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Draw a cross through the box (☒) if you have NOT written in this booklet

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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Physics, Earth and Space Science 2024

92047 Demonstrate understanding of a physical system using energy concepts

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of a physical system using energy concepts.	Explain a physical system using energy concepts.	Analyse a physical system using energy concepts.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Pull out Resource Booklet 92047R from the centre of this booklet.

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement TOTAL 08

QUESTION ONE: ENERGY CHANGES

Janet drops a tennis ball from the top of a building.

(a) Describe the energy changes (transfer) that take place as the ball falls down.

Before Janet drops the ball, the ball has gravitational potential energy. Then, when Janet drops the ball, that gravitational potential energy transfers into kinetic energy.

(b) The mass of the tennis ball is 0.0585 kg. The tennis ball falls through a height of 14.7 m.

Show that the gravitational potential energy the ball loses as it falls to the ground is 8.6 J.

$E_p = m g \Delta h$

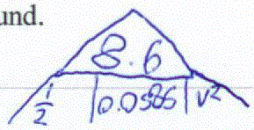
$= 0.0585 \times 10 \times 14.7 = 8.5995$, round up is 8.6 J

(c) Calculate the speed with which the ball hits the ground.

$E_p = E_k$

$E_k = \frac{1}{2} m v^2$

$E_k = 8.6$



$v^2 = 8.6 \div (\frac{1}{2} \times 0.0585) = 294.02$

$\sqrt{294.02} = 17.15\ s^{-1}$

(d) In reality, the speed of the ball when it hits the ground is not the same as what was calculated in part (c) above.

Explain the reason for this difference, including a statement whether the speed was more or less than what was calculated above.

The speed of the ball would not be the same as what was calculated above due to the ball being effected by friction. The ball would lose energy due to friction and produce wasteful energy such as heat and sound.

(e) Janet's friend Maya retrieves the ball from the ground and runs up two flights of stairs, covering a total height of 15 m. Maya has a mass of 48 kg and she takes 34.2 seconds to reach the top.

Calculate the power.

- Begin your answer by describing the meaning of power and how it relates to Maya running up the stairs.
- State any assumptions you make.
- Include a unit with your answer.

Power is the amount of energy it takes for an object to preform a task.

$W = Fd = 48 \times 15 = 720$

$P = W \div t$

$= 720 \div 34.2 = 21.05$ J

I am assuming that Maya isn't taking any breaks when running up the flight of stairs.

QUESTION TWO: THERMAL ENERGY

Oliver wants to be able to keep his water cool the whole day while he is at school. Firstly, he tries freezing a bottle of water to take to school. Over the day, Oliver finds that it takes a long time for the ice to melt. Once the ice has melted, the water gets to room temperature quite quickly.

The specific heat capacity of water $= 4200 \text{ J kg}^{-1}$
The latent heat of fusion $= 334\,000 \text{ J kg}^{-1}$
Mass of water in the bottle $= 0.750 \text{ kg (750 mL)}$

(a) What does the term 'latent heat of fusion' mean?

Latent heat of fusion is the amount of heat energy needed to turn a solid into a liquid

(b) Calculate the heat energy required for 0.750 kg of water to change state from solid to liquid.

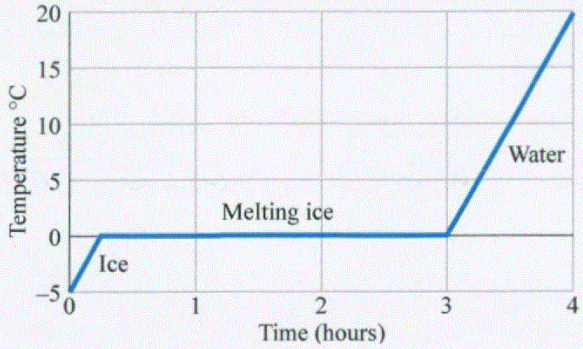
$E_{thermal} = mL$

$= 0.750 \times 334\,000 = 250\,500 \text{ J kg}^{-1}$

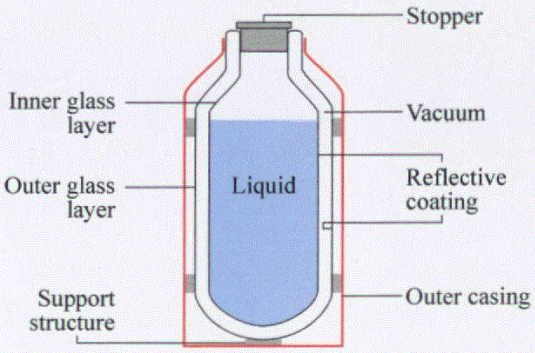
(c) The temperature against time graph below shows what happens to ice when taken out of the freezer.

Use the information provided opposite and the graph below to describe the reason why it takes a longer time for the ice to completely melt, and a much shorter time for the melted water to get to room temperature.

Temperature against time graph for ice left outside



(d) Oliver next decides to try using a Thermos that holds the same volume of water as his earlier bottle. The Thermos flask is also known as a vacuum flask. It is a double-walled glass vessel that is designed to minimise heat transfer by keeping hot things hot, and cold things cold.



Describe TWO key features of a Thermos that reduce heat transfer, and explain the type of heat transfer each feature is designed to reduce.

1.

2.

(e) Oliver decides to test his Thermos, and finds that at the start of the day, the temperature of the water is 5 °C. Five hours later, he finds the temperature has risen to 12 °C.

Show that the average rate of thermal energy absorption of the water in the Thermos over the five hours is approximately 1.2 W.

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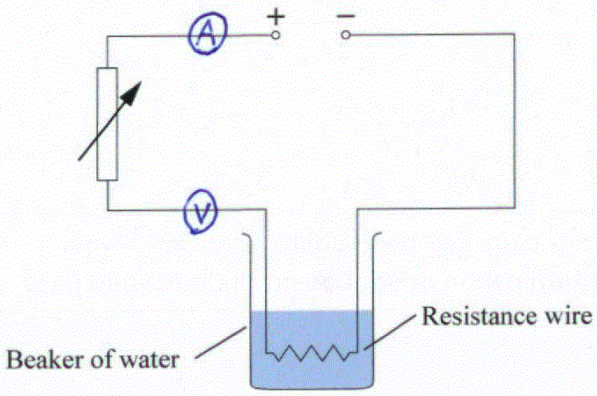
The examination continues on the following page.

QUESTION THREE: ELECTRICITY

Tane is studying the relationship between current, voltage, and resistance. He uses a power supply, a variable resistor, and a piece of resistance wire submerged in a beaker of water. He connects the components as follows:

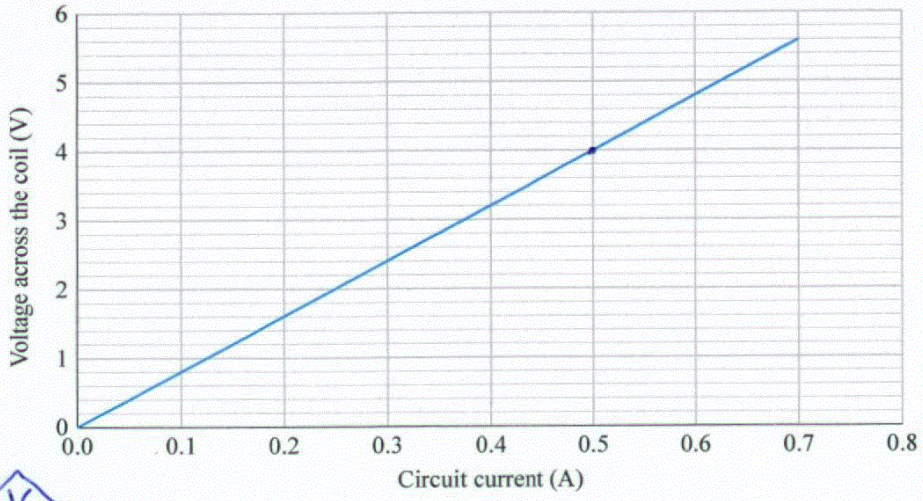


(a) In the above diagram, include an ammeter to measure the circuit current and a voltmeter to measure the voltage across the coil of wire.

(b) The following graph shows the relationship between voltage and current.

Using information from the graph, calculate the resistance of the coil and include an appropriate unit.

Show your working clearly.



V
I R

R = V ÷ I

= 4 ÷ 0.5 = 2 Ω

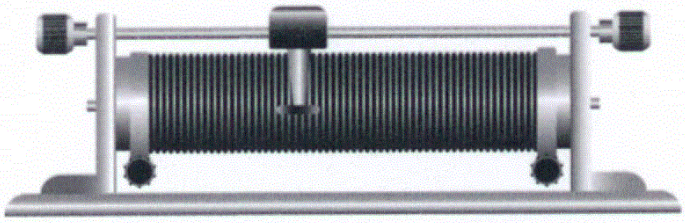
(c) Give a reason why the wire is submerged in water during the experiment.

(d) Using the data from the graph, what is the maximum rate of electrical potential energy being used?

Include units with your answer.

Question Three continues on the following page.

(e) One of the components in the circuit is a variable resistor.



https://stock.adobe.com/nz/search?k=%22variable%20resistor%22

Explain how the variable resistor is used, and analyse the effect it has on both the current and the voltage for components in the circuit, as the resistance is increased.

A variable resistor is used to control the resistance of a circuit. When the resistance on the variable resistor is increased, it weakens the current due to the higher resistance. Also, when the variable resistor is increased, it also lowers the voltage.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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QUESTION NUMBER

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Achievement

Subject: Physics, Earth and Space Science

Standard: 92047

Total score: 8

Q	Grade score	Marker commentary
One	4	Transfer of energy from gravitational potential to kinetic is stated. This candidate has shown the correct calculation for the gravitational potential energy. The speed that the ball hits the ground is shown. There is no indication if the ball is faster or slower once air resistance is considered. The calculation of work and power is incorrect along with the definition of power.
Two	2	A definition of latent heat is provided. Calculation of amount of energy required is correct. No further evidence is given in this question.
Three	2	The ammeter in the circuit is correct. Although the numbers are correct, the resistance calculated is incorrect. The effect of changing the variable resistor on the current is suggested.