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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Time 2 hours

Paper reference 4PH1/1PR 4SD0/1PR

Physics

UNIT: 4PH1

Science (Double Award) 4SD0

PAPER: 1PR

You must have:
Ruler, calculator, protractor

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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J:1/1/1/

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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\qquad E = I \times V \times t$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad v = \frac{2 \times \pi \times r}{T}$$

(final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved)

$$v^2 = u^2 + (2 \times a \times s)$$

pressure × volume = constant $\qquad p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

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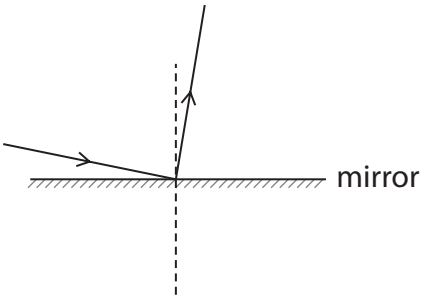
Answer ALL questions.

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 ☒.

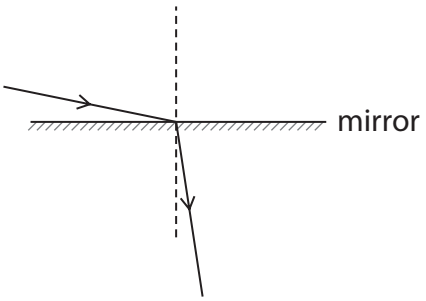
1 This is a question about reflection.

(a) Which diagram shows a light ray correctly reflected from a mirror?

(1)



☒ **A**



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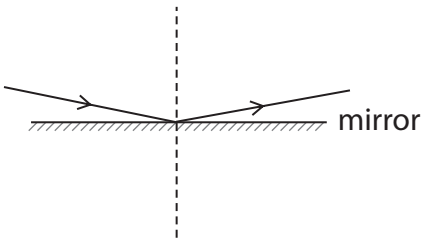
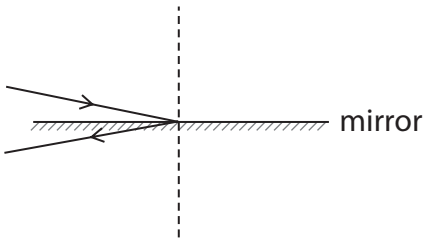


☒ **C**



☒ **D**

(b) Name the equipment needed to measure the angle of incidence on a ray diagram.

(1)

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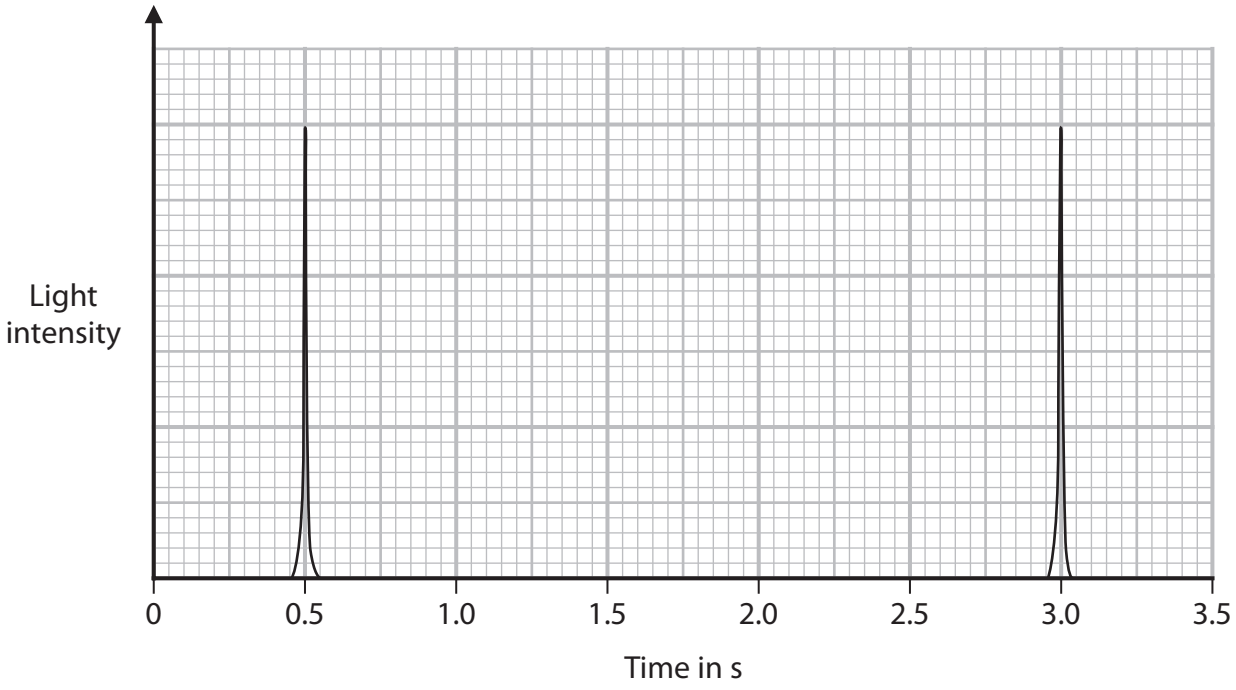
(c) Light from a laser on the Earth reflects off special mirrors on the Moon.

The graph shows the data from a light sensor attached to the laser.

The first peak shows when the light leaves the laser and the second peak shows when the light has returned from the Moon.



(i) Determine the time taken for the light to travel from the Earth to the Moon and back again.

(2)

time taken = ... s

(ii) The speed of light is 3.0×10^5 km/s.

Calculate the total distance travelled by the light from the laser.

[average speed = distance moved ÷ time taken]

(2)

total distance = ... km

(iii) Calculate the distance from the Earth to the Moon.

(1)

distance = ... km

(Total for Question 1 = 7 marks)

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2 The diagram shows the orbit of the Earth around the Sun.

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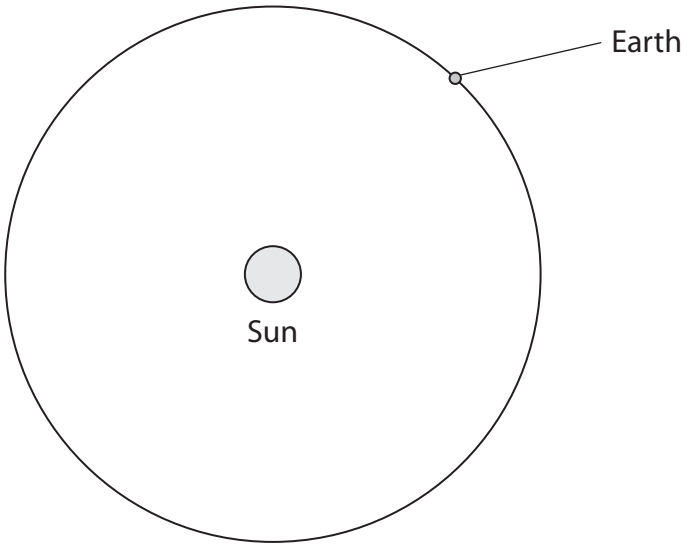

(a) (i) Draw the orbit of the Earth's Moon on the diagram.

(2)

(ii) Draw the orbit of a comet on the diagram.

(2)

(b) Earth orbits the Sun in 365 days with an orbital radius of 150 000 000 km.

Calculate the Earth's orbital speed in km/s.

(3)

orbital speed = ... km/s

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(c) Which force keeps the Earth in orbit around the Sun?

(1)

- ☒ **A** electrostatic
- ☒ **B** gravitational
- ☒ **C** magnetic
- ☒ **D** nuclear

(d) Describe the evolution of the Sun from the first stage of its evolution to the final stage of its evolution.

(4)

(Total for Question 2 = 12 marks)

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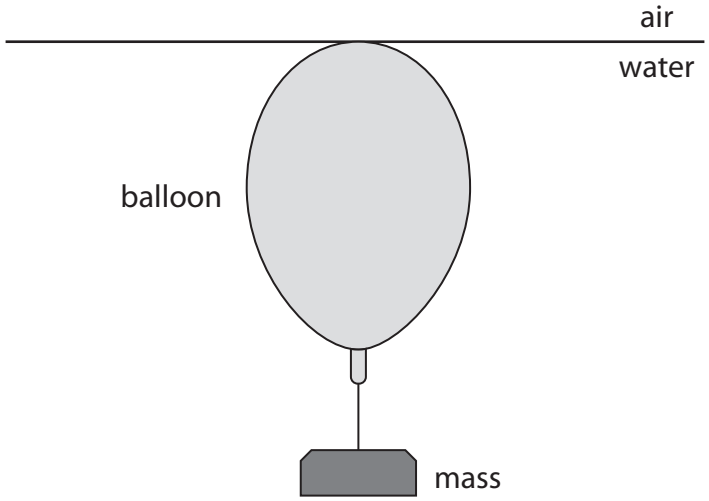
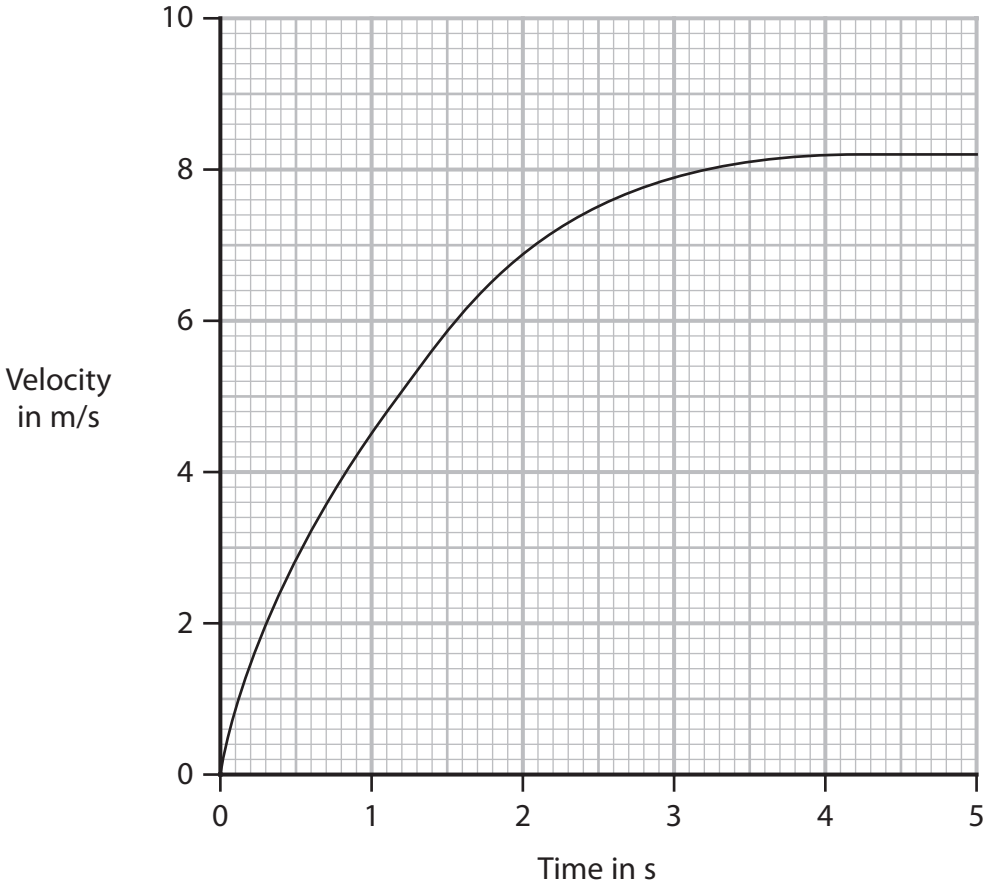
3 The diagram shows a balloon with a mass attached held at rest just below the surface of a deep pool of water.



(a) The balloon and mass are released.

The graph shows the velocity-time graph for the balloon and mass as they fall through the water.



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(i) Use information from the graph to determine the terminal velocity of the balloon and mass.

(1)

terminal velocity = ... m/s

(ii) Explain how the balloon reaches terminal velocity.

You should use ideas about forces acting on the balloon in your answer.

(3)

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(b) (i) State the formula linking pressure difference, height, density and gravitational field strength.

(1)

(ii) Calculate the increase in pressure on the balloon when it has reached a depth of 25 m in the water.

[for water, density = 1000 kg/m^3]

(2)

pressure increase = ... Pa

(iii) At the surface, the atmospheric pressure on the balloon is 1.0×10^5 Pa.

Show that the total pressure on the balloon at a depth of 25 m is 3.5×10^5 Pa.

(1)

(iv) At the surface, where the pressure is 1.0×10^5 Pa, the balloon has a volume of 0.46 m^3.

Calculate the volume of the balloon at a depth of 25 m.

(3)

volume = ... m^3

(Total for Question 3 = 11 marks)

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4 A student investigates how the current in a filament lamp varies with the voltage across it.

The student has this equipment

- filament lamp
- cell
- variable resistor
- ammeter
- voltmeter
- connecting wires

(a) Draw a circuit diagram that the student could use for this investigation.

(4)

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(b) The table gives the student's results.

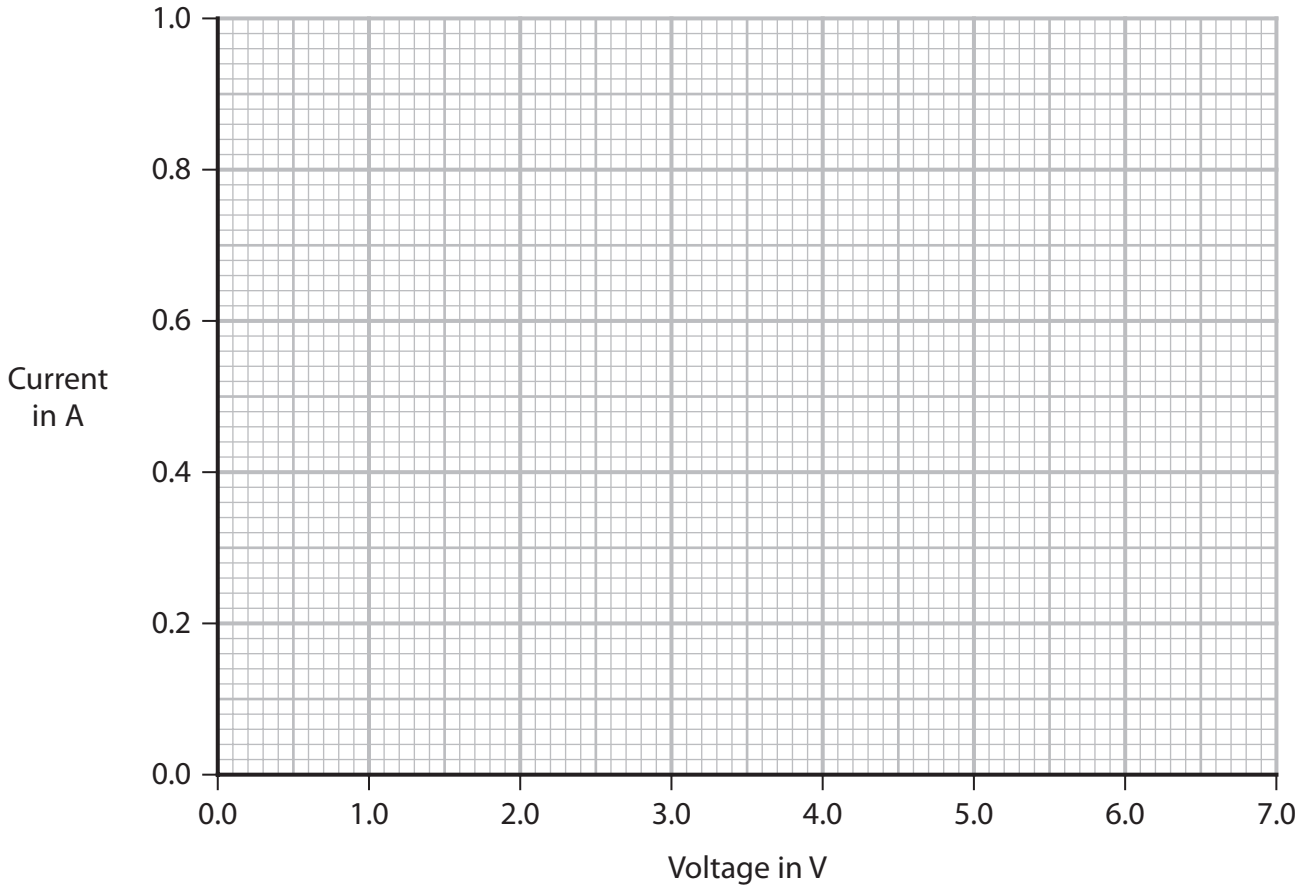
Voltage in V	Current in A
0.0	0.0
1.0	0.38
2.0	0.61
3.0	0.80
4.0	0.90
5.0	0.96
6.0	1.00

(i) Plot the results on the grid.

(1)

(ii) Draw the curve of best fit.

(1)



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(c) The filament of the lamp is made of metal.

The student suggests that a straight line on the graph is more appropriate than a curve because current is directly proportional to voltage for a metal.

(i) Suggest how the student could improve their investigation to find out whether a straight line or curve is more appropriate.

(1)

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(ii) Explain why the student should not expect current to be proportional to voltage for this filament lamp.

(2)

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(Total for Question 4 = 9 marks)

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5 The photograph shows the nuclear fusion reactor called ITER.



(Source: © Efman/Shutterstock)

(a) Describe the difference between nuclear fusion and nuclear fission.

(2)

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.....

.....

.....

(b) At ITER, hydrogen-3 and hydrogen-2 will be fused into helium and another particle labelled X.

(i) Complete the nuclear equation for the fusion of hydrogen-3 and hydrogen-2.

(2)

$$^{3}_{1}H + ^{2}_{1}H \rightarrow ^{4}_{2}He + ^{\square}_{\square}X$$

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(ii) Discuss potential safety advantages of a fusion reactor compared with a fission reactor.

You should refer to the products of this fusion reaction and to the fission reaction of uranium.

(3)

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(c) The half-life of a radioactive isotope is 12 years.

The activity of a sample of this isotope is 120 kBq.

Calculate the activity of this sample after 48 years.

(3)

activity = ... kBq

(Total for Question 5 = 10 marks)

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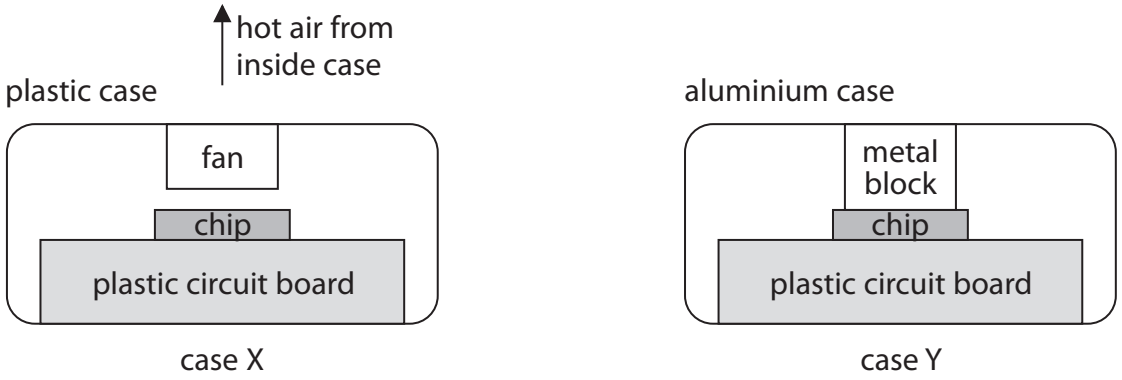
6 The diagram shows a small computer in two difference cases, X and Y.

The electronic chip in the computer is hot when in use. Each case is designed to cool the computer chip.



Case X is made of white plastic and has a fan.

Case Y is made of black-painted aluminium metal and has no fan. There is a metal block that is in contact with the case and the chip.

(a) Explain the main method of heat transfer from the chip to the surroundings for case X.

(3)

(b) Explain the main method of heat transfer from the chip to the surroundings for case Y.

(3)

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(c) (i) State the formula linking power, current and voltage.

(1)

(ii) The small computer operates at a voltage of 5.1 V with a current of 2.9 A.

Calculate the power of the small computer.

Give the unit.

(3)

power = ... unit .....

(Total for Question 6 = 10 marks)

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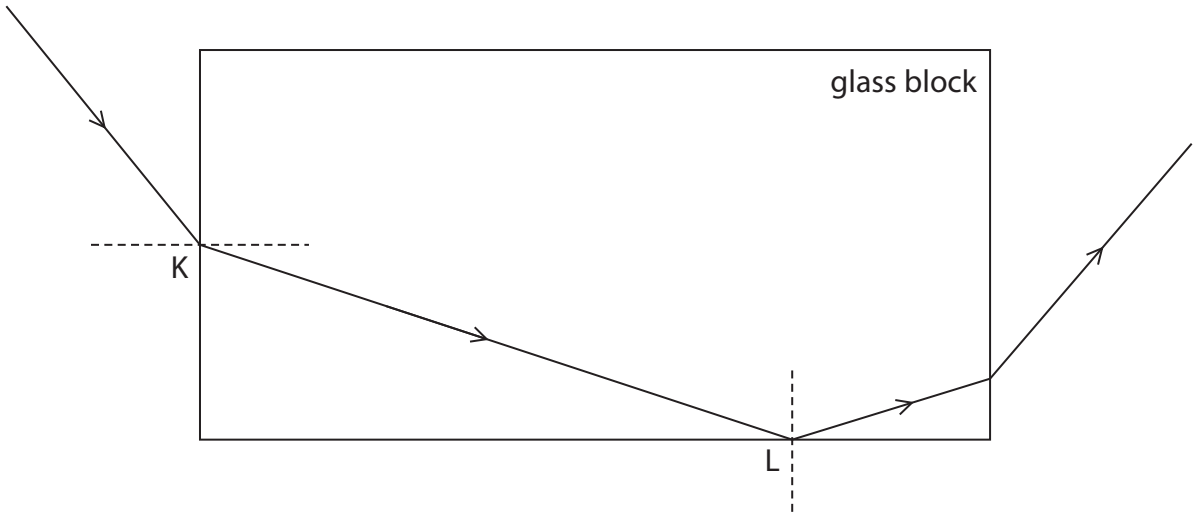
7 The diagram shows the path of a ray of light.



(a) (i) Measure the angle of incidence for the ray at point K.

Which of these is the angle of incidence?

(1)

- ☒ **A** 43°
- ☒ **B** 47°
- ☒ **C** 51°
- ☒ **D** 55°

(ii) State the formula linking refractive index, angle of incidence and angle of refraction.

(1)

(iii) The block has a refractive index of 1.52

Use the formula to show that the angle of refraction is about 30° for the ray at point K.

(3)

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(b) (i) The refractive index of the block is 1.52

Calculate the critical angle of the block.

(3)

(ii) State what happens to the ray at point L.

(1)

.....

.....

.....

(Total for Question 7 = 9 marks)

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8 A student wants to determine the density of air using an irregularly-shaped balloon made of metal foil.

The balloon has a label stating that the volume of the balloon when full is 490 cm^3.

This is part of the student's method.

Step 1 measure the mass of the empty balloon

Step 2 fill the balloon with air

Step 3 measure the mass of the full balloon

Step 4 subtract the mass of the empty balloon from the mass of the full balloon.

(a) (i) Name the equipment the student could use to measure the mass of the balloon.

(1)

.....

(ii) Suggest how the student could improve the reliability of their data.

(1)

.....

.....

(b) The table shows the student's results.

Mass of empty balloon in g	15.00
Mass of balloon when full of air in g	15.61
Volume of air in cm^3	490

Calculate the density of air to 2 significant figures.

Give the unit.

(4)

density = ... unit .....

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(c) Describe how the volume of the balloon full of air could be measured using a large beaker and some water.

You may use a diagram to help your answer.

(3)

(Total for Question 8 = 9 marks)

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9 A teacher demonstrates the penetrating ability of alpha, beta and gamma radiation from some radioactive sources.

(a) (i) State a precaution the teacher should take to make sure they are working safely with the radioactive sources.

(1)

.....

.....

.....

(ii) State the name of a detector the teacher could use to detect the radiation from each source.

(1)

.....

.....

(b) Draw crosses (×) in the table to show which type of radiation **cannot** penetrate each material in the table.

(3)

	Material		
Type of radiation	**10 cm of air**	**2 cm of aluminium**	**10 cm of lead**
alpha			
beta			
gamma			

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(c) An alpha particle of mass 6.6×10^{-27} kg travelling at a speed of 2.1×10^{7} m/s hits a sheet of paper.

(i) Calculate the kinetic energy (KE) of the alpha particle.

(3)

KE = ... J

(ii) State the work done on the alpha particle when its speed is reduced to 0 m/s by the sheet of paper.

(1)

work done = ... J

(iii) State which energy store of the paper increases when the alpha particle is stopped.

(1)

.....

(Total for Question 9 = 10 marks)

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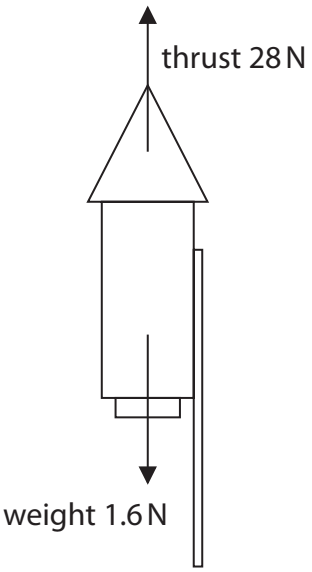
10 The diagram shows the forces acting on a firework at take-off.



(a) (i) Calculate the magnitude of the resultant force on the firework.

(1)

magnitude of resultant force = ... N

(ii) State the formula linking resultant force, mass and acceleration.

(1)

(iii) The mass of the firework is 160 g.

Calculate the acceleration of the firework.

(3)

acceleration = ... m/s^2

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(iv) Explain how the acceleration of the firework changes between take-off and running out of fuel.

You can assume that the thrust force stays the same as the firework burns the fuel.

(3)

(b) The firework makes a sound with constant frequency.

As the firework moves upwards, people on the ground notice that the frequency of the sound they hear changes.

This is called the Doppler effect.

Explain how the Doppler effect causes the observed frequency of sound to change for the people on the ground.

(4)

(Total for Question 10 = 12 marks)

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11 The diagrams show some equipment that the physicist Ørsted used in an investigation in 1820.

Diagram 1 shows the position of eight compass needles around a wire with no current in the wire.

The compass needles line up with and show the direction of the Earth's magnetic field lines.

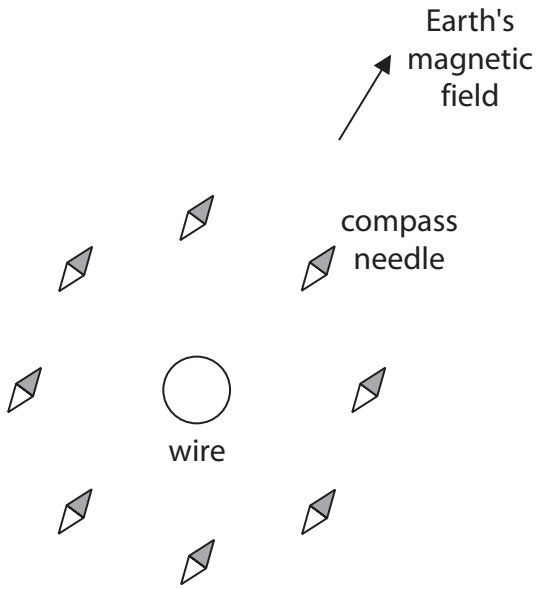

Diagram 1

Diagram 2 shows the position of the same compass needles when a current is in the wire.

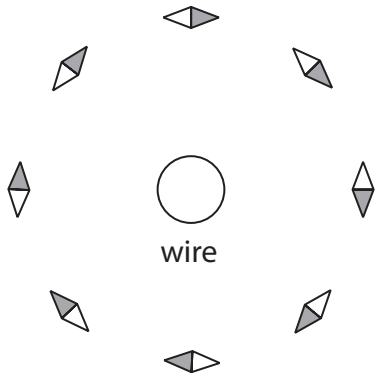

Diagram 2

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(a) (i) Explain why the compass needles turn when the current is switched on.

(2)

.....

.....

.....

.....

(ii) Using evidence from the compass needles in diagram 2, draw on diagram 2 the shape and direction of a magnetic field line produced by the current in the wire.

(2)

(iii) Suggest what happens to the magnetic field when the current in the wire is reversed.

(1)

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(b) The current in the wire is turned off.

Diagram 3 shows the wire placed in a uniform magnetic field.

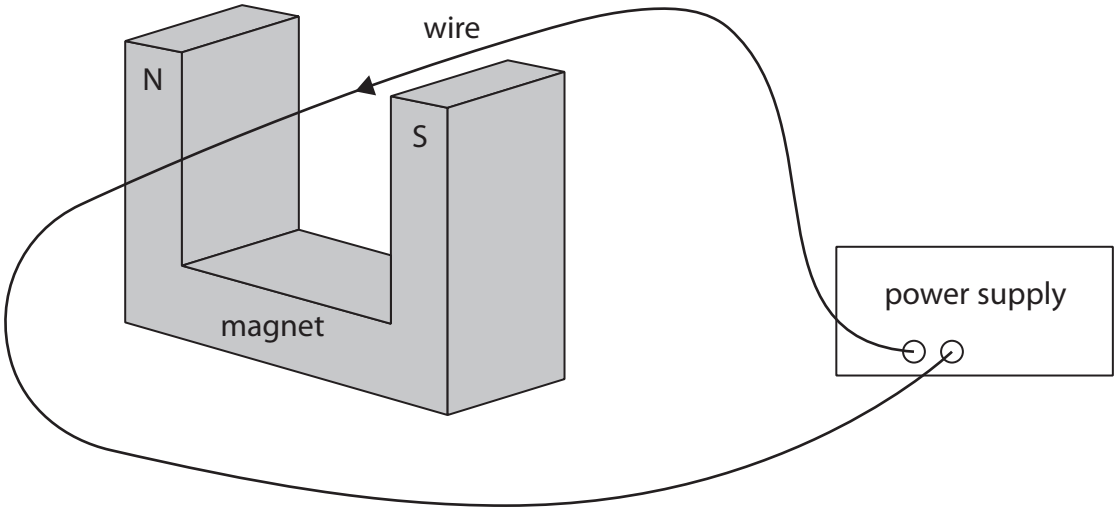

Diagram 3

The current is now switched on.

Draw an arrow to show the direction of the force on the wire.

(2)

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(c) The power supply in diagram 3 is replaced by an ammeter.

(i) When the wire is moved, a current is detected.

Explain which direction the wire is moved in the magnetic field to produce a current in the wire.

(2)

(ii) Explain why a current is produced in the wire when the wire is moved in the magnetic field.

(2)

(Total for Question 11 = 11 marks)

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