

**Combined Science**  
**PAPER 6**  
**Higher Tier**

Total Marks
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**Time: 1 hour 10 minutes plus your additional time allowance**

**In the boxes below, write your name, centre number and candidate number.**

<b>Surname</b>					
<b>Other names</b>					
<b>Centre Number</b>					
<b>Candidate Number</b>					

**YOU MUST HAVE**

**Calculator, ruler, protractor**

**YOU WILL BE GIVEN**

**Diagram Booklet**

**Equation Booklet**

**INSTRUCTIONS**

**Answer ALL questions.**

**Answer the questions in the spaces provided – there may be more space than you need.**

**Calculators may be used.**

**Any diagrams may NOT be accurately drawn, unless otherwise indicated.**

**You must show all your working out with your answer clearly identified at the end of your solution.**

## **INFORMATION**

**The total mark for this paper is 60.**

**The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.**

**In questions marked with an ASTERISK (\*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.**

**An Equation Booklet is provided.**

## **ADVICE**

**Read each question carefully before you start to answer it.**

**Try to answer every question.**

**Check your answers if you have time at the end.**

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**Answer ALL questions. Write your answers in the spaces provided.**

**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 (a) Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows the results from an experiment where the potential difference (voltage) across a filament lamp was varied.**

**The current and voltage were measured.**

- (i) Describe the relationship between the current and the voltage as shown in the graph in Figure 1.  
(2 marks)**

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**Turn over**

**1 continued.**

- (ii) Use the values of the voltage and current at point P and at point Q on the graph in Figure 1 to complete the table in Figure 2 for Question 1(a)(ii) in the Diagram Booklet.  
(2 marks)**

**(continued on the next page)**

**1 continued.**

- (iii) Calculate the resistance of the filament lamp when the voltage is 4.5 V and the current is 51 mA.  
(2 marks)**

**Use the equation**

$$R = \frac{V}{I}$$

**resistance = \_\_\_\_\_  $\Omega$**

**(continued on the next page)**

**1 continued.**

- (iv) Explain why the resistance of the filament lamp changes as the voltage across it increases.  
(3 marks)**

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

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- 2 (a) Describe, in terms of particles, TWO differences between a solid and a liquid of the same substance.**  
**(2 marks)**

**1** \_\_\_\_\_

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\_\_\_\_\_

**2** \_\_\_\_\_

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**(continued on the next page)**



**2 continued.**

**(b) Look at Figure 3 for Question 2(b) in the Diagram Booklet. It shows the dimensions of a solid block of concrete.**

**Density of concrete,  $\rho$ , = 2100 kg/m<sup>3</sup>.**

**Calculate the mass of the concrete block.  
(3 marks)**

**Use the equation**

$$m = \rho \times V$$

**mass of concrete block = \_\_\_\_\_ kg**

**(continued on the next page)**

**Turn over**

**2 continued.**

- (c) Look at Figure 4 for Question 2(c) in the Diagram Booklet. It shows a shed made mostly of concrete blocks.**

**State TWO practical ways to reduce heat loss from this shed.  
(2 marks)**

**1** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(continued on the next page)**

**2 continued.**

- (d) On a very cold day, the temperature of the air is  $-4^{\circ}\text{C}$ .**

**Calculate the value of this temperature on the kelvin scale.**

**(1 mark)**

**temperature = \_\_\_\_\_ K**

**(Total for Question 2 = 8 marks)**

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- 3 (a) A student uses plotting compasses to investigate the magnetic field between the poles of two bar magnets.**

**Look at Figure 5 for Question 3(a) in the Diagram Booklet. It shows ONE of the plotting compasses and ONE of the bar magnets.**

**The student places the two magnets on a piece of paper with a pole of one magnet a few centimetres away from a pole of the other magnet.**

**The student places 20 plotting compasses on the paper near the magnets.**

**Look at Figure 6 for Question 3(a) in the Diagram Booklet. It shows the direction in which each of the plotting compasses points.**

- (i) Draw two rectangles on Figure 6 to show the positions of the two bar magnets.**

**Label the N-pole and the S-pole of each magnet.**

**(2 marks)**

**(continued on the next page)**

**3 continued.**

- (ii) The student wants to determine the shape of the magnetic field for a larger area around the magnets.**

**Describe how the student should continue the investigation using just one plotting compass.  
(3 marks)**

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**3 continued.**

- (b) Two long, thin magnets are held with their N-poles facing each other.**

**The force,  $F$ , between the magnets can be calculated using the equation**

$$F = \frac{K}{d^2}$$

**where**

**$K$  is a constant value**

**$d$  is the distance between the magnets.**

- (i) The magnets are 4.0 cm apart.**

**The force between the magnets is 1.2 N.**

**Calculate the value of  $K$ .**

**State the unit.**

**(3 marks)**

**$K =$  \_\_\_\_\_ unit \_\_\_\_\_**

**(continued on the next page)**

**Turn over**

**3 continued.**

- (ii) The magnets are held the same distance apart but with the N-pole of one magnet now facing the S-pole of the other magnet.**

**The value of  $K$  does not change.**

**State how the force would compare with the force in part (i).**

**(1 mark)**

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**(Total for Question 3 = 9 marks)**

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- 4 (a) Two cyclists ride on a hilly road and go through points P, Q, R and S.

Look at Figure 7 for Question 4(a) in the Diagram Booklet. It shows how the vertical height of the road changes during the journey from P to S.

- (i) The greatest overall change in gravitational potential energy for each cyclist is between which two points on the journey?  
(1 mark)

☐ A P and Q

☐ B Q and R

☐ C P and S

☐ D R and S

(continued on the next page)



**4 continued.**

- (ii) The total weight of one cyclist and bicycle is 700 N.**

**Calculate the total amount of work done against gravity when the cyclist travels from point P to point Q in the journey.  
(2 marks)**

**work done = \_\_\_\_\_ J**

**(continued on the next page)**

**4 continued.**

- (iii) The gravitational potential energy of the other cyclist changes by 11 250 J when travelling from point Q to point R.**

**Calculate the mass of this cyclist.  
(2 marks)**

**Gravitational field strength = 10 N/kg**

**Use the equation**

$$\Delta \text{GPE} = m \times g \times \Delta h$$

**mass = \_\_\_\_\_ kg**

**(continued on the next page)**

**4 continued.**

- (iv) Explain why the total amount of work done by a cyclist between points Q and R is different from the change in gravitational potential energy of the cyclist between points Q and R. (2 marks)**

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**(continued on the next page)**

**4 continued.**

- (v) The cyclists lubricated the chains and the wheel bearings of their bicycles before setting off.**

**Lubricating the chains and wheel bearings helps to  
(1 mark)**

- ☐ **A decrease the amount of work done against gravity**
- ☐ **B decrease the efficiency of the cyclist and bicycle**
- ☐ **C increase the efficiency of the cyclist and bicycle**
- ☐ **D increase the overall amount of energy transferred by the cyclist**

**(continued on the next page)**

4 continued.

(b) The kinetic energy of another cyclist is 2800 J.

The mass of the cyclist is 85 kg.

Calculate the velocity of this cyclist.  
(3 marks)

Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

velocity = \_\_\_\_\_ m/s

(Total for Question 4 = 11 marks)

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- 5 A technician investigates different electrical devices that are used in a car.**

**The technician connects a device to the 12V car battery.**

**The technician measures the current in the circuit and the potential difference (voltage) across the device.**

**Look at Figure 8 for Question 5 in the Diagram Booklet. It shows the car battery and the device that is being tested.**

- (a) (i) Draw on Figure 8 to show how the circuit should be completed so that the current in the circuit and voltage across the device can be measured.  
(2 marks)**

**(continued on the next page)**

**5 continued.**

**(ii) The technician tests a headlamp.**

**The current in the headlamp is 4.8A when connected to the 12V battery.**

**Calculate the power supplied to the headlamp.  
(2 marks)**

**power = \_\_\_\_\_ W**

**(continued on the next page)**

**Turn over**

**5 continued.**

**(iii) The technician tests an interior light.**

**The current in the interior light is 600 mA when connected to the 12 V battery.**

**Calculate the energy transferred to the interior light in 7 minutes.**

**Use an equation selected from the Equation Booklet.  
(2 marks)**

**energy transferred = \_\_\_\_\_ J**

**(continued on the next page)**



**5 continued.**

- (b) The technician connects four devices to the car battery.**

**Each device is connected to its own switch and its own fuse.**

**Look at Figure 9 for Question 5(b) in the Diagram Booklet. It shows how the four devices, fuses and switches are connected.**

**The current in each device is shown next to the device.**

- (i) Calculate the current in the wires to the battery when all the devices are switched on.  
(1 mark)**

**current = \_\_\_\_\_ A**

**(continued on the next page)**

**5 continued.**

- (ii) State how the overall resistance of the circuit changes when any one of the devices is switched off.**  
**(1 mark)**

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- (iii) There is a current of 2.3A in the radio when the radio is working correctly.**

**Which of these should the technician choose to protect the radio circuit?**  
**(1 mark)**

- ☐ **A 2A fuse**
- ☐ **B 5A fuse**
- ☐ **C 10A fuse**
- ☐ **D 13A fuse**

**(continued on the next page)**

**Turn over**

**5 continued.**

- (iv) Explain why the wires to the battery in a car are thicker than the wires that connect each device to its switch and its fuse.  
(2 marks)**

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**(Total for Question 5 = 11 marks)**

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- 6 (a) An electric kettle contains 1.41 kg of water at 25°C.

The kettle is switched on.

After a while, the water reaches boiling point at 100°C.

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

- (i) Calculate the amount of thermal energy supplied to the water by the kettle.

Give your answer to the appropriate number of significant figures.

Use an equation selected from the Equation Booklet.

(3 marks)

energy supplied = \_\_\_\_\_ J

**6 continued.**

- (ii) The kettle is kept switched on and the water continues to boil.**

**After a while, the mass of the water in the kettle has decreased to 1.21 kg.**

**The thermal energy supplied to the water during this time was 450 000 J.**

**Calculate the specific latent heat of vaporisation of water.**

**Use an equation selected from the Equation Booklet.**

**(3 marks)**

**specific latent  
heat of vaporisation = \_\_\_\_\_ J/kg**

**(continued on the next page)**

**Turn over**

**6 continued.**

**\*(b) This question is about determining the specific heat capacity of aluminium.**

**Look at Figure 10 for Question 6(b) in the Diagram Booklet. It shows an aluminium block placed in boiling water.**

**The piece of string is tied to the aluminium block so the block can be transferred from the boiling water to the cold water.**

**Describe how a student could use this apparatus, and any additional items needed, to determine the specific heat capacity of aluminium.**

**Your answer should include how the student would**

- obtain the necessary measurements**
- use the measurements to calculate the specific heat capacity of aluminium.**

**(6 marks)**

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**Turn over**

**6 continued.**

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**Turn over**

**6 continued.**

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**(Total for Question 6 = 12 marks)**

**TOTAL FOR PAPER = 60 MARKS**  
**END OF PAPER**