



Additional Assessment Materials  
Summer 2021

Pearson Edexcel GCSE in Physics (1PH0)  
Higher

Resource Set Topic H: Particle Model,  
Forces and Matter

Questions

(Public release version)

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## General guidance to Additional Assessment Materials for use in 2021

### Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

### Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1 (a) Figure 1 shows air inside a cylinder with a movable piston.

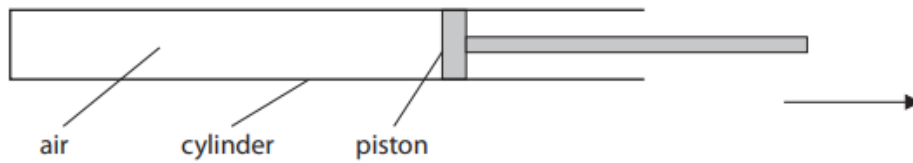


Figure 1

The piston is pulled a little way in the direction of the arrow, but stays inside the cylinder.

Which of these increases?

(1)

- A The mass of the air inside the cylinder.
- B The rate at which air particles collide with the walls of the cylinder.
- C The volume of the air inside the cylinder.
- D The pressure of the air inside the cylinder.

(b) Figure 2 shows a rubber tube that can be used inside a bicycle tyre.

The tube is inflated with a bicycle pump.



before being inflated



after being inflated

Figure 2

(i) The air inside the tube exerts an outward force on the wall of the tube.

State the angle that this outward force makes with the wall of the tube.

(1)

90 degrees

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- (ii) It takes 4.8 litres of air from the atmosphere to inflate the empty tube to a pressure of 400 000 Pa.

Atmospheric pressure is 100 000 Pa.

Calculate the volume of air inside the tube.

Assume the temperature of the air inside the tube is the same as the temperature of the air outside the tube.

Use an equation selected from the list of equations at the end of this paper.

(3)

$$P_1 V_1 = P_2 V_2$$

$$400000 \times V_1 = 100000 \times 4.8$$

$$V_1 = \frac{4.8 \times 100000}{400000} = 1.2$$

volume = 1.2 litres

- (iii) When a bicycle pump is used to inflate the tube, the air in the bicycle pump gets warm.

You should ignore any effects of friction in the pump.

Explain why the air in the bicycle pump gets warm.

(2)

As the pump is pushed, the volume decreases in the pump, increasing the pressure. This increases the KE of the air molecules, causing an increase of temperature.

- 2 (a) A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

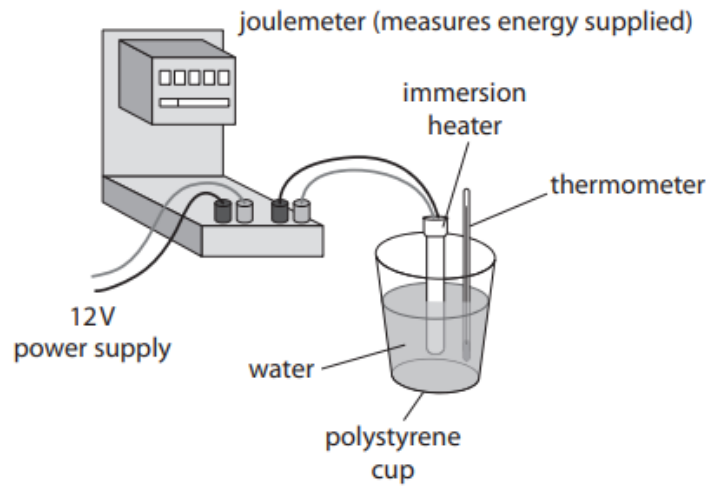


Figure 3

- (i) State the measurements needed to calculate the specific heat capacity of water.

(4)

Mass of the water

Initial temperature reading of the water

Final temperature reading of the water

Energy Supplied

- (ii) State **two** ways that the apparatus could be adapted to improve the procedure.

(2)

1 Add a lid to the polystyrene cup to minimize the heat loss to the surrounding

2 Use a stirrer to distribute heat across the water

- (b) The student decides to measure the temperature of the water every minute while it is being heated.

Figure 4 shows a graph of the student's results.

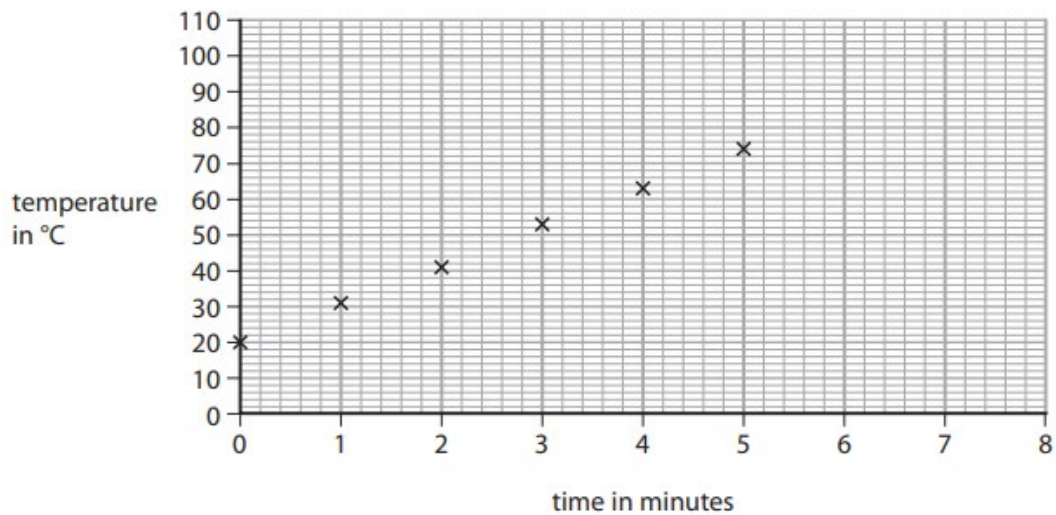


Figure 4

Predict the temperature of the water if the heating continues up to 8 minutes.

(1)

temperature of the water = 100 °C

- (c) Another student decides to melt some ice.

The student melts 380 g of ice at 0 °C.

The specific latent heat of fusion of ice is  $3.34 \times 10^5$  J/kg.

Calculate the thermal energy needed to melt the ice.

Select an equation from the list of equations at the end of this paper.

(2)

$$\begin{aligned} E &= mL \\ &= 0.380 \times 3.34 \times 10^5 \\ &= 1.269 \times 10^5 \\ &\approx 1.27 \times 10^5 \end{aligned}$$

thermal energy needed =  $1.27 \times 10^5$  J

7 (a) A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

Weigh (M) a known number of marbles using the weighing balance. Fill the measuring cylinder with a known volume of water. Add the marbles and record the new volume. The change of volume reading gives the volume (V) of the marbles. Find the density by finding the ratio of mass and volume of the marbles ( $d=M/V$ ).

(b) A beaker contains 0.25 kg of water at room temperature.

The beaker of water is heated until the water reaches boiling point (100 °C).

The specific heat capacity of water is 4200 J/kg °C.

The total amount of thermal energy supplied to the water is 84 000 J.

(i) Calculate the temperature of the water before it was heated.

Use an equation selected from the list of equations at the end of this paper.

(3)

$$E = mc \Delta T$$

$$84000 = 0.25 \times 4200 \times \Delta T$$

$$\Delta T = \frac{84000}{4200 \times 0.25} = 80$$

$$100 - 80 = 20$$

temperature before heating = 20 °C



- (ii) The heating continues until 0.15 kg of the water has turned into steam.  
The thermal energy needed to turn the boiling water into steam is 0.34 MJ.

Calculate the specific latent heat of vapourisation of water.

Use an equation selected from the list of equations at the end of this paper.

(2)

$$E = mL$$

$$0.34 \times 10^6 = 0.15 \times L$$

$$L = \frac{340000}{0.15} = 2.26 \times 10^6 \approx 2.3 \times 10^6$$

specific latent heat = 2.3 MJ/kg

- (iii) The graph in Figure 13 shows how the **volume** of 1 kg of water changes with temperature.

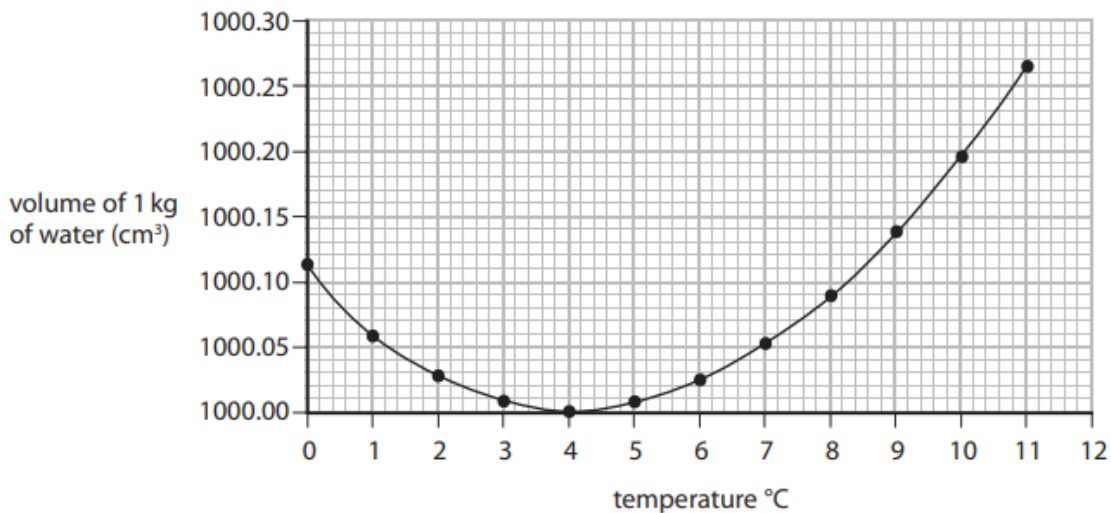


Figure 13

Describe how the **density** of water changes with temperature over the range of temperature shown in Figure 13.

Calculations are not required.

(2)

Density increases from 0 °C to 4 °C, reaching a maximum at 4 °C and decreases above 4 °C.

- 8 (a) Figure 14 shows an athlete using a fitness device.

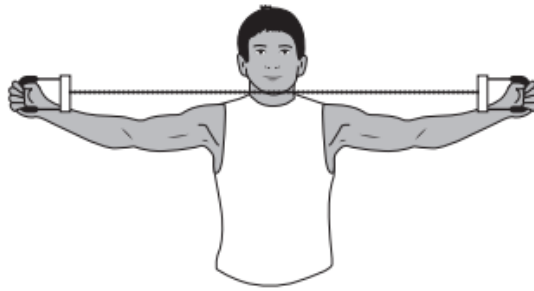


Figure 14

The athlete stretches the spring in the device by pulling the handles apart.

The spring constant of the spring is 140 N/m.

The athlete does 45 J of work to extend the spring.

The athlete takes 0.6 s to expand the spring.

- (i) Calculate the useful power output of the athlete when stretching the spring.

(2)

$$P = \frac{\text{work done}}{\text{time}}$$
$$= \frac{45}{0.6} = 75$$

useful power output of the athlete = 75 W

- (ii) Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

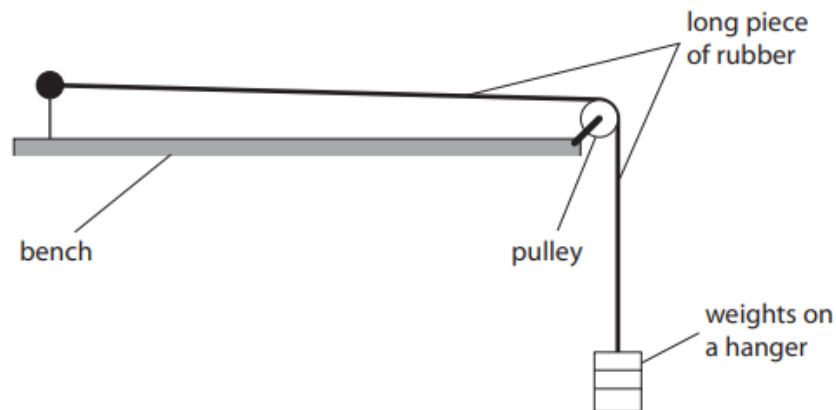
$$E = \frac{1}{2} k x^2$$
$$45 = \frac{1}{2} \times 140 \times x^2$$
$$x^2 = \frac{45 \times 2}{140}$$

$$x = 0.8017 \approx 0.8$$

extension of the spring = 0.8 m

(b) A student investigates the stretching of a long piece of rubber.

Figure 15 shows the apparatus to be used.



**Figure 15**

The student puts just enough weight on the weight hanger to make the piece of rubber just tight.

The student wants to plot a graph to show how the extension of the piece of rubber varies with the force used to stretch it.

The student adds a known weight to the weight hanger.

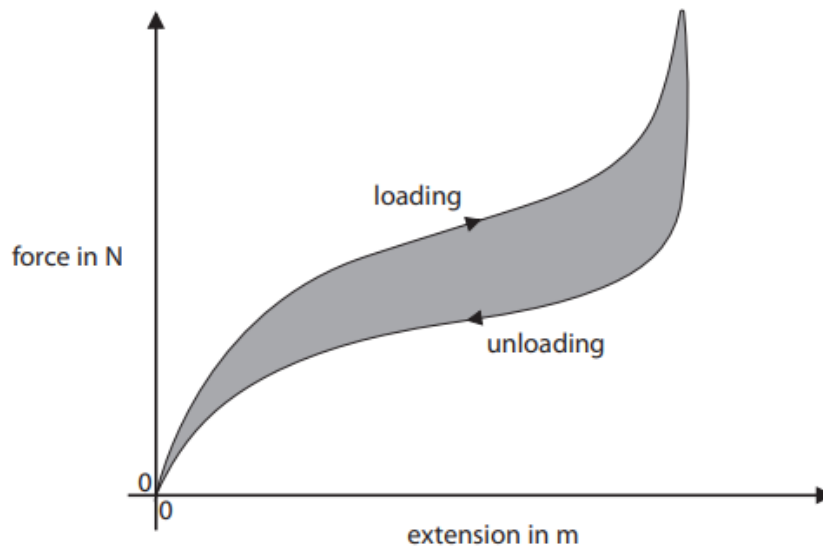
- (i) Describe how the student could measure the extension of the rubber when he adds another weight to the weight hanger.

(2)

Measure the initial distance of the rubber from the center of the pulley and the start of the weights. After adding the weight, use the same methodology to calculate the new distance. The difference between new distance and initial distance will be the extension.

- (ii) The student obtains a series of values of force and extension while loading the piece of rubber and then unloading it.

Figure 16 shows the graph of the student's values.



**Figure 16**

Explain how the shape of this graph shows that the distortion of the piece of rubber being stretched is different from the distortion of a spring being stretched.

(2)

The graph of rubber band is not directly proportional and the unloading graph does not go through the same points of the loading graph.

- (c) The area between the curve and the extension axis of a force/extension graph corresponds to work done or energy transferred.

Suggest what the shaded area of the graph in Figure 16 represents.

(2)

The difference of energy transferred between loading and unloading which is the energy dissipated to the surrounding as heat.

- 9 Figure 17 shows a crane lifting a concrete block from the bottom of a deep pool of water. The top of the block is a distance,  $h$ , below the surface of the water.

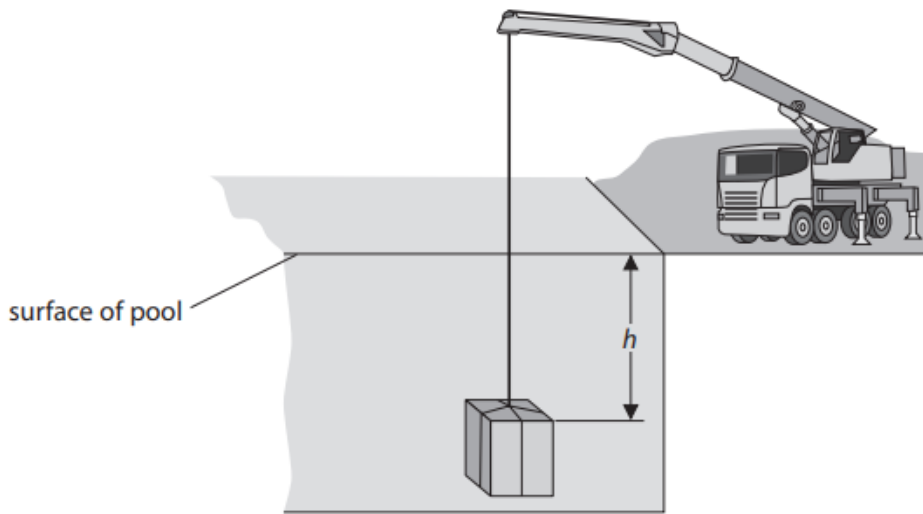


Figure 17

- (a) The force on the top of the block due to the water above it is 41 000 N.

The pressure due to the water on the top surface of the block is 66 000 Pa.

- (i) Calculate the area of the top surface of the block.

$$P = \frac{F}{A} = \frac{41000}{66000} = 0.621 \approx 0.62$$

$$66000 = \frac{41000}{A}$$

area of the top surface of the block = 0.62 m<sup>2</sup>

- (ii) The density of water is 1000 kg/m<sup>3</sup>.

Calculate the distance,  $h$ , between the top of the block and the surface of the water.

Gravitational field strength,  $g$ , is 10 N/kg.

Use an equation selected from the list of equations at the end of this paper.

$$P = h\rho g$$

$$66000 = h \times 1000 \times 10$$

$$= \frac{66000}{1000 \times 10}$$

$h = 6.6$  m

(iii) Explain why there is an upthrust produced by the water on the block.

(2)

The pressure exerted by the water on the bottom surface of the block is greater than the pressure on the top surface. Hence the force exerted on the bottom is larger than the top of the block, causing a resultant force upwards.

\*(iv) The crane raises the block until it is high enough out of the water to be loaded on to a lorry.

The block moves upwards at a constant speed even though the lifting force in the cable changes.

Figure 18 shows the graph of how the lifting force changes while the block is being raised.

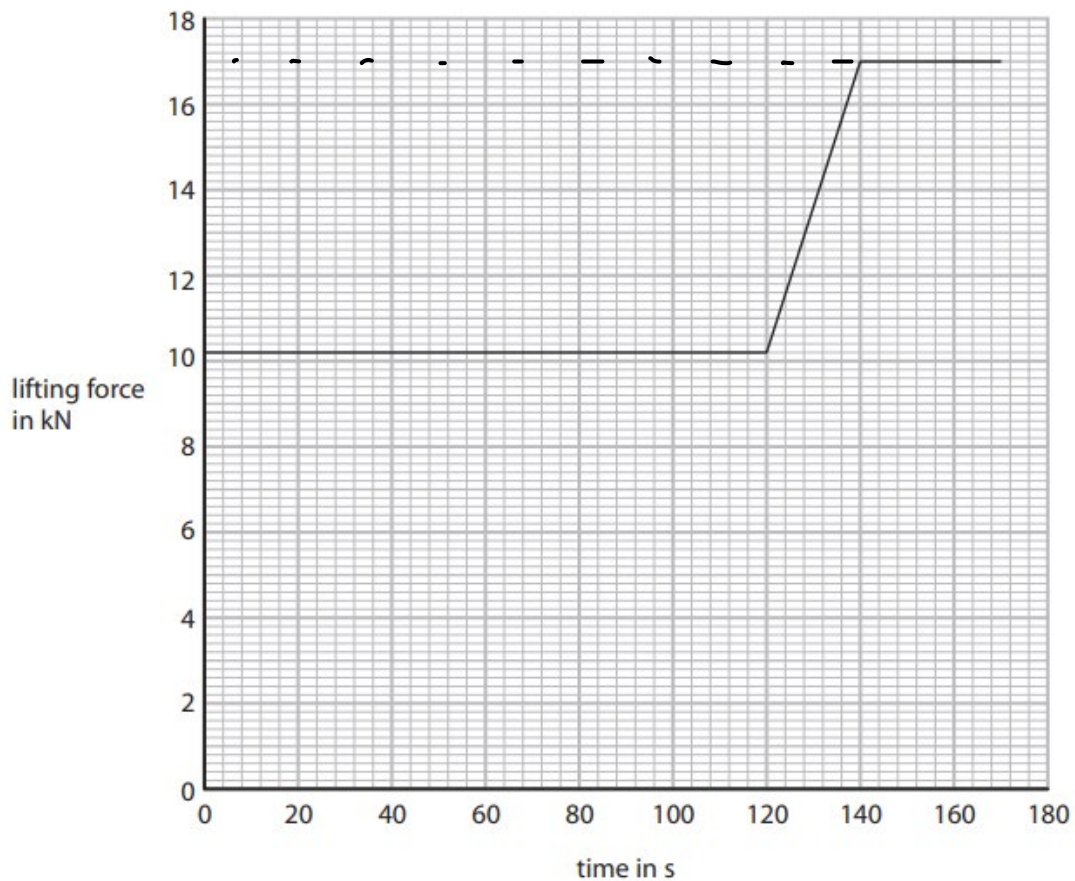


Figure 18

upthrust

Explain why the lifting force changes as shown on the graph in Figure 18. Include calculation(s) in your answer.

(6)

$$17 - 10.2 = 6.8 \text{ kN}$$

In the first 120 seconds the force required to lift the block is lower than the weight because there is an upthrust force of 6.8kN. The lifting force remains constant due to the upthrust remaining constant. During 120 and 140 seconds, the block is emerging from the water and the upthrust is decreasing. Therefore, the force in the cable increases during the 20 seconds the block takes to come out of the water. After 140 seconds, the block is completely out of the water and experience no upward force. The force in the cable is equal to the weight of the block and the force is constant as the weight is constant.

2 (a) Figure 4 shows a small piece of copper about 3 cm high.



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Figure 4

A student wants to determine the density of copper.

The student uses a balance to measure the mass of the piece of copper.

(i) Explain how the student could measure the volume of the piece of copper.

(3)

Measure the initial volume of water in a large measuring cylinder. Add the piece of copper into the measuring cylinder and measure the volume reading. The difference between the new reading and the initial reading is the volume of the copper.

(ii) The mass of the piece of copper is 0.058 kg.

The volume of the piece of copper is  $6.5 \times 10^{-6} \text{ m}^3$ .

Calculate the density of copper.

(2)

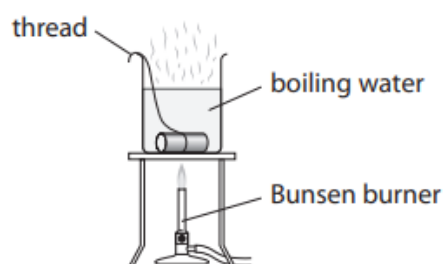
$$\begin{aligned} d &= \frac{m}{V} = \frac{0.058}{6.5 \times 10^{-6}} \\ &= 8923 \\ &\approx 8900 \end{aligned}$$

density of copper = 8900 kg/m<sup>3</sup>



(b) A student wants to determine the specific heat capacity of copper.

Figure 5 shows a piece of copper, with a thread tied around it, in a glass beaker of boiling water.



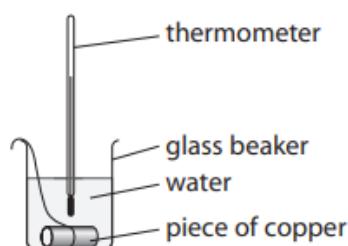
**Figure 5**

The student leaves the piece of copper in the boiling water so that the copper reaches a temperature of  $100^{\circ}\text{C}$ .

The student uses the thread to take the piece of copper out of the boiling water.

The student puts the hot piece of copper into a different beaker of cold water at  $20^{\circ}\text{C}$ .

The apparatus is shown in Figure 6.



**Figure 6**

The student assumes that the thermal energy gained by the water equals the thermal energy lost by the piece of copper.

The water and copper both reach a temperature of  $22^{\circ}\text{C}$ .

The cold water gains 1050 J of energy.

The mass of the piece of copper is 0.058 kg.

(i) Calculate a value for the specific heat capacity of copper, using these results.

Use the equation

change in thermal energy = mass  $\times$  specific heat capacity  $\times$  change in temperature

$$\Delta Q = m \times c \times \Delta\theta \quad (2)$$

$$1050 = 0.058 \times c \times (100 - 22)$$

$$1050 = 0.058 \times c \times 78$$

$$c = \frac{1050}{0.058 \times 78} = 232 \approx 230$$

specific heat capacity of copper from these results = 230 J/kg°C

(ii) The value for the specific heat capacity of copper obtained from the student's results is lower than the correct value.

State **two** ways that the experiment could be improved to give a value that is closer to the correct value.

(2)

- 1 Cover the cold water beaker with a lid during the cooling to reduce heat gain from the surrounding
- 2 When the copper is suspended, ensure it is not in direct contact with the bottom of the beaker.

6 Figure 14 shows a spring standing on a table.

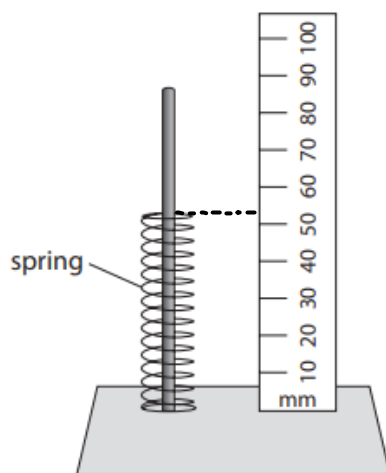


Figure 14a

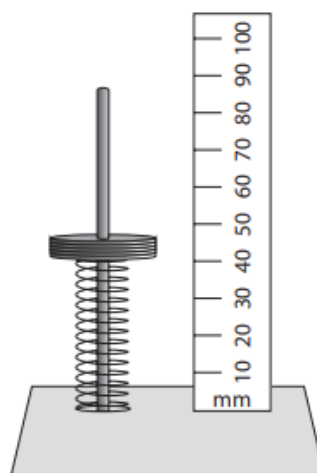


Figure 14b

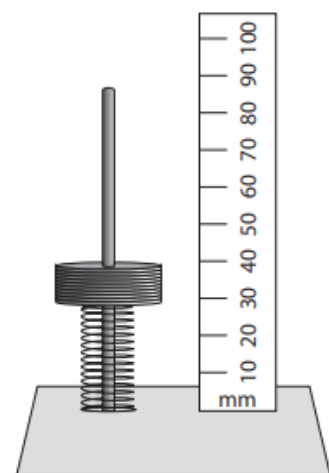


Figure 14c

Weights are added to the spring as shown in Figures 14b and 14c.

(a) (i) Estimate the original length of the spring as shown in Figure 14a.

(1)

original length = 53 mm

(ii) Describe how the reduction in the length of the spring when weights are added can be determined.

(2)

Measure the length ( $L_2$ ) of the spring after the weights are added.

Determine the reduction by subtracting  $L_2$  from the original length

(53).

(iii) State **two** ways that the experimental procedure could be improved.

(2)

1 Use a more length spring or a thicker spring to increase the number of readings.

2 Fix a pointer to the end of the spring to measure the length more accurately.

(iv) Give **one** reason why the reduction in length eventually reaches a limit as more weights are added.

(1)

Maximum spring compression has been achieved.

(b) A different spring is extended.

A force of 0.50 N gives an extension of 13 mm.

Calculate the spring constant  $k$  in N/m.

(3)

$$F = kx$$

$$0.50 = k \times \frac{13}{1000}$$

$$k = \frac{0.5 \times 1000}{13} = 38.46 \approx 38.5$$

spring constant  $k =$  ..... 38.5 ..... N/m

(c) Another spring is extended.

The work done to extend the spring is 0.14 J.

The spring constant of the spring is 175 N/m.

Calculate the extension of the spring.

Use an equation selected from the list of equations at the end of this paper.

(3)

$$E = \frac{1}{2} k x^2$$

$$0.14 = \frac{1}{2} \times 175 \times x^2$$

$$x^2 = 1.6 \times 10^{-3}$$

$$x = 0.04$$

extension of spring = ..... 0.04 ..... m

10 (a) Figure 25 shows four identical metal cans, each filled with water to the same level.

Each can has three tubes.

Water comes out of each tube.

Which of these shows the correct pattern of water coming out of the tubes?

(1)

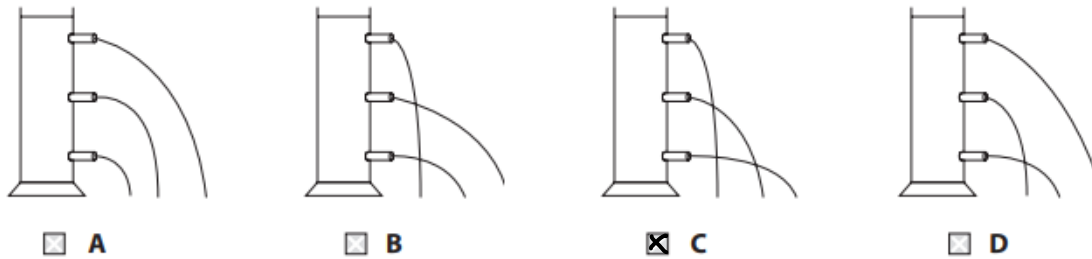


Figure 25

(b) Figure 26 shows a glass U-tube containing water of density  $1000 \text{ kg/m}^3$ .

The water levels are the same on both sides of the U-tube.

Both ends of the U-tube are open to the atmosphere.

Atmospheric pressure is  $101\,000 \text{ N/m}^2$ .

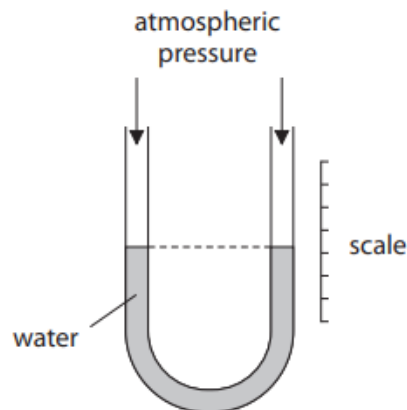


Figure 26

Figure 27 shows the U-tube with one side connected to a gas supply.

The difference in the levels of water,  $h$ , is  $0.200 \text{ m}$ .

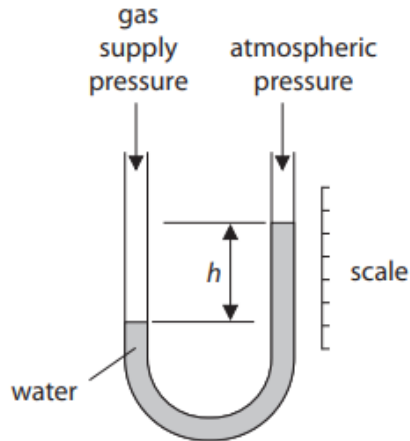


Figure 27

- (i) Calculate the gas supply pressure.  
Use an equation selected from the list of equations at the end of the paper.

(3)

$$\begin{aligned}
 P &= h\rho g \\
 &= 0.2 \times 1000 \times 10 \\
 &= 2000
 \end{aligned}$$

$$P_{\text{gas}} = 101000 + 2000$$

pressure of gas supply = 103000 N/m<sup>2</sup>

- (ii) The measurement is repeated using a U-tube of larger cross-sectional area.

Explain why the value of  $h$  does not change.

(2)

From the equation  $P=h\rho g$ , it is noticed that cross-sectional area does not affect the pressure due to a water column. Hence, using a U-tube with a larger cross-sectional area doesn't affect the height  $h$  as the same pressure difference is exerted.

