6

The stopping distance is the sum of the thinking distance and the braking distance.

The stopping distance of the car is 45 m.

The braking distance of the car is 36 m.

Calculate the thinking distance of the car.

[2 marks]

Thinking distance = _____ m



A standard car needs a driver.

Scientists are developing driverless cars that do not need a driver.

0 1 . 7 A driverless car and a standard car are both driven at the same speed.

The stopping distance of the standard car is 45 m.

The stopping distance of the driverless car is 60% of the stopping distance of the standard car.

Calculate the stopping distance of the driverless car.

[2 marks]

Stopping distance of the driverless car = _____ m

0 1 . 8 Some people are concerned about the development of driverless cars.

Suggest **one** reason why.

[1 mark]

15

Turn over for the next question

Turn over ►



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



0 2

All substances are made of atoms with a small central nucleus.

0 2 . 1

What is the approximate radius of an atom?

[1 mark]

Tick (✓) **one** box. 10^{-10} metres☐

10 metres

☐ 10^{10} metres☐

0 2 . 2

Complete **Table 1** to show the relative charges of the particles in an atom.

The first row has been completed for you.

[2 marks]

Table 1

Particle	Relative Charge
Proton	+1
Neutron	
Electron	

0 2 . 3

Complete the sentence to name the particles in the nucleus of an atom.

Use **Table 1**.

[1 mark]

The nucleus of an atom contains _____ and

_____.

Question 2 continues on the next page**Turn over ►**

0 2 . 4 An atom of oxygen can be represented as:



Complete the sentences about this atom of oxygen.

Choose answers from the box.

[2 marks]

atomic	ion	mass	neutron
--------	-----	------	---------

In this atom of oxygen, 16 is the _____ number.

In this atom of oxygen, 8 is the _____ number.

Some atoms have an unstable nucleus.

An unstable nucleus can emit alpha, beta or gamma radiation.

0 2 . 5 Which type of radiation is the most ionising?

[1 mark]

Tick (✓) **one** box.

Alpha

☐

Beta

☐

Gamma

☐


0 2 . 6

Which type of radiation has the longest range in air?

[1 mark]

Tick (✓) **one** box.

Alpha

☐

Beta

☐

Gamma

☐

0 2 . 7

Which type of radiation consists of particles that contain 2 protons and 2 neutrons?

[1 mark]

Tick (✓) **one** box.

Alpha

☐

Beta

☐

Gamma

☐

9

Turn over for the next question

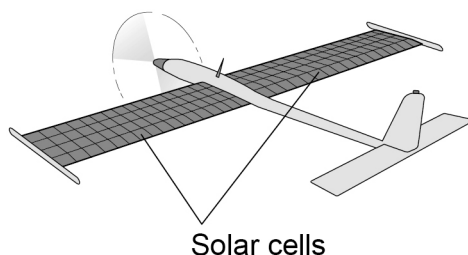
Turn over ►



0 3

Figure 1 shows a solar-powered aircraft.

Figure 1



The solar-powered aircraft has wings completely covered in solar cells.

0 3 . 1

When light is incident on the solar cells, the cells produce a direct current.

Complete the sentence.

[1 mark]

Direct current in an electrical circuit always passes in the same

_____.

0 3 . 2

Suggest **one** advantage of having a large area of solar cells on the wings of the aircraft.

[1 mark]

0 3 . 3

The wings of the aircraft have an area of 240 m^2 .

One solar cell has an area of 0.20 m^2 .

Calculate the number of solar cells on the wings of the aircraft.

[1 mark]

Number of solar cells = _____



The aircraft is flying at a constant height with a constant velocity.

0 3 . 4

What is the size of the resultant force acting on the aircraft?

[1 mark]

Resultant force = _____ N

0 3 . 5

The weight of the aircraft acts downwards.

Name **one** other force acting on the aircraft.

Give the direction of the force.

[2 marks]

Name of force _____

Direction of force _____

0 3 . 6

The mass of the aircraft is 1500 kg.

Gravitational field strength = 9.8 N/kg

Calculate the weight of the aircraft.

Use the Physics Equations Sheet.

[2 marks]

Weight = _____ N

Question 3 continues on the next page

Turn over ►



0	3	.	7
---	---	---	---

The velocity of the aircraft is 40 m/s.

The mass of the aircraft is 1500 kg.

Calculate the kinetic energy of the aircraft.

Use the Physics Equations Sheet.

[2 marks]

Kinetic energy = _____ J

10



0 4

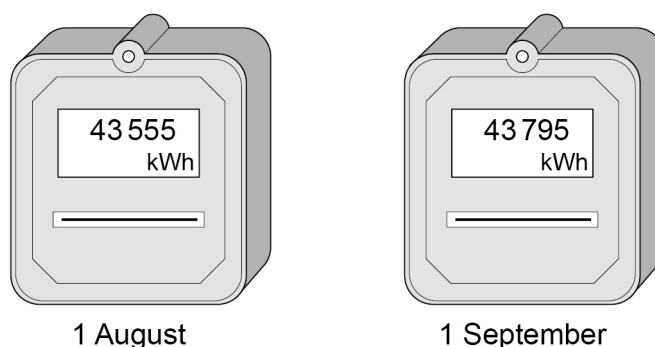
The electricity supplied to houses is generated using different energy resources.

0 4 . 1

An electricity meter measures the energy transferred by the electrical appliances in a house.

Figure 2 shows the readings on an electricity meter one month apart.

Figure 2



The meter measures energy transferred in kilowatt-hours (kW h).

Determine the energy transferred from 1 August to 1 September.

Give your answer in kW h.

[1 mark]

Energy transferred = _____ kW h

0 4 . 2

One kilowatt-hour of energy costs \$0.25

Calculate the total cost of the energy transferred between 1 August and 1 September.

Use your answer from Question **04.1** and the equation:

$$\text{total cost (\$)} = \text{energy (kW h)} \times \text{cost per kW h (\$)}$$

[2 marks]

Total cost = \$ _____

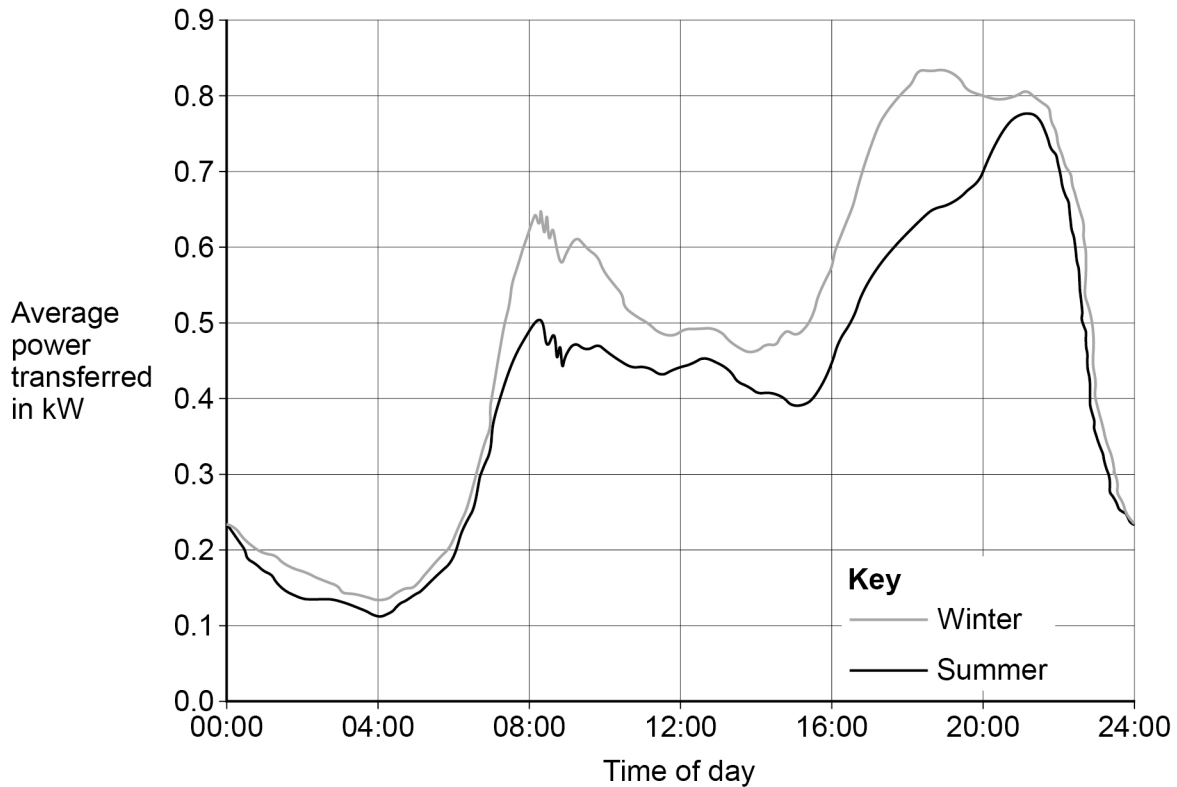
Question 4 continues on the next page

Turn over ►



Figure 3 shows the average power transferred in a house at different times of the day in summer and winter.

Figure 3



0 4 . 3 What time of day has the lowest average power transferred?

Suggest a reason for this.

[2 marks]

Time of day _____

Reason _____

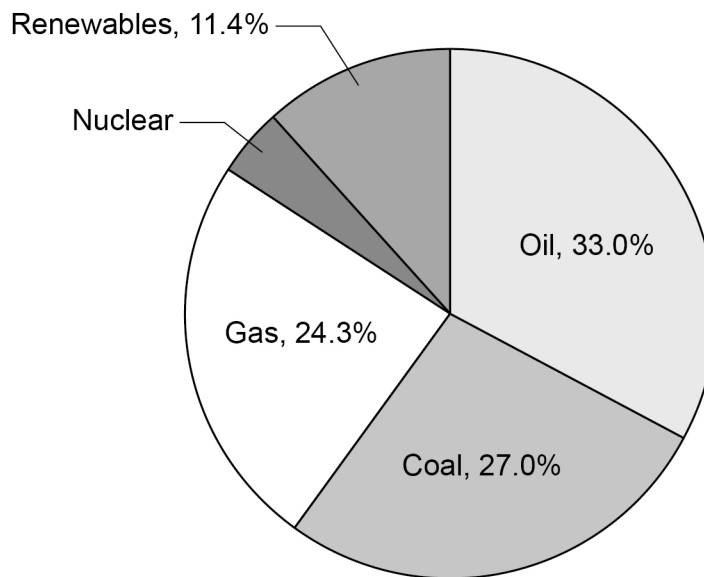
0 4 . 4 Calculate the difference between the average power transferred at 20:00 in summer and in winter.

Use **Figure 3**.

[2 marks]

Difference in average power transferred = _____ kW



0 4 . 5**Figure 4** shows the energy resources used to generate electricity across the world.**Figure 4**

Determine the percentage of electricity generated by nuclear power.

[1 mark]

Percentage of electricity generated by nuclear power = _____ %

0 4 . 6

Nuclear power is a non-renewable energy resource.

What is meant by 'non-renewable energy resource'?

[1 mark]**Question 4 continues on the next page****Turn over ►**

0 4 . 7

Give **two disadvantages** of using nuclear power to generate electricity.**[2 marks]**

1 _____

2 _____

0 4 . 8

Nuclear power stations use nuclear fission to generate electricity.

Describe the process of nuclear fission.

[2 marks]

13



0 5

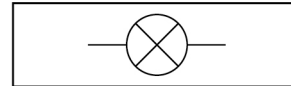
A student investigated electrical circuits.

0 5 . 1

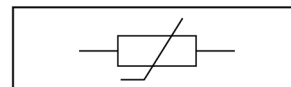
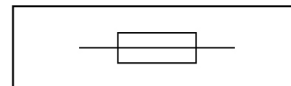
Draw one line from each component to the correct circuit symbol.

[2 marks]**Component****Circuit symbol**

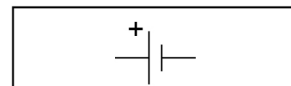
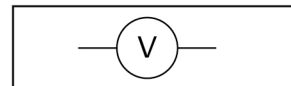
Cell



Fuse



Lamp

**0 5 . 2**

Complete the sentence.

Choose the answer from the box.

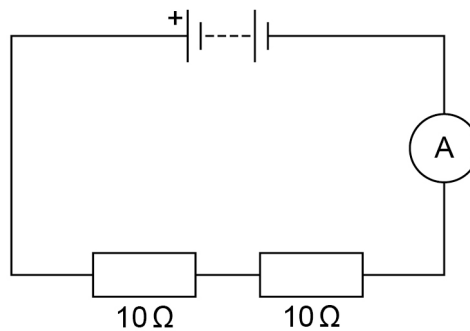
[1 mark]**charge****energy****potential difference**

Electric current is the rate of flow of _____.

Question 5 continues on the next page**Turn over ►**

Figure 5 shows an electrical circuit the student set up.

Figure 5



0 5 . 3

Calculate the total resistance of the resistors in **Figure 5**.

[1 mark]

Total resistance = _____ Ω

0 5 . 4

The reading on the ammeter in **Figure 5** is 0.30 A.

Determine the potential difference across the battery.

Use your answer to Question **05.3** and the equation:

$$\text{potential difference} = \text{current} \times \text{total resistance}$$

[2 marks]

Potential difference = _____ V



0 5 . 5

The reading on the ammeter in **Figure 5** is 0.30 A.

Calculate the charge flow through the battery in 2.0 minutes.

Use the equation:

$$\text{charge flow} = \text{current} \times \text{time}$$

[3 marks]

Charge flow = _____ C

Question 5 continues on the next page

Turn over ►

The student then investigated how varying the potential difference across the resistors affected the current through the resistors.

The student measured the potential difference across the resistors with a voltmeter.

0 5 . 6

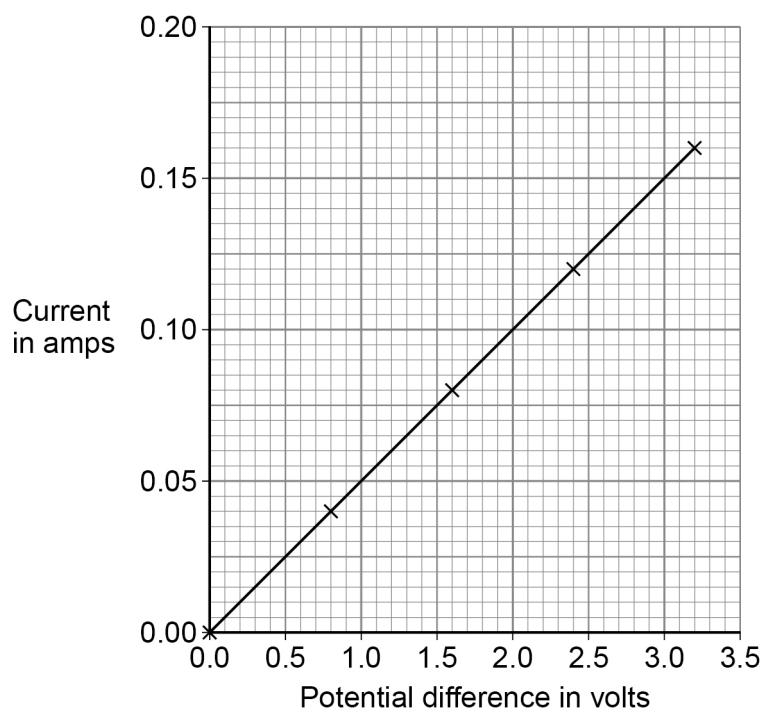
Give the component the student could use to vary the potential difference across the resistors.

[1 mark]

0 5 . 7

Figure 6 shows the results.

Figure 6



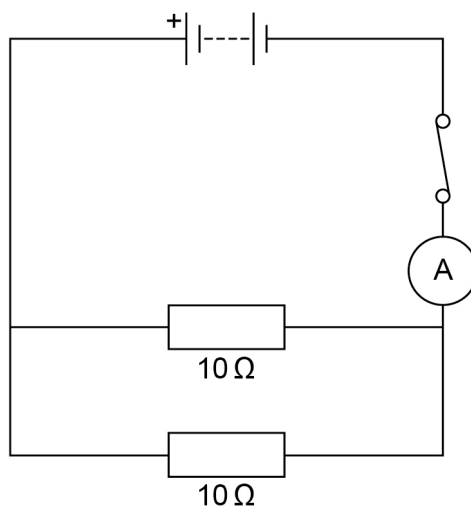
Describe the relationship between potential difference across the resistors and current in the resistors.

[2 marks]



Figure 7 shows a different circuit that the student set up.

Figure 7



0 5 . 8 The current through **each** resistor in **Figure 7** is 0.60 A.

What is the current in the battery in **Figure 7**?

[1 mark]

Tick (✓) **one** box.

0.30 A

☐

0.60 A

☐

1.20 A

☐

2.40 A

☐

0 5 . 9 The student opened the switch so there was no current in the circuit.

The reading on the ammeter in **Figure 7** was 0.10 A.

What type of error is this?

[1 mark]



0 6

X-rays are sometimes used at airports to scan passengers.

X-rays form part of the electromagnetic spectrum.

Figure 8 shows the order of the different waves in the electromagnetic spectrum.

Figure 8

Radio waves	A	Infrared	B	Ultraviolet	C	Gamma rays
-------------	---	----------	---	-------------	---	------------

0 6 . 1

Which letter on **Figure 8** represents X-rays?

[1 mark]

Tick (✓) **one** box.

A

☐

B

☐

C

☐

0 6 . 2

Complete the sentences.

Choose answers from the box.

[2 marks]

amplitude	frequency	velocity	wavelength
-----------	-----------	----------	------------

Compared with radio waves, gamma rays have a greater

_____.

Compared with radio waves, gamma rays have a smaller

_____.



0 6 . 3

The frequency of the X-rays used for airport scans is 2.5×10^{18} Hz.

speed of X-rays = 3.0×10^8 m/s

Calculate the wavelength of the X-rays.

Use the Physics Equations Sheet.

[3 marks]

Wavelength = _____ m

0 6 . 4

X-rays are high energy electromagnetic waves.

Explain why X-rays can be harmful to humans.

[2 marks]

Question 6 continues on the next page

Turn over ►

0	6	.	5
---	---	---	---

Radiation dose is measured in millisieverts (mSv).

The maximum radiation dose that is considered safe for a person in one year is 50 mSv.

The average radiation dose from one airport scan is 0.1 mSv.

Explain why having an airport scan is considered safe.

Use data in your answer.

[2 marks]

10



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

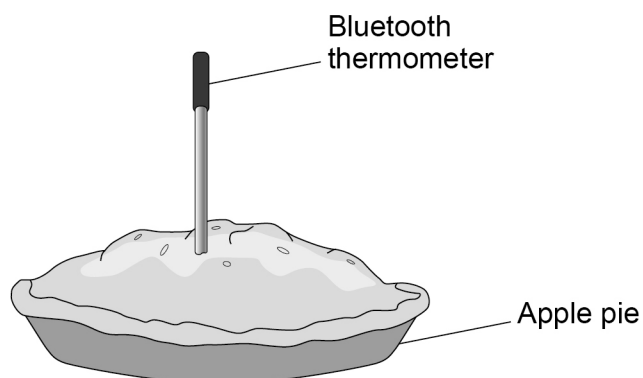
Turn over ►



0	7
---	---

Figure 9 shows a Bluetooth thermometer in an apple pie. The apple pie is in an oven.

Figure 9



The thermometer sends the temperature reading of the pie to a mobile phone using Bluetooth.

0	7	.	1
---	---	---	---

Bluetooth uses electromagnetic waves.

Electromagnetic waves are transverse waves.

Describe what is meant by 'transverse waves'.

[2 marks]



0 7 . 2

The initial temperature of the apples in the pie was 22 °C.

The final temperature of the apples in the pie was 93 °C.

The mass of the apples was 0.94 kg.

specific heat capacity of apples = 3600 J/kg °C

Calculate the energy transferred to the apples.

Use the Physics Equations Sheet.

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

[4 marks]

Energy (two significant figures) = _____ J

0 7 . 3

The cooked apple pie was removed from the oven and left to cool.

Give **two** factors that affect the rate at which the apple pie cools.

[2 marks]

1 _____

2 _____

8

Turn over ►



0	8
---	---

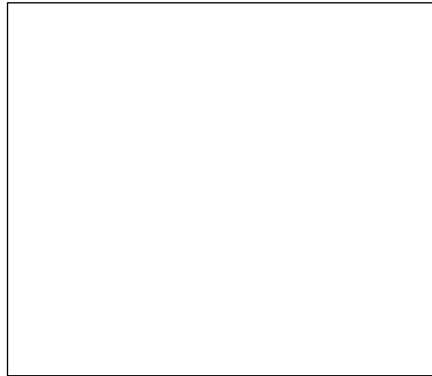
Filament lamps and LEDs are types of light bulbs used in homes.

LEDs are increasingly used in homes.

0	8	.	1
---	---	---	---

Draw the circuit symbol for an LED in the box below.

[1 mark]



0 8 . 2 **Table 2** gives information about the two types of light bulb.

Table 2

	Type of light bulb	
	Filament lamp	LED
Efficiency	0.10	0.75
Cost per light bulb in \$	1.00	4.00
Lifetime per light bulb in hours	1000	25 000

Both types of light bulb emit light of the same brightness.

Evaluate the benefits of replacing filament lamps with LEDs.

Use data from **Table 2**.

[4 marks]

Question 8 continues on the next page

Turn over ►



0	8	.	3
---	---	---	---

The efficiency of the LED is 0.75

The useful power output of the LED is 6.6 W.

Calculate the total power input to the LED.

Use the Physics Equations Sheet.

[3 marks]

Total power input = _____ W

0	8	.	4
---	---	---	---

What happens to the energy wasted from the LED?

[1 mark]

9



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



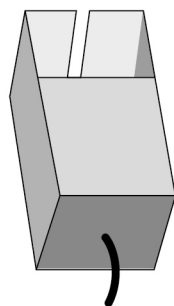
0 9

A student investigated how the angle of incidence affected the angle of refraction for a glass block.

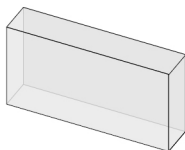
0 9**1**

Figure 10 shows some of the equipment used.

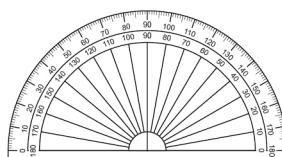
Figure 10



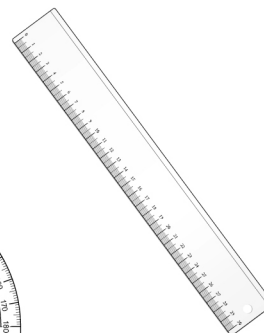
Ray box



Rectangular
glass block



Protractor



Ruler

Describe a method the student could have used to make measurements of the angle of incidence and the angle of refraction.

You may include a labelled diagram in your answer.

[6 marks]



Question 9 continues on the next page

Turn over ►



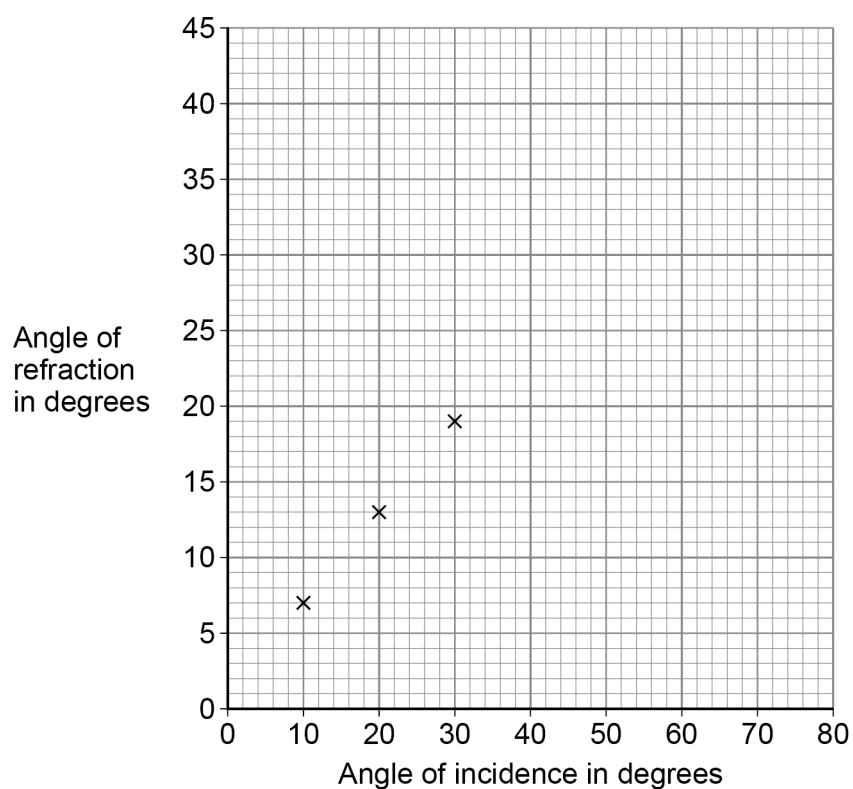
Table 3 shows the results.

Table 3

Angle of incidence in degrees	Angle of refraction in degrees
10	7
20	13
30	19
40	25
50	31
60	35
70	39
80	41

Figure 11 shows an incomplete graph of the data in **Table 3**.

Figure 11



0 9 . 2 Complete **Figure 11**.

You should:

- plot the remaining data from **Table 3** on the graph
- draw a line of best fit.

[3 marks]

0 9 . 3 Why is it more suitable to draw a line graph than a bar chart for the data in **Table 3**?

[1 mark]

Tick (✓) **one** box.

Both variables are categoric.

☐

Both variables are continuous.

☐

One variable is categoric and one is continuous.

☐

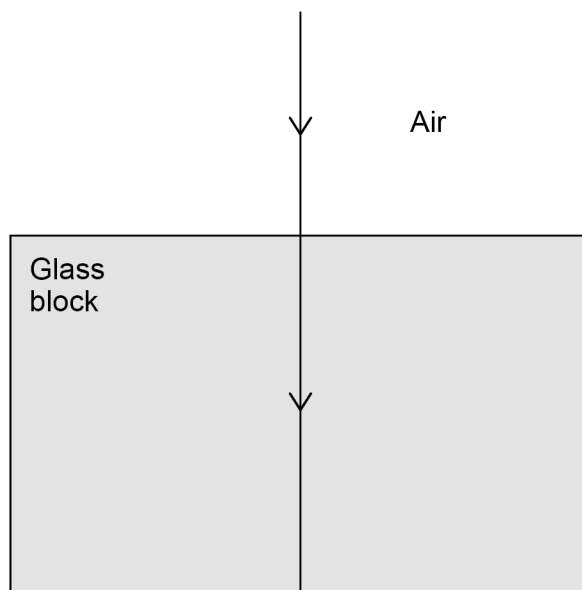
Question 9 continues on the next page

Turn over ►



Figure 12 shows a light ray in air incident on a glass block.

Figure 12



0 9 . 4

What happens to the speed of the light as the ray passes from the air into the glass block?

[1 mark]

0 9 . 5

Give the reason why the light ray does not change direction when entering the glass block.

[1 mark]

12

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



[illegible]

[illegible]

