SUPERVISOR'S USE ONLY

1

92047

920470

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

+

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.

Merit

TOTAL 14

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.

As janet drops the tennis ball from the top of the building the tennis balls E_p changes to E_k. Halfway down the building the E_p and E_k will be equal. At the bottom, ~~all~~ Ground level, all E_p will be transferred to E_k.

(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.

$GPE = mgh$

$GPE = 0.0585\,kg \times 10 \times 14.7$

$GPE = 8.5995$

$GPE = E_p$

$E_p = 8.5995 (8.6)\,J$

As the ball falls to the ground it 8.6J of E_p is transferred to E_k.

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

$v = \sqrt{\frac{2 \times E_k}{m}}$

$v = \sqrt{\frac{2 \times 8.6}{0.0585}}$

$v = 17.15\,m/s^{-1}$

(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.

A reason the speed was not accurate above is because as the tennis ball falls E_p changes to E_k plus heat energy. Some E_p would transfer to heat energy when the ball falls. For example if the ball lost 1J of E_k to heat energy this means the equation would be $v = \sqrt{\frac{2 \times 7.6}{0.0585}}$ This would equal $16.12\,m/s^{-1}$. This means the speed is less than cauculated in part (c).

(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.

The meaning of power is how much eletrical force is used. It relates to maya running up the stairs because she has energy.

$\Delta E = Pt$ $\Delta E = E_p$

$P = \Delta E \div t$ $E_p = m \times g \times h$

$P = \Delta E \div 34.2$ $E_p = 48 \times 10 \times 15$

$P = 7200 \div 34.2$ $E_p = 7200J$

$P = 210.53pW$

An Assumtion I make is that after travelling up the two flights of stairs the power of 210.53w is equalivent to mayas pulse.

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 J kg^{-1}
The latent heat of fusion = 334 000 J kg^{-1}
Mass of water in the bottle = 0.750 kg (750 mL)

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

The term "latent heat of fusion" means the energy required to fuse together substances. In this example to fuse water and ~~ice~~ the melted ice (water) it requires 334,000J kg^{-1}.

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

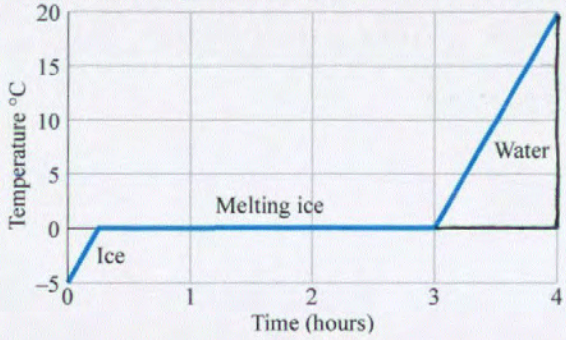
~~E(thermal) = mc Δt~~
~~E(thermal) = 0.75 x 4200 x Δt~~
~~E(thermal) = 3150 Δt~~

E(thermal) = mL
E(thermal) = 0.75 (334,000)
E(thermal) = 250,500 J

(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.

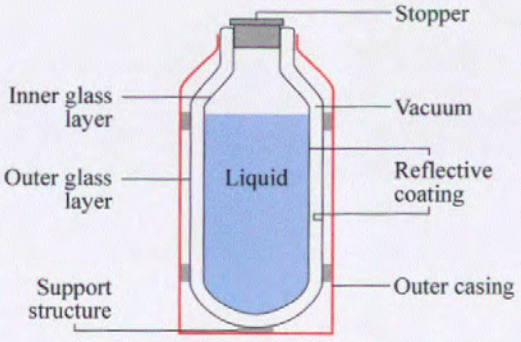
Temperature against time graph for ice left outside



~~E(thermal) = mc Δt~~ The water heats to room temperature
~~E(thermal) = 0.75 x 4200 x 3~~ ~~because~~ quickly once the ice
~~E(thermal) = 9450J~~ has melted because of heat transfer.
The cold particles which are within the ice are slow
and close together. When these particles are melting

(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. Reflective coating, This works by reflecting particles back at the substance using radiation. The reflective coating will keep the cold or hot particles inside and when they try to transfer reflect them back.
2. Stopper. The stopper called could also be called a lid. this provides insulation as the particles do not have a way to escape this minimizes heat transfer by keeping the particles inside the bottle.

(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.

$E(\text{thermal}) = mc\Delta t$

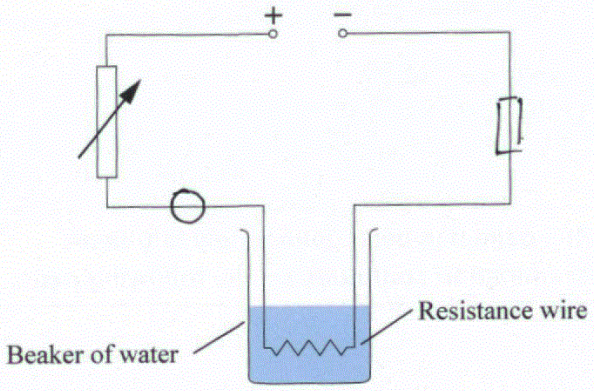
$E(\text{thermal}) = 0.75 \times 4200 \times 7$

$E(\text{thermal}) = 22{,}050\ \text{J}$

This page has been deliberately left blank.
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:

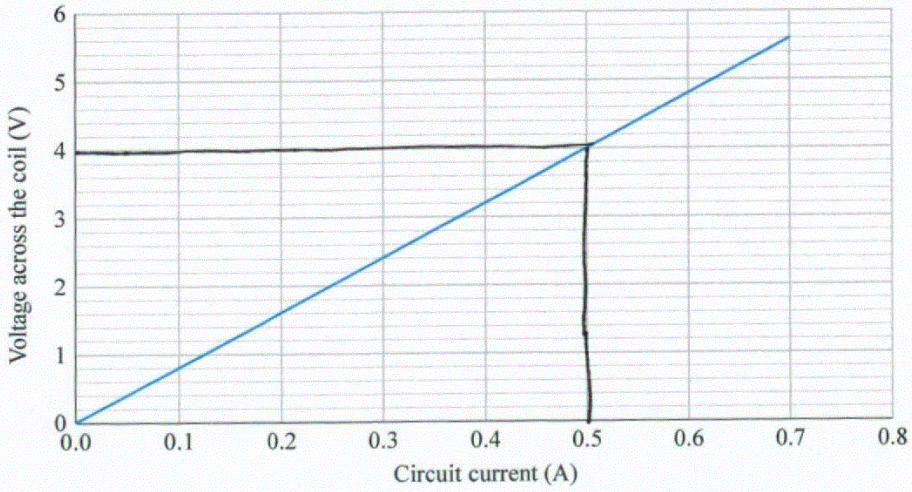


(a) In the above diagram, include an ammeter to measure the circuit current and a voltmeter to measure the voltage across the coil of wire.

(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.



Relationship between volts and current = $\frac{\text{Rise}}{\text{Run}}$

$= \frac{0.5}{4}$

$= 0.125$

0.125 (A) : 1 (V)

$V = IR$

$R = V \div I$

$R = 5.5 \div 0.7$

$R = 7.86\,\Omega$

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

The wire is submerged because water is a conductor of electricity. This because the resistance wire is mesaured at 7.86 so since the water is a good conductor of electricity it is buld eletrical current around the resistance wire.

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

Include units with your answer.

$\Delta E = Pt$ $P = VI$

$\Delta E = 3.85t$ $P = 5.5 \times 0.7$

$P = 3.85$

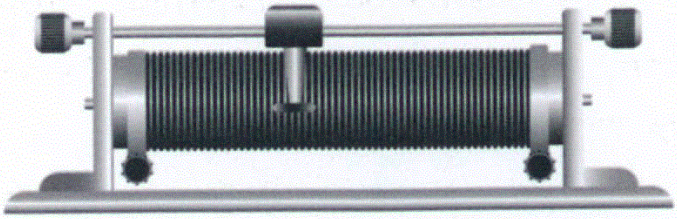
In one second $\Delta E = 3.85w$

one ~~hour~~ minute $= \Delta E = 231w$

one hour $= \Delta E = 13860w$

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 current of the circuit. It is a rëstor you can adapt, change, and control. The effect it has on the current is it would be able to increase or decrease the Amps(I) and the effect it has on the voltage is it requires volts to turn into power. As the resistance is increased thes means the current would decrease and the volts would increase because the current is further apart meaning more voltage in each amp.

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

QUESTION NUMBER

they transfer to the warmer particles of the water. This heats the ice up to make the particles faster and cools the water down. The water then heats to room temperature quickly once the ice has melted because there is no more cold, slow and compact particles from the ice being transfered to the water.

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

QUESTION NUMBER

92047

Merit

Subject: Physics, Earth and Space Science

Standard: 92047

Total score: 14

Q	Grade score	Marker commentary
One	6	Candidate has explained the transfer of energy from E_p to E_k. Candidate has shown how to calculate the E_p. Candidate has calculated the velocity of the ball just before it hits the ground. Candidate has identified that some E_p is lost to heat energy but has not explained exactly where the heat energy comes from. Candidate has calculated the energy and power correctly but has not given an adequate definition of power and has not identified an assumption for this energy transformation to be calculated.
Two	5	A definition of latent heat of fusion is at the Achieved level. Candidate has calculated the heat energy required for 0.750kg of water to change from a solid to a liquid. An explanation of the temperature time graph is not given using ideas of specific and latent heat. Although the type of heat transfer is given the explanation for radiation is incorrect. This candidate has correctly calculated the energy absorbed but has not gone on to calculate the power required.
Three	3	The voltmeter or ammeter on the first circuit are not labelled. The resistance of this circuit is calculated incorrectly on the right, but a good attempt has been made on the left. The reason to submerge the wire in water is incorrect. Candidate has calculated the power correctly in the first three lines. They have left out the correct unit.