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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Monday 13 January 2020

Afternoon (Time: 2 hours) | Paper Reference **4PH1/1PR 4SD0/1PR**

Physics

Unit: 4PH1
Science (Double Award) 4SD0
Paper: 1PR

You must have:
Ruler, protractor, calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **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.
- 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

- 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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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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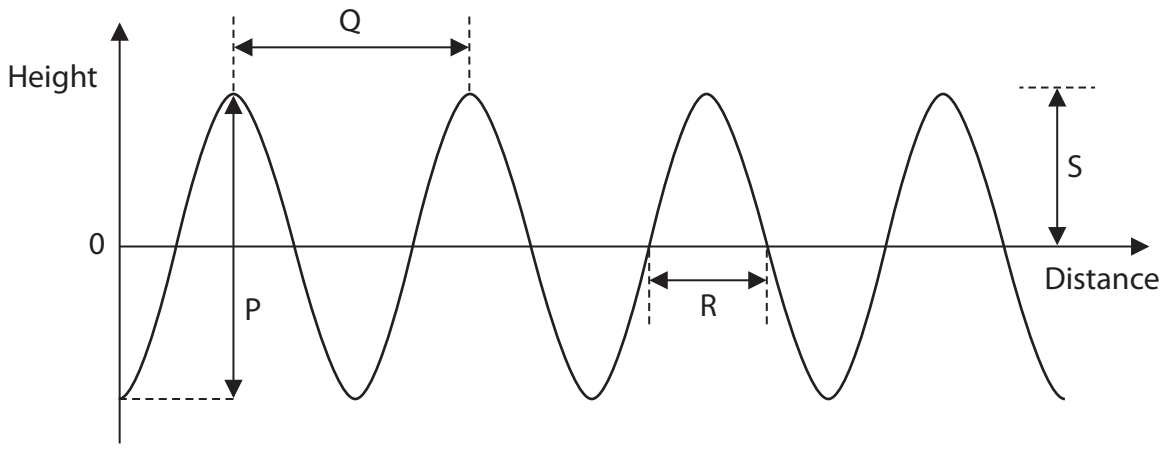
Answer ALL questions.

1 The diagram represents a water wave travelling on the surface of some water.



(a) Which arrow represents the amplitude of the wave?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(b) Which arrow represents the wavelength of the wave?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **A** S

(c) What type of wave is this water wave?

(1)

☒ **A** electromagnetic

☒ **B** gravitational

☒ **C** longitudinal

☒ **D** transverse

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(d) The time period of the wave is 2.7 s.

Calculate the frequency of the wave.

(2)

frequency= ..... Hz

(Total for Question 1 = 5 marks)

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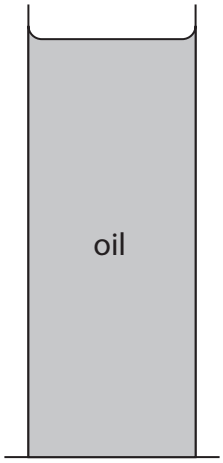
2 The diagram shows a can filled with oil.



(a) The total pressure at the bottom of the can is 110 kPa.

Atmospheric pressure is 101 kPa.

Calculate the pressure difference due to the oil.

(1)

pressure difference = ... kPa

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

(1)

(c) Calculate the height of the oil in the can.

[density of oil = 960 kg/m^3]

(3)

height = ... m

(Total for Question 2 = 5 marks)

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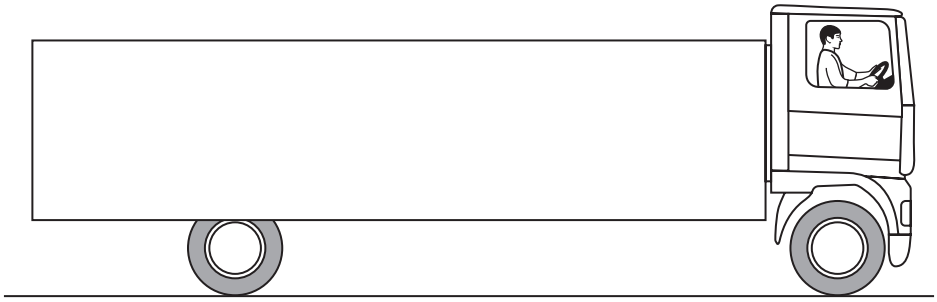
3 The diagram shows a truck travelling along a horizontal road.



(a) The driver sees an obstacle in the road and then applies the brakes.

(i) Which of these factors affects thinking distance?

(1)

- ☒ **A** condition of the tyres
- ☒ **B** consumption of alcohol by the driver
- ☒ **C** mass of the vehicle
- ☒ **D** condition of the road

(ii) Which of these factors affects both thinking distance and braking distance?

(1)

- ☒ **A** condition of the brakes
- ☒ **B** condition of the road
- ☒ **C** mass of the vehicle
- ☒ **D** speed of the vehicle

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(b) The truck experiences a braking force of 46 000 N.

(i) State the formula linking work done, force and distance moved.

(1)

(ii) The truck has 590 000 J of energy in its kinetic energy (KE) store before the driver applies the brakes.

The braking force does work on the truck to reduce the KE store of the truck to 0 J.

The braking distance is defined as the distance required for the KE store of the truck to reduce to 0 J when the brakes are applied.

Calculate the braking distance of the truck.

(3)

distance = ... m

(c) The brakes increase in temperature when the truck is braking.

(i) State the name of the energy store that has increased for the brakes.

(1)

.....

(ii) State the method of energy transfer from the truck to the brakes.

(1)

.....

(Total for Question 3 = 8 marks)

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4 Betelgeuse is a red supergiant star.

Betelgeuse has a mass that is much larger than the Sun.

Describe the evolution of Betelgeuse through its entire life cycle.

(5)

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(Total for Question 4 = 5 marks)

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5 A table tennis ball is a very light plastic ball filled with air.

(a) A student drops a table tennis ball from rest.

The ball falls 13 m to the ground.

Show that the final speed of the ball, just before it reaches the ground, should be about 16 m/s.

Assume that there is no air resistance.

(3)

(b) The student suggests that the ball will reach the ground with a speed that is less than 16 m/s because of air resistance.

Use ideas about forces to justify the student's suggestion.

(5)

(Total for Question 5 = 8 marks)

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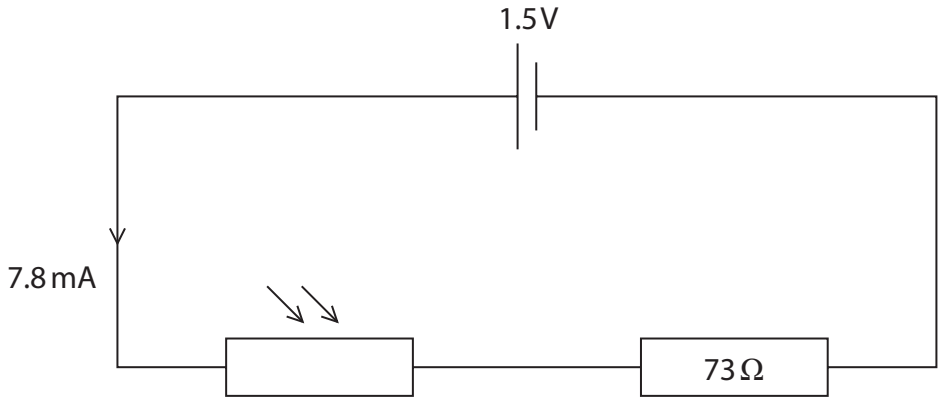
6 The circuit diagram shows a light dependent resistor (LDR) and a 73 Ω resistor connected in series with a 1.5 V cell.



(a) Complete the diagram by adding an instrument to measure the voltage of the LDR.

(2)

(b) (i) State the formula linking voltage, current and resistance.

(1)

(ii) The current in the circuit is 7.8 mA.

Calculate the voltage across the 73 ohm resistor.

(2)

voltage across resistor = ... V

(iii) Calculate the voltage across the LDR.

(2)

voltage across LDR = ... V

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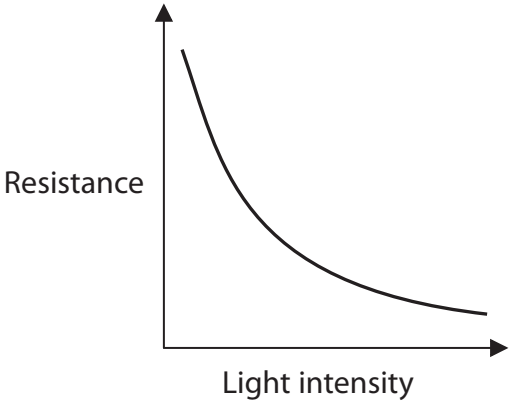
(c) The graph shows how the resistance of the LDR changes with light intensity.



(i) Describe the relationship between the resistance of the LDR and light intensity.

(2)

(ii) The resistance of the LDR decreases.

State the effect on the current in the circuit.

(1)

(iii) Explain why the voltage across the LDR decreases when the resistance of the LDR decreases.

(2)

(Total for Question 6 = 12 marks)

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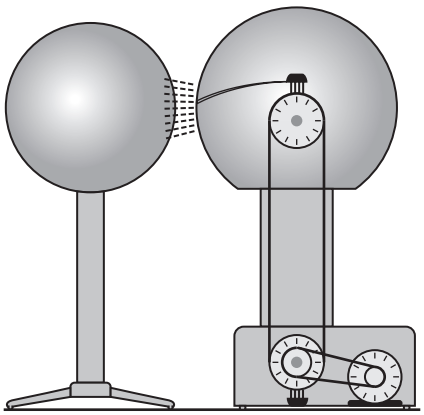
7 The diagram shows a van der Graaff generator, which is designed to provide very high voltages.



Source: www.shutterstock.com

(a) (i) The unit of voltage is the volt.

Which of these units is a volt?

(1)

- ☒ **A** coulomb per second
- ☒ **B** joule per coulomb
- ☒ **C** joule per second
- ☒ **D** newton per coulomb

(ii) State the formula linking energy transferred, voltage and charge.

(1)

(iii) Calculate the energy transferred to an electron when it passes through a voltage of 150 kV.

[charge of electron = 1.6×10^{-19} C]

(3)

energy transferred = ... J

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(b) When the van der Graaff generator is fully charged, it stores 2.9×10^{-8} C of charge.

(i) State the formula linking charge, current and time.

(1)

(ii) The charge on the generator discharges through the air as a spark.

The charge takes a time of 0.68 ms to leave the generator.

Calculate the mean (average) current in the air.

(3)

mean current = ... A

(Total for Question 7 = 9 marks)

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8 A scientist investigates different samples of rock.

(a) The scientist wants to calculate the density of a rock sample.

She needs to measure the mass and the volume of the rock.

Describe how to obtain accurate measurements of the mass and the volume of the rock.

You may draw a diagram to support your answer.

(5)

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(b) The table shows the scientist's results for rocks made from different materials.

Material	Mass in g	Volume in cm^3	Density in g/cm^3
coal	54	41	1.3
marble	44	18	2.4
quartz	54	20	2.7
fluorite	32	10	3.2
hematite	64	12	5.3

(i) State the formula linking density, mass and volume.

(1)

(ii) Rock X has a mass of 32 g and a volume of 12 cm^3.

Calculate the density of rock X.

Give your answer to 2 significant figures.

(3)

density = ... g/cm^3

(iii) Rock X is made from the same material as one of the samples in the table.

Explain which material rock X is made from.

(2)

.....

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.....

.....

(Total for Question 8 = 11 marks)

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9 A deioniser is a device used in rooms where workers build sensitive electronic circuits.

The deioniser contains a small block of polonium-210.

(a) (i) Complete the equation that shows the alpha decay of polonium-210 into lead-206.

(2)

$$^{210}_{84}\text{Po} \rightarrow {}^{206}_{82}\text{Pb} + \square\!\!\square\ \alpha$$

(ii) The alpha particle ionises air molecules in the room.

State what is meant by the term **ionisation**.

(1)

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(iii) Explain why workers in the same room as the deioniser are not at risk from the alpha radiation it emits.

(2)

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(b) The half-life of polonium-210 is 140 days.

(i) State what is meant by the term **half-life**.

(2)

.....

.....

.....

.....

(ii) The initial activity of the polonium-210 source in the deioniser is 70 kBq.

Calculate the activity of the source after 420 days.

(3)

activity = ... kBq

(Total for Question 9 = 10 marks)

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10 This is a question about refraction.

(a) (i) State the formula linking critical angle and refractive index.

(1)

(ii) Diamond has a critical angle of 26 degrees.

Calculate the refractive index of diamond.

(2)

refractive index = ...

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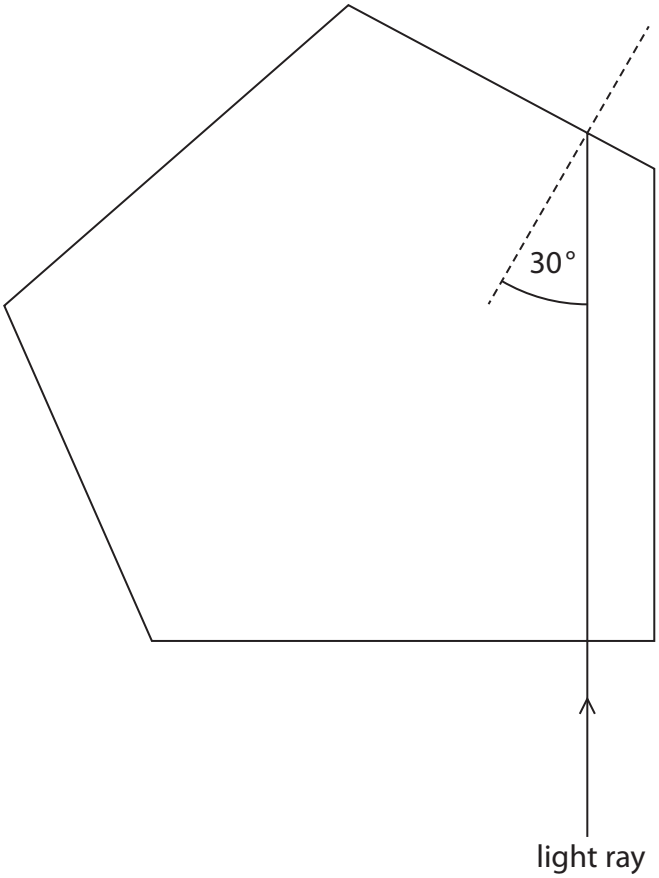
(iii) The diagram shows a light ray entering a block of diamond.

Complete the diagram to show the light ray emerging from the block.

(3)



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(b) A student plans an investigation to determine the refractive index of glass.

The student uses a graph of sin(i) against sin(r) to determine the refractive index.

(i) The student uses this equipment

- a ray box
- a rectangular glass block
- a protractor
- a pencil

Describe how the student should collect her data.

You may draw a diagram to support your answer.

(4)

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

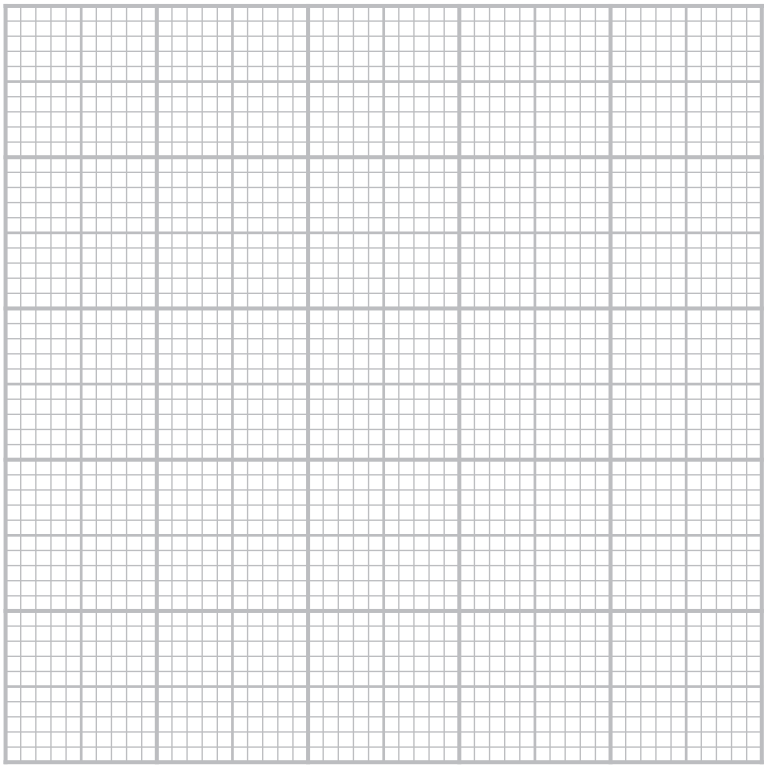
sin(i)	sin(r)
0.10	0.06
0.30	0.19
0.50	0.31
0.70	0.44
0.90	0.56

Plot a graph of the student's results.

(3)

(iii) Draw a line of best fit.

(1)



(iv) Use the graph to calculate the refractive index of the glass block.

(2)

refractive index = ...

(Total for Question 10 = 16 marks)

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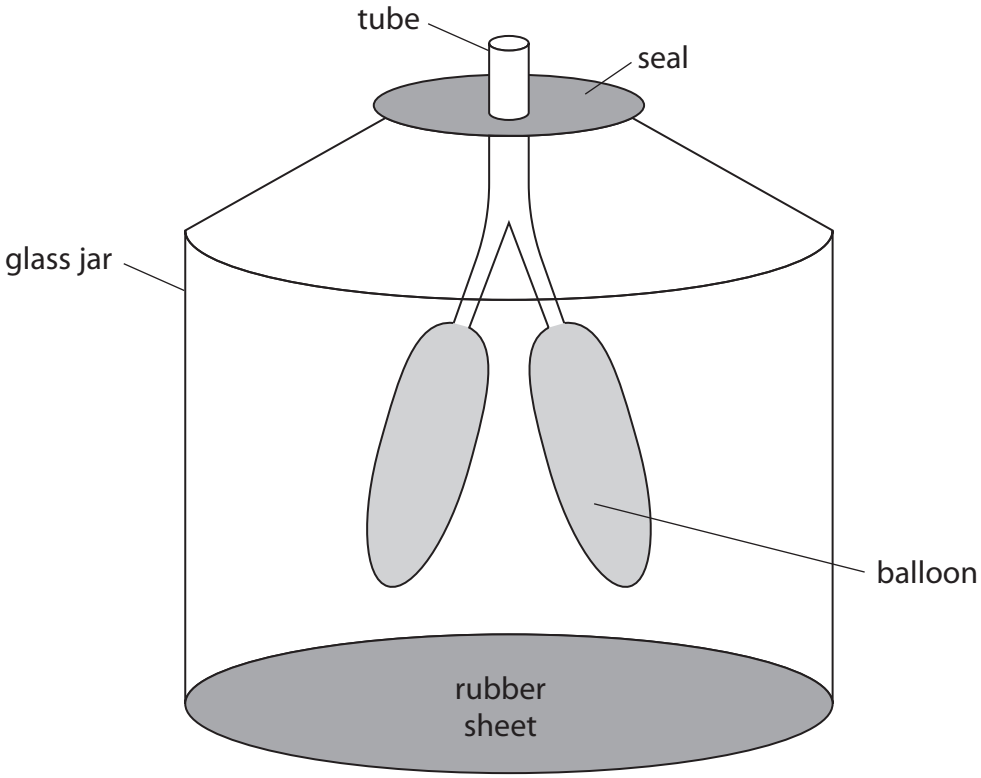
11 The diagram shows a model of the human breathing system.



The rubber sheet is pulled downwards so that the air inside the glass jar occupies a larger volume.

The temperature of the air does not change.

(a) Explain, in terms of particles, why the pressure of the air inside the glass jar decreases.

(3)

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(b) Before the rubber sheet is pulled down, the air inside the jar is at atmospheric pressure.

The volume of gas inside the jar increases from 110 cm^3 to 140 cm^3.

Calculate the pressure inside the jar after the rubber sheet is pulled down.

[atmospheric pressure = 101 kPa]

(3)

pressure = ... Pa

(c) The jar is sealed, but the balloons are open to the atmosphere.

Before the rubber sheet is pulled down, the air inside the balloons is at atmospheric pressure.

Explain why the balloons start to expand when the rubber sheet is pulled down.

(3)

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(Total for Question 11 = 9 marks)

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12 Diagram 1 shows some apparatus used to demonstrate the magnetic force on a current-carrying wire in a magnetic field.

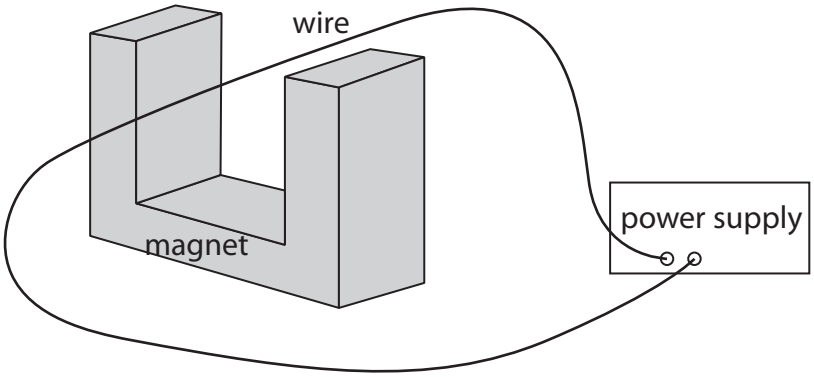

Diagram 1

(a) Diagram 2 shows four different arrangements of the apparatus.

The symbol ⊙ shows that the current is directed out of the page.

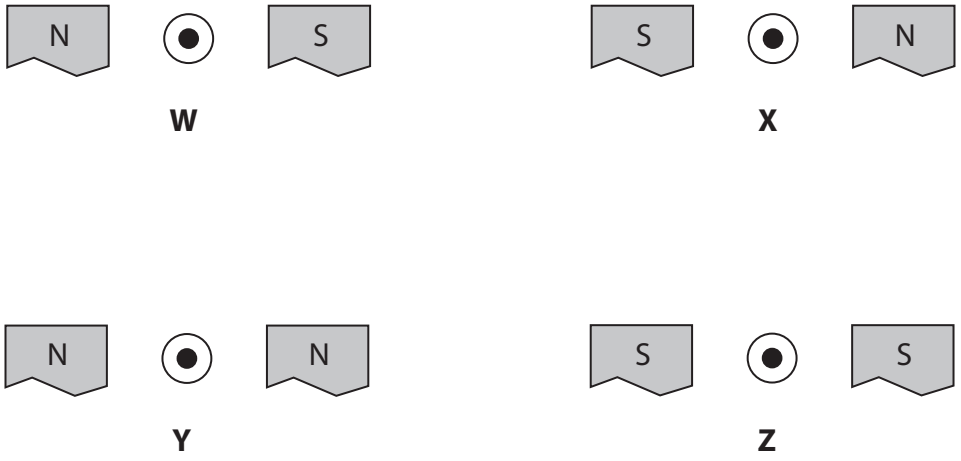

Diagram 2

Which arrangement of the apparatus will cause there to be an upwards magnetic force on the wire?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

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(b) The wire has a mass of 6.5 g.

(i) Calculate the weight of the wire.

Give your answer in mN.

(2)

weight = ... mN

(ii) There is an upwards magnetic force of 34 mN acting on the wire.

Calculate the acceleration of the wire.

(5)

acceleration = ... m/s^2

QUESTION 12 CONTINUES ON NEXT PAGE

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(iii) Explain one method of increasing the magnitude of the magnetic force on the wire.

(2)

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.....

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(iv) Explain how the circuit could be changed to make the wire vibrate.

(2)

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(Total for Question 12 = 12 marks)

TOTAL FOR PAPER = 110 MARKS

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