Write your name here

| Surname | Other names |
|---|---|
| | |

**Pearson Edexcel**
**International GCSE**

Centre Number | Candidate Number

# Physics

## Unit: 4PH0
## Science (Double Award) 4SC0
## Paper: 1PR

Thursday 15 May 2014 – Morning
**Time: 2 hours**

Paper Reference
**4PH0/1PR**
**4SC0/1PR**

**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 120.
- 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.
- Keep an eye on the time.
- 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* ▶

P41928A



1/1/1/1/1/1/

P 4 1 9 2 8 A 0 1 3 2

PEARSON

## EQUATIONS

You may find the following equations useful.

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

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

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

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

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

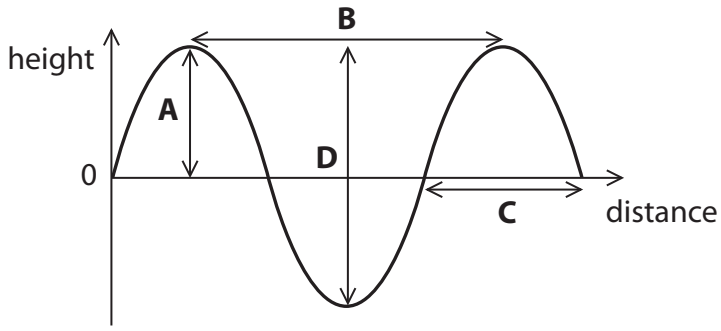
$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad v = \frac{2 \times \pi \times r}{T}$$

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

**BLANK PAGE**

**Answer ALL questions.**

**1** The diagram shows part of a water wave.




(a) (i) Which letter represents the wavelength?

**(1)**

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which letter represents the amplitude?

**(1)**

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(iii) This water wave is transverse. Other waves can be longitudinal.

State a similarity and a difference between a transverse wave and a longitudinal wave.

**(2)**

similarity .....

.....

difference .....

.....

(b) A student writes some sentences about electromagnetic waves.

His teacher circles a mistake in each sentence.

In the table, write a suitable correction for each mistake.

The first one has been done for you.

**(5)**

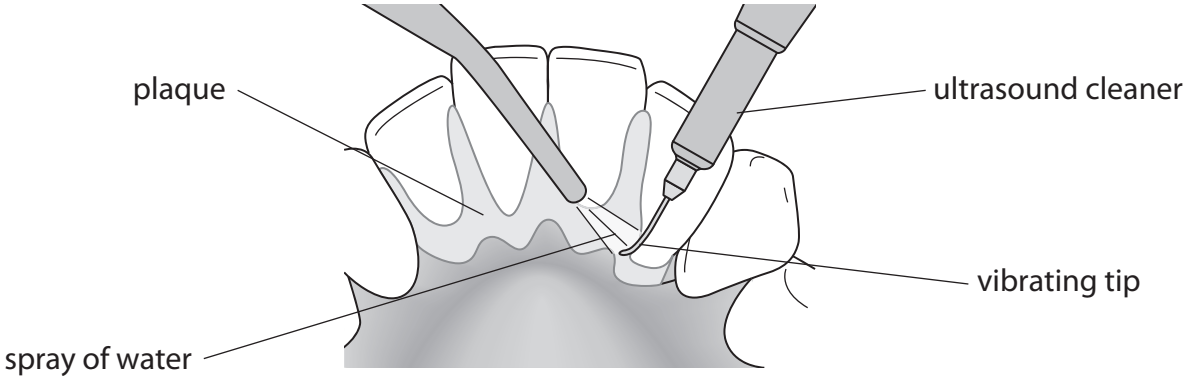
| Sentence | Correction |
|---|---|
| Electromagnetic waves travel at $3 \times (10^2)$ m/s in a vacuum. | $10^8$ |
| (Sound) waves are electromagnetic. | |
| (Infra-red) waves are the most harmful to people. | |
| (Gamma) waves are used for heating up food. | |
| (Radio) waves have the highest frequency. | |
| (Gamma) waves have a very long wavelength. | |

**(Total for Question 1 = 9 marks)**

**2** Ultrasound waves are sound waves with a very high frequency. They are often used for medical purposes.

(a) Dentists use ultrasound waves to clean patients' teeth.

The diagram shows an ultrasound cleaner removing plaque from teeth.




The tip of the ultrasound cleaner vibrates 96 million times per second and is sprayed with water.

(i) State the frequency of the ultrasound emitted by the cleaner and give the unit.

**(2)**

frequency = ..... unit .....

(ii) Suggest how the cleaner removes plaque.

**(1)**

.....

.....

(iii) Suggest why water is sprayed on the tip of the cleaner.

**(1)**

.....

.....

(b) Ultrasound waves are also used to produce images.

This is an ultrasound image of a fetus surrounded by fluid.


(i) The ultrasound image is caused by waves which bounce off the fetus.

This is an example of waves that are

**(1)**

- ☒ **A** absorbed
- ☒ **B** reflected
- ☒ **C** refracted
- ☒ **D** repelled

(ii) State the equation linking wave speed, frequency and wavelength.

**(1)**

(iii) The ultrasound waves have a wavelength of 0.00044 m and travel at a speed of 1540 m/s in the fluid.

Calculate the frequency, in MHz, of the ultrasound waves.

**(3)**

frequency = ..... MHz

(c) Other waves also have medical uses.

Ultraviolet waves are used by doctors to cure some skin conditions.

Suggest two differences between ultrasound waves and ultraviolet waves.

**(2)**

1 .....

.....

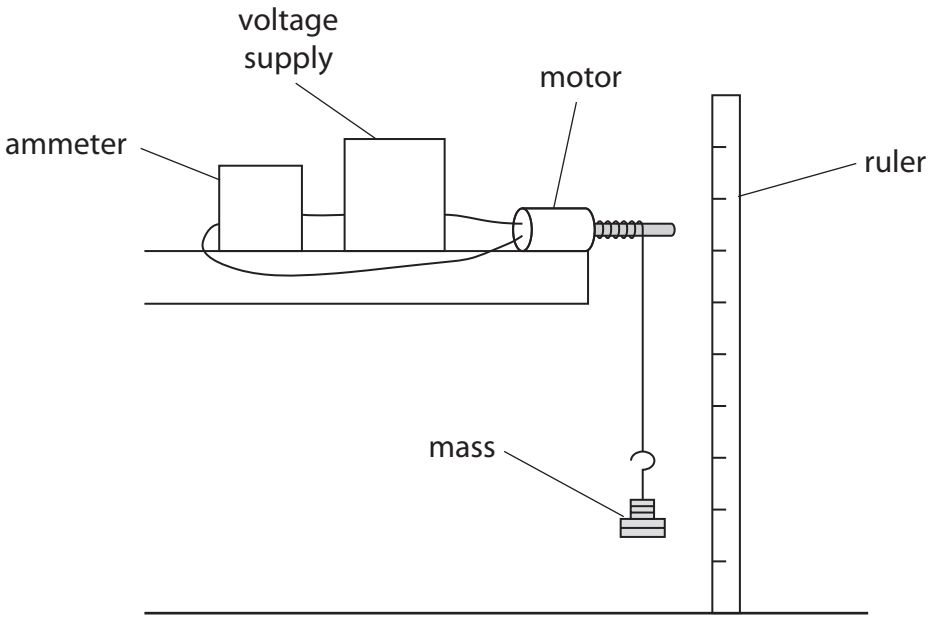
2 .....

.....

**(Total for Question 2 = 11 marks)**

**BLANK PAGE**

**3** (a) The diagram shows a motor lifting a 130 g mass.




The current in the motor is 2.1 A and the voltage across it is 12 V.

The motor takes 1.5 s to lift the mass.

(i) Calculate the electrical energy transferred to the motor as it lifts the mass.

Give your answer to two significant figures.

**(3)**

energy = ..... J

(ii) State the equation linking gravitational potential energy, mass, *g* and height.

**(1)**

(iii) The motor lifts a 130 g mass to a height of 63 cm.

Calculate the gravitational potential energy (GPE) gained by the 130 g mass.

**(2)**

GPE = ..... J

(iv) Why is the amount of GPE gained by the mass less than the amount of electrical energy transferred to the motor?

**(2)**

.....

.....

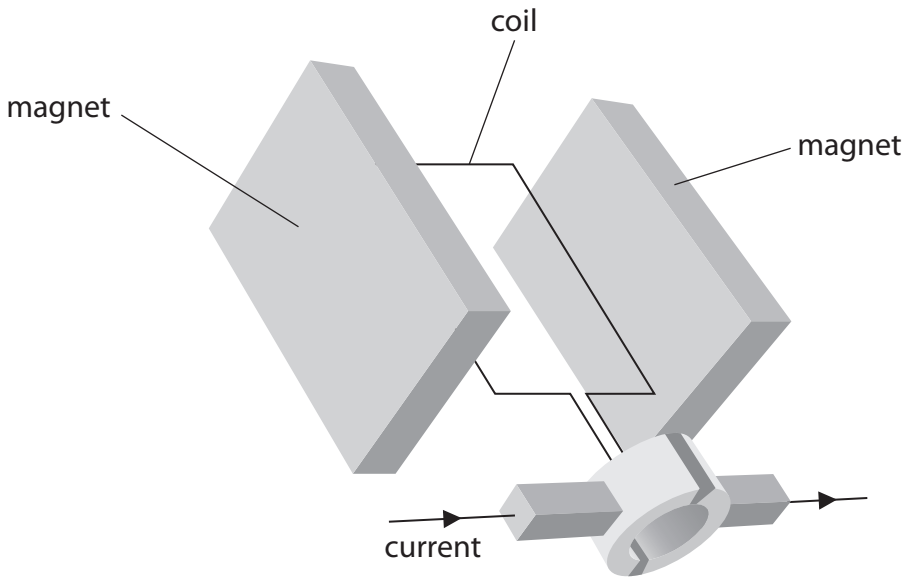
.....

.....

.....

.....

(b) The diagram shows an electric motor and the direction of current.




Explain how the current produces movement of the coil.

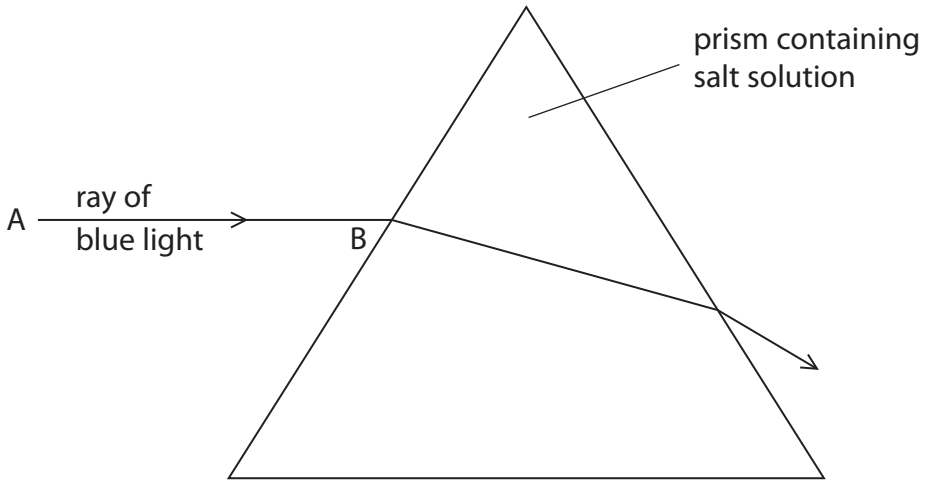
**(4)**

**(Total for Question 3 = 12 marks)**

**4** (a) A student investigates refraction of light by using a salt solution in a hollow prism.

He shines a ray of blue light from A to B and traces the path of the ray through the prism.

The diagram shows the path of the ray of blue light.




(i) Explain what is meant by the term **refraction**.

**(1)**

.....

.....

.....

(ii) On the diagram, draw the normal at B and measure the angle of incidence.

**(3)**

angle of incidence = .....

(iii) The student then shines a ray of red light from A to B.

The refractive index of the salt solution is lower for red light than it is for blue light.

On the diagram, sketch a possible path for the red light through the solution and out of the prism.

**(3)**

(iv) Suggest what would happen to the path of the blue light if the student used a salt solution with a higher refractive index.

**(2)**

.....

.....

.....

.....

(b) A technician working in a soft drinks factory uses refraction of light to measure sugar concentration in drinks.

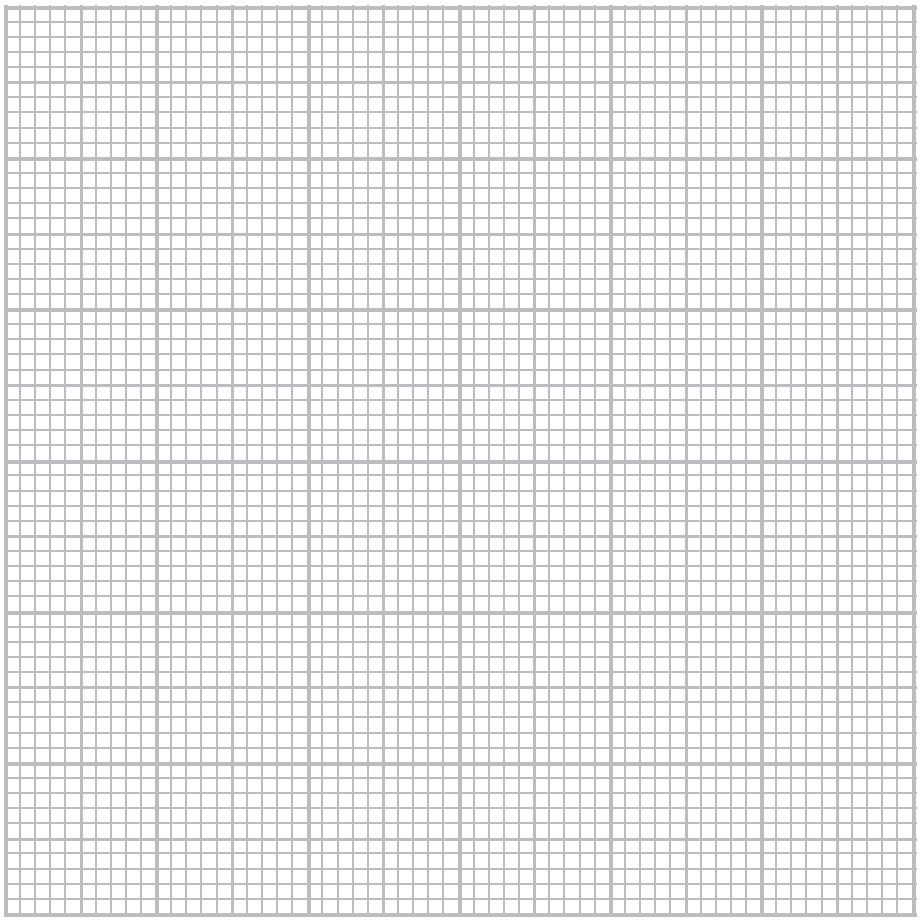
She takes readings using a refractometer. Different sugar concentrations give different scale readings on the refractometer.

The table shows her results.

| Sugar concentration (%) | Refractometer reading |
|---|---|
| 0 | 48 |
| 10 | 60 |
| 30 | 57 |
| 50 | 69 |
| 70 | 86 |
| 90 | 108 |

(i) Plot a graph of the refractometer reading against sugar concentration and draw the curve of best fit.

**(5)**



(ii) Circle the anomalous point on your graph and suggest what the correct refractometer reading should be.

**(2)**

refractometer reading = .....

(iii) Use your graph to find the sugar concentration when the refractometer reading is 80.

**(1)**

sugar concentration = ..... %

(iv) Describe the pattern shown by your graph.

**(2)**

.....

.....

.....

.....

.....

.....

**(Total for Question 4 = 19 marks)**

**5** A student investigates the motion of different falling masses by measuring the time taken for empty cupcake cases to fall from a window.

(a) The student drops one case from the window.

He repeats the experiment with two cases stuck together, then with three cases and then with four.

Name two measuring instruments that he would need for his investigation.

**(2)**

1 .....

2 .....

(b) What are the dependent and independent variables in this investigation?

**(2)**

dependent variable .....

independent variable .....

(c) State one factor that the student should keep constant in order to make this investigation valid (a fair test).

**(1)**

.....

(d) The student draws this table to record his results.

Add suitable headings to his table.

**(2)**

| ..... in ..... | ..... in ..... |
|---|---|
| | |

(e) State one way that the student can improve his investigation.

**(1)**

.....

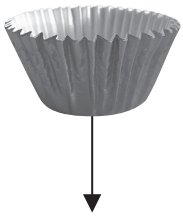
.....

(f) The student notices that the cases accelerate and then fall at constant speed.

(i) The arrows in the diagrams show the size and direction of the forces acting on a case at different points in its fall.

Label the forces on the middle diagram.

**(2)**



at the start

part of the way down

near the bottom

(ii) Explain why the case accelerates and then falls at constant speed.

**(3)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(Total for Question 5 = 13 marks)**

**6** The table describes the nuclei of four atoms.

| uranium-234 | uranium-235 | plutonium-238 | americium-238 |
|---|---|---|---|
| $^{234}_{92}U$ | $^{235}_{92}U$ | $^{238}_{94}Pu$ | $^{238}_{95}Am$ |

(a) Atoms contain electrons.

Which nucleus needs the largest number of electrons to form a neutral atom?

**(1)**

☒ **A** uranium-234

☒ **B** uranium-235

☒ **C** plutonium-238

☒ **D** americium-238

(b) (i) Which two nuclei have the same number of protons?

**(1)**

..... and .....

(ii) Which two nuclei have the same number of nucleons?

**(1)**

..... and .....

(iii) Which two nuclei have the same number of neutrons?

**(1)**

..... and .....

(c) All of the nuclei are unstable and have a different half-life.

(i) Explain what is meant by the term **unstable**.

**(1)**

.....

.....

(ii) Explain what is meant by the term **half-life**.

**(2)**

.....

.....

.....

.....

(d) When plutonium decays, it emits an alpha particle and a gamma ray.

(i) Complete the decay equation for plutonium-238.

**(4)**

$$^{238}_{94}\text{Pu} \longrightarrow {}^{4}_{\ }\alpha + {}^{\ }_{\ }\mathbf{X} + {}^{\ }_{0}\gamma$$

(ii) Use information from the table to identify element X.

**(1)**

element X = .....

(e) The nucleus of americium-238 can absorb an electron.

When this happens, one of the protons in the nucleus becomes a neutron.

This equation describes the process.

$$\begin{matrix} 1 & & 0 & & & & 1 \\ p & + & e & & \longrightarrow & & n \\ 1 & & -1 & & & & 0 \end{matrix}$$

(i) Describe how this process affects the proton number and the nucleon number of the nucleus that absorbs the electron.

**(2)**

.....

.....

.....

.....

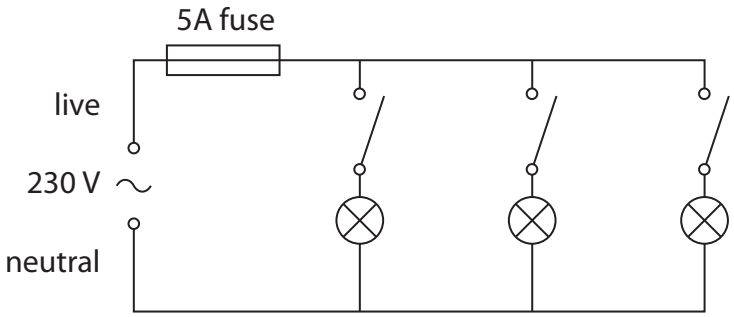
(ii) Identify the new nucleus formed by this process.

**(1)**

.....

**(Total for Question 6 = 15 marks)**

**7** The diagram shows the lighting circuit in an office.




(a) (i) State two advantages of connecting lamps in parallel rather than in series.

**(2)**

1 .....

.....

2 .....

.....

(ii) What is the purpose of the 5 A fuse?

**(1)**

.....

.....

(iii) Explain how a fuse works.

**(3)**

.....

.....

.....

.....

.....

.....

(b) A label on one of the office computers includes this information.

| 230 V | 0.25 kW |
|---|---|

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

**(1)**

(ii) Use the information on the label to calculate the current in the computer.

**(3)**

current = ..... A

(iii) Fuses are available with values of 1 A, 3 A, 10 A and 13 A.

Suggest the most suitable fuse value for the computer.

Give a reason for your answer.

**(2)**

fuse value ..... A

reason .....

.....

(iv) Some circuits use a circuit breaker instead of a fuse.

State two advantages of using a circuit breaker instead of a fuse.

**(2)**

1 .....

.....

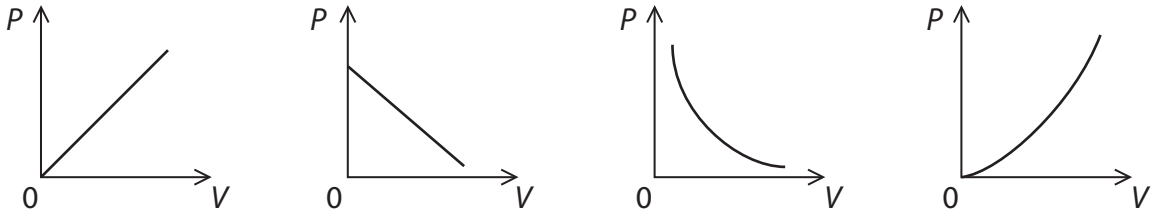
2 .....

.....

(c) The graphs show some ways that power (*P*) can vary with voltage (*V*).

Which is the correct graph for a fixed resistor?

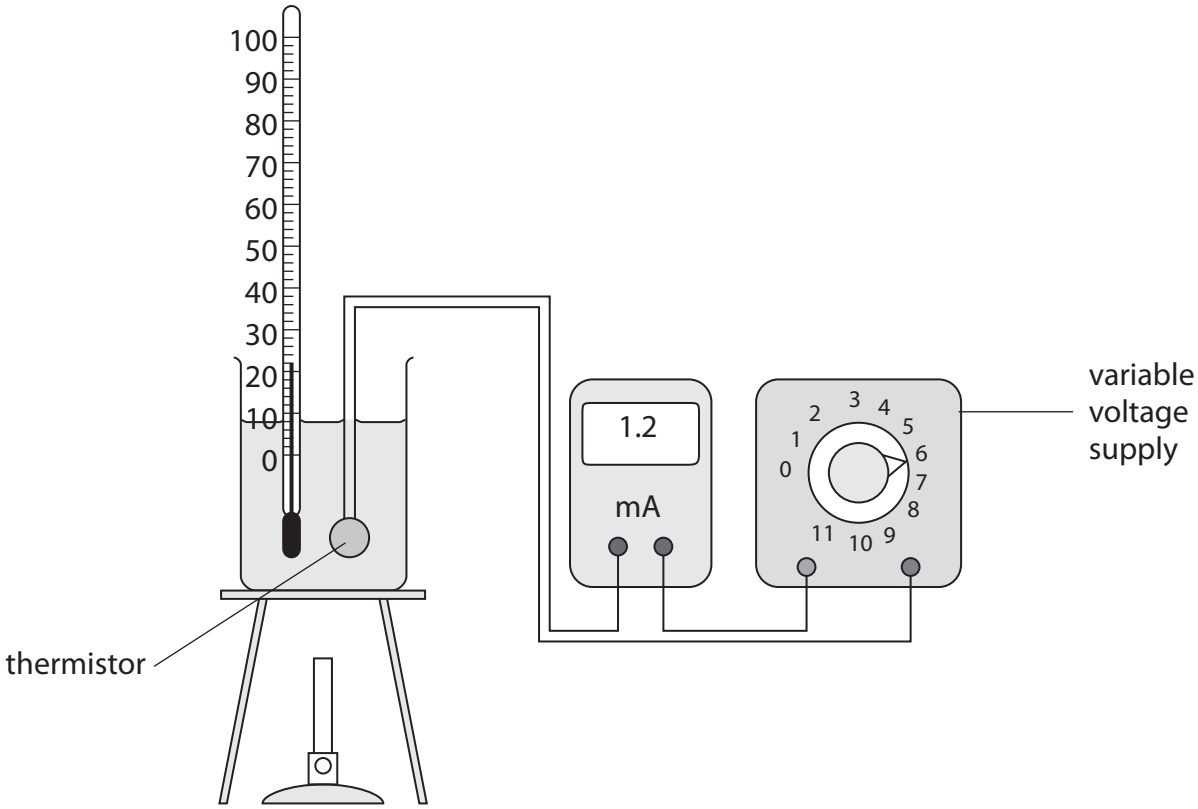
**(1)**




☒ **A** ☒ **B** ☒ **C** ☒ **D**

**(Total for Question 7 = 15 marks)**

**8** (a) A student uses this apparatus to investigate how the resistance of a thermistor changes with temperature.




(i) Draw a circuit diagram for this investigation.

**(2)**

(ii) The student wants to measure the voltage across the thermistor.

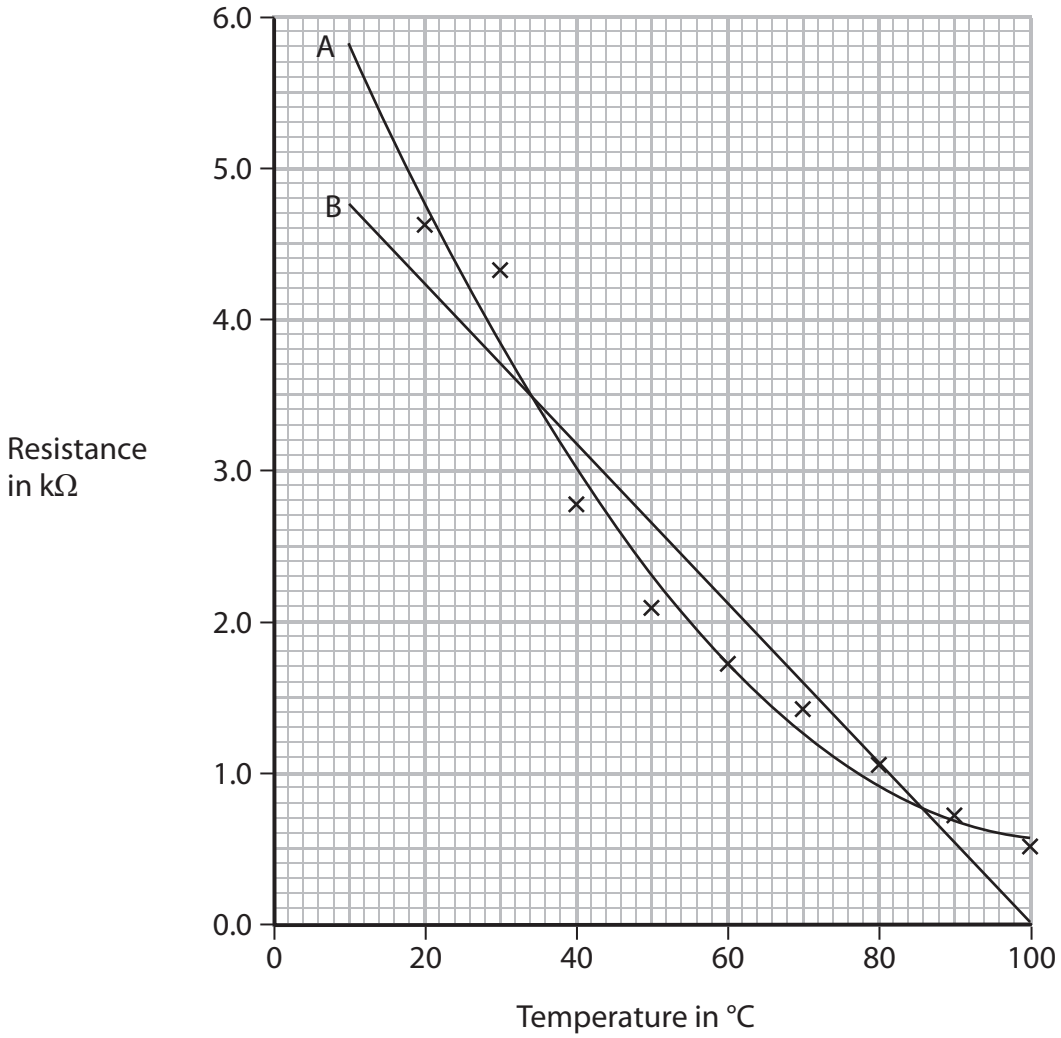
On your diagram, add a symbol to show how she should connect the voltmeter to the circuit.

**(1)**

(iii) Explain how the student can use the apparatus to investigate how the resistance of the thermistor varies with temperature between 0 °C and 100 °C.

**(5)**

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




Two students discuss the line of best fit for this graph.

One student thinks it is the curved line A.

The other student thinks that it is the straight line B.

(i) Suggest which line is better, giving a reason for your choice.

**(1)**

.....

.....

.....

(ii) Suggest why measuring the resistance of the thermistor at 10 °C could help to decide which line is better.

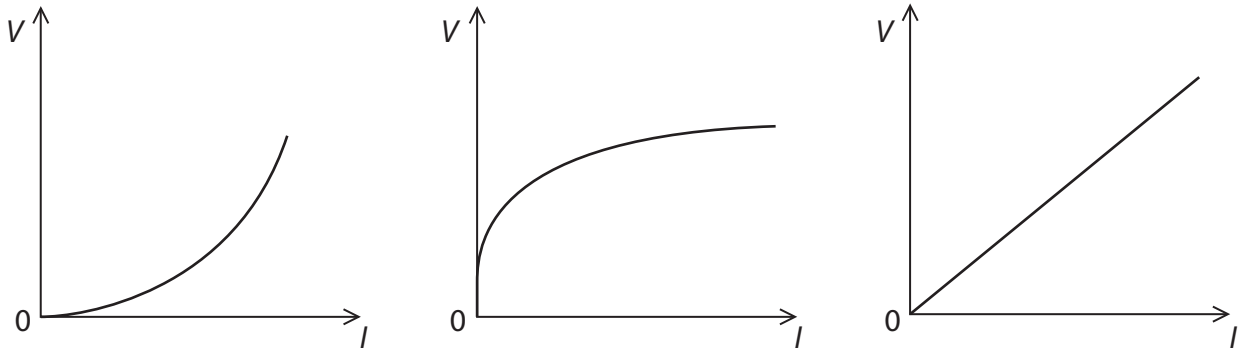
**(1)**

.....

.....

.....

(c) These graphs show the voltage (*V*) changes with the current (*I*) for three components.




**J** **K** **L**

The components are a metal wire at constant temperature, a diode and a filament lamp.

Which letter represents the correct graph for each component?

**(2)**

metal wire at constant temperature .....

diode .....

filament lamp .....

**(Total for Question 8 = 12 marks)**

**BLANK PAGE**

**9** John Leslie was a scientist who investigated heat and thermometers.

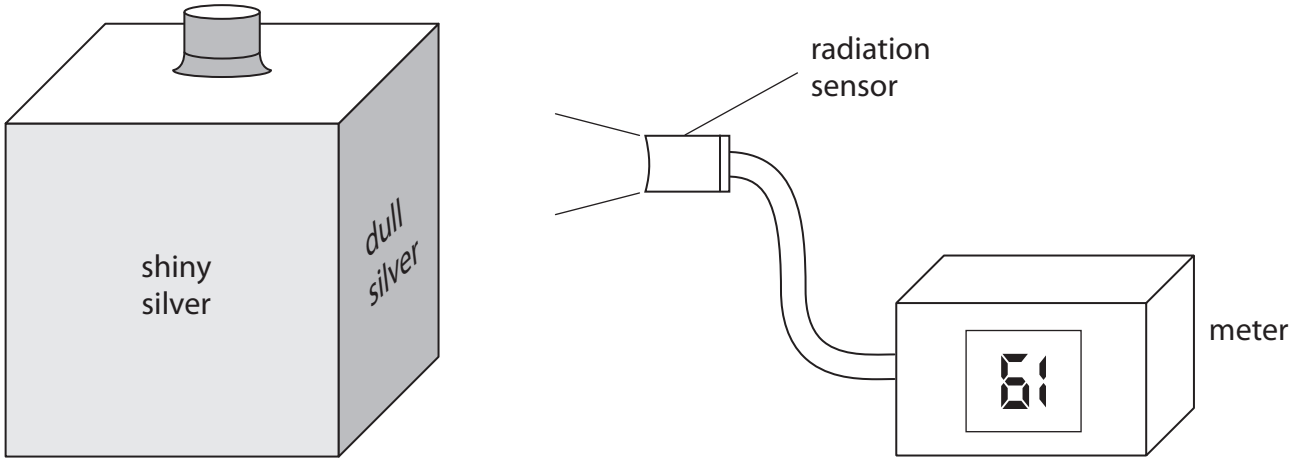
He experimented with a hollow metal cube. The cube had different surfaces on each side and was filled with boiling water.

(a) A student uses a modern version of Leslie's cube to investigate how the surface of a hot object affects the radiation emitted.

She uses a cube with four different vertical surfaces.

She fills the cube with boiling water so that the temperature of each surface is the same.

She uses the radiation sensor to measure the radiation emitted from each surface.




(i) The student's results are shown below.

Draw a line linking each surface colour with its correct meter reading.

One has been done for you.

**(2)**

| surface colour | meter reading |
|---|---|
| shiny black | 87 |
| dull black | 61 |
| dull silver | 70 |
| shiny silver | 47 |

(ii) The temperature of each surface is the same, but the radiation sensor gives a different reading for each surface.

What can you conclude from this?

**(1)**

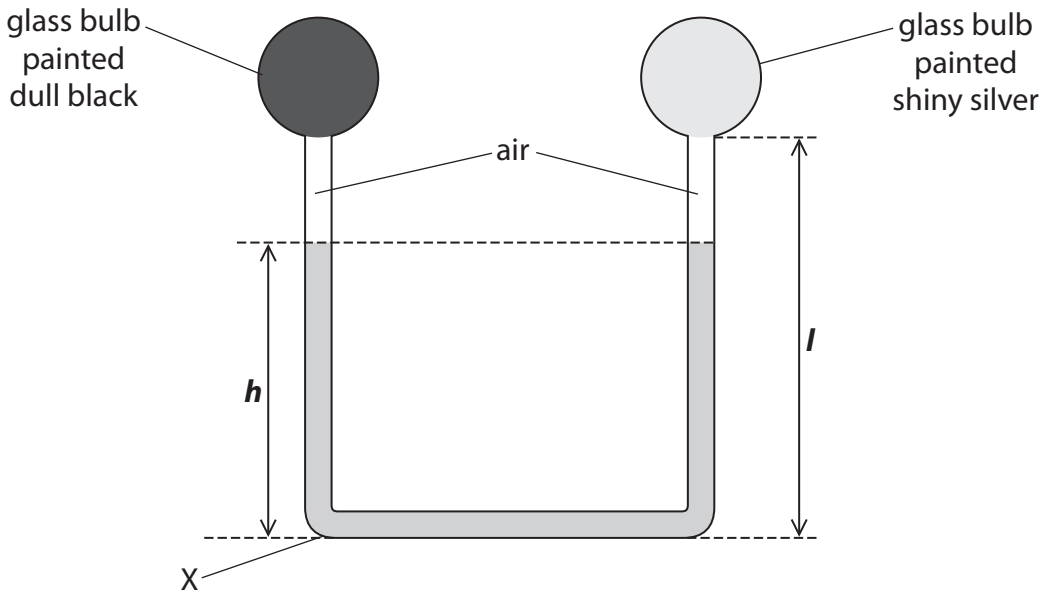
.....

.....

(b) John Leslie also invented a differential thermometer.

The diagram shows this thermometer.

The bulbs are filled with air and are connected by a tube which contains liquid.




(i) State the equation linking pressure difference, height, density and *g*.

**(1)**

(ii) The density of the liquid is 1260 kg/m$^3$.

Calculate the pressure due to the liquid at X when the height, *h*, of the column of liquid is 0.25 m.

Give the unit.

**(3)**

pressure = ..... unit .....

(iii) The student places the differential thermometer in bright sunlight for a few minutes.

She observes that the liquid level

- falls on the side of the dull black bulb making *h* lower
- rises on the side of the shiny silver bulb

Use ideas about heat transfer and particle theory to explain these observations.

**(3)**

(iv) Explain what would happen to the levels of the liquid if the student repeated the experiment with a denser liquid in the thermometer.

**(2)**

**QUESTION 9 CONTINUES ON THE NEXT PAGE**

(v) Two students discuss the effect of changing the length, *l*, of the tube on both sides, while keeping the total volume of liquid constant.

If the length of the tube is increased, the thermometer can measure higher temperatures.

Changing the length of the tube will not make any difference to the range of temperatures that the thermometer can measure.

Explain which of these ideas is correct.

**(2)**

.....

.....

.....

.....

**(Total for Question 9 = 14 marks)**

**TOTAL FOR PAPER = 120 MARKS**