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92047



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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Physics, Earth and Space Science 2025

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 the margins (▨▨▨▨). This area will be cut off when the booklet is marked.

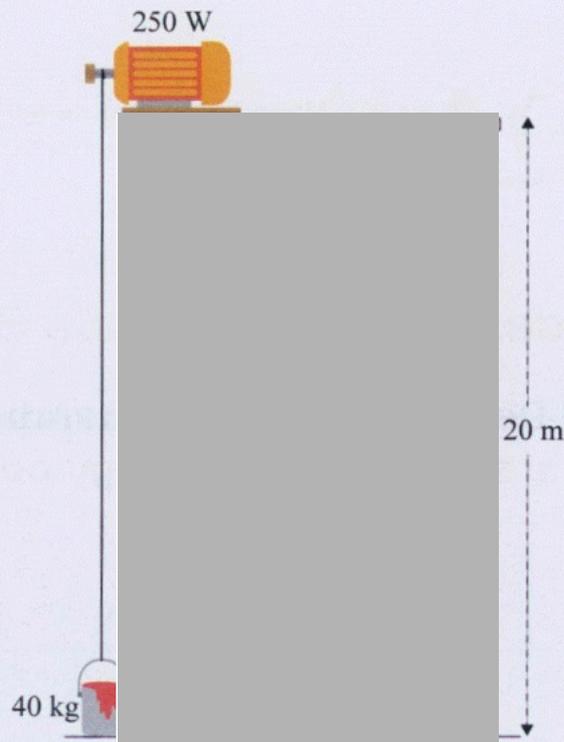
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 16

QUESTION ONE: LIFTING A PAINT POT

A paint pot is attached to a very light rope. A painter uses a 250 Watt electric motor to lift a 40 kilogram paint pot up the side of a 20 metre building from the ground. It takes 35 seconds to lift the pot from the ground to the top of the building.



Adapted from: https://img.pikbest.com/png-images/qiantu/city-cartoon-vector-building-mbe-style-apartment-house_2583356.png!sw800

- (a) Describe the energy changes as the motor lifts the paint pot up the side of the building.

Electrical energy \rightarrow Kinetic energy \rightarrow gravitational potential energy

- (b) Compare the amount of energy provided by the motor with the gain in gravitational potential energy of the paint pot when it is at the top of the building.

In your answer, you should:

- consider the amount of electrical energy provided by the motor
- consider the amount of gravitational potential energy gained by the paint pot from the ground to a height of 20 m
- explain why there is a difference between these two numbers.

$$\Delta E = P \times t \quad 250 \times 35 = 8750 \text{ Joules}$$

$$E_p = mgh \quad 40 \times 10 \times 20 = 8000 \text{ Joules}$$

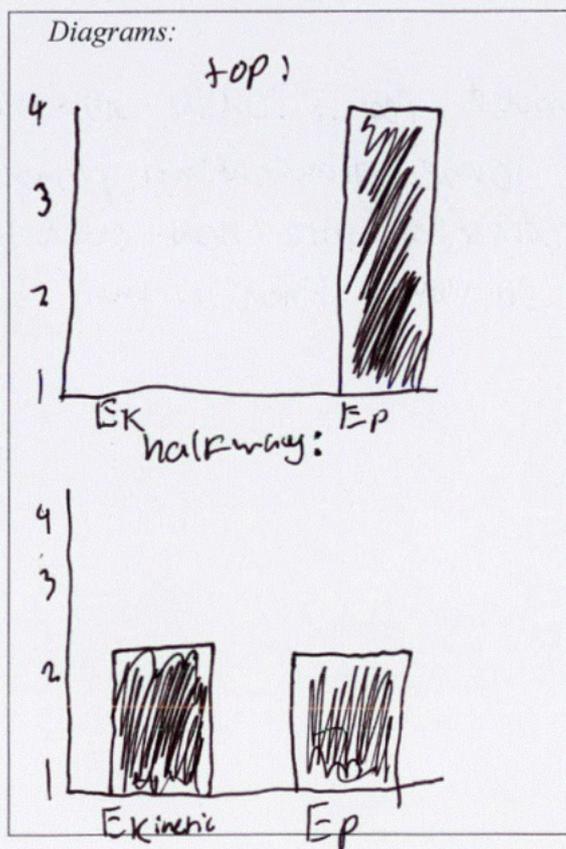
there is a difference because they two different types of energies.

electrical energy is based on the power output while gravitational potential is based on the ~~weight~~ weight, height and gravity.

- (c) The paint pot is at the top of the building and the rope breaks.

Discuss the energy transfer of the paint pot from the top of the building to when it is halfway down.

You may use diagrams or words (or both) for your answer.



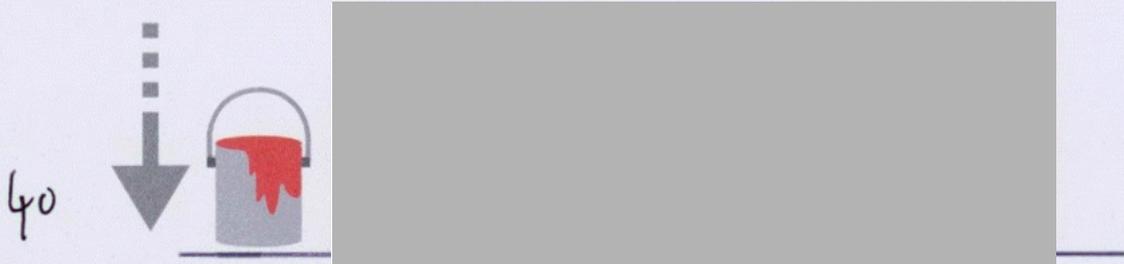
The energy of the paint pot turns from gravitational potential to kinetic as it falls and gets more speed.

- (d) The paint pot falls from 20 m.

Discuss the speed of the paint pot just before it hits the ground.

In your answer, you will need to:

- calculate the maximum speed at which the paint pot hits the ground
- include any assumptions you have made in this calculation
- explain why the paint pot will not reach this speed.



$$E_k = \frac{1}{2}mv^2$$

$$v = \sqrt{E_k \div (\frac{1}{2} \times m)}$$

$$v = \sqrt{8000 \div (\frac{1}{2} \times 40)}$$

$$v = 20 \text{ ms}^{-1}$$

$$E_p = mgh$$

$$40 \times 2000$$

This is assuming that there's no wind, ^{and} all of the gravitational potential energy is converted into kinetic energy.

But the pot would realistically not reach this speed because some gravitational potential energy would get converted into heat and sound energy so it would be slower than 20 ms^{-1}

QUESTION TWO: KEEPING WARM

Loa is in the lounge and feeling cold. She connects a convection heater to the power supply and switches it on. Loa places the heater in the room and notices the temperature of the air begin to rise.



- (a) Compare the concepts of temperature and heat energy.

heat energy is that the total amount of heat energy in ~~the room~~ something. But temperature is the average amount of heat energy in something.

- (b) Loa notices the maximum power rating for the heater is 2000 W.

The voltage supply in her house is 240 V.

She sets the dial to **50% maximum**.

Calculate the current in the heater circuit.

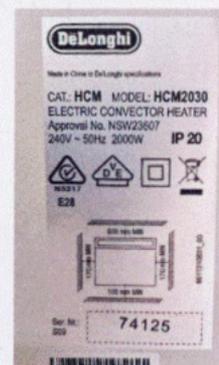
Include the correct units.

$$P = VI$$

$$I = P \div V \quad 2000 \div$$

$$I = (2000 \div 2) \div 240$$

$$I = 4.17 \text{ amps}$$



- (c) Loia turns the dial on the heater, which increases the current in the heater.

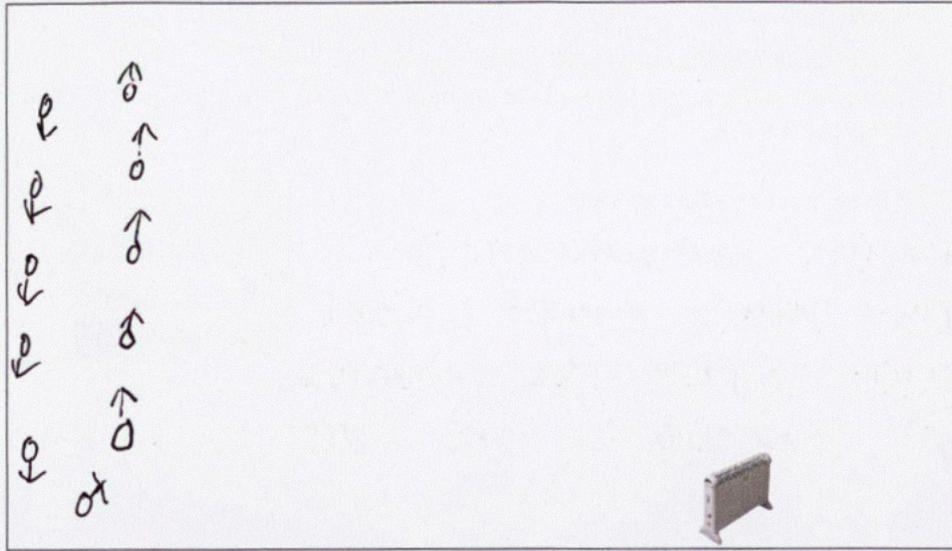
Discuss how an increase in current in the circuit affects the amount of thermal energy released by the heater.

Use relevant formulae to support your answer; calculations are not required.

Because current is the push of a circuit it'll work faster if the amps are increased so more thermal energy is being released.

$P = VI$ so if more amps then more power and the heater will work more and release more thermal energy.

- (d) In the space below, draw a labelled diagram showing how the air particles move as a result of the heater heating the air.



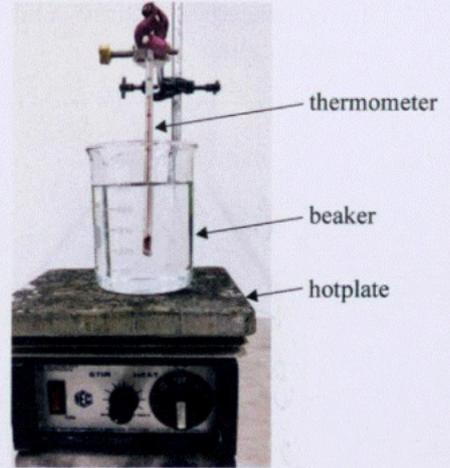
Discuss particle movement in various parts of your diagram, and how this results in the pattern you have drawn in your diagram.

When the heater ~~put~~ releases thermal energy, it heats up the air particles which make them less dense and they rise up whilst the colder more dense air particles fall down where they heat up and then rise again.

QUESTION THREE: HEATING WATER

Cecelia uses the equipment shown to measure the specific heat capacity (c) of water.

She puts 0.5 kg of water in a beaker on a hotplate to heat the water. The voltage of the hotplate is 24 V, and the current provided to the hotplate is 5.0 A.



- (a) Define the term **specific heat capacity**.

Specific heat capacity is how much energy it would take to raise the temperature of something by one degree.

1 kg or

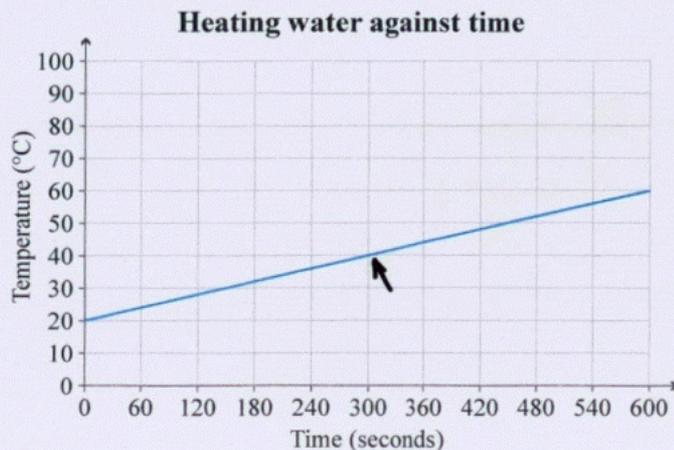
- (b) Show that the electrical energy used by the hotplate over 10 minutes (600 seconds) is 72 000 J.

$$P = VI \quad \Delta E = P \times t$$

$$P = 24 \times 5 \quad \Delta E = 120 \times 600$$

$$P = 120 \text{ W} \quad \Delta E = 72000 \text{ J}$$

- (c) Cecelia graphs the increase in water temperature over time, and obtains the following result.



- (i) Calculate Cecelia's value for the specific heat capacity gained from her results over 10 minutes.

In your answer, you should:

- consider the electrical energy is 72 000 J
- use the graph to find the change in temperature over 10 minutes
- then calculate Cecelia's value for the specific heat capacity of water.

Include the correct unit in your final answer.

$$E_{\text{thermal}} = mc \times \Delta T \quad 60 - 20 = 40^{\circ}\text{C}$$

$$c = E_{\text{thermal}} \div (m \times \Delta T)$$

$$c = 72000 \div (0.5 \times 40)$$

$$c = 3600 \text{ J/kg}^{\circ}\text{C}$$

- (ii) Cecelia then compares her value with the one in the textbook.

Discuss why her value and the textbook value are different.

Maybe her thermometer isn't working properly or the hot plate. Maybe she didn't measure amount of water properly.

Maybe thermometer

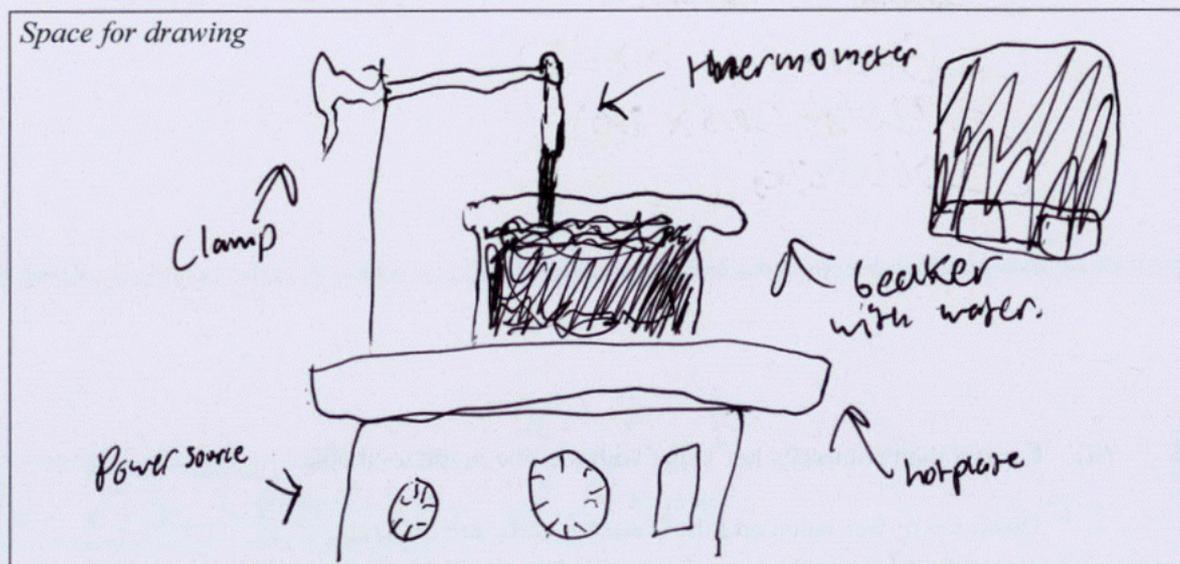
Question Three
continues on the
following page.

- (d) Cecelia's value for the specific heat capacity of water is different from the value given in a textbook.

Discuss how she could improve this experiment to get a more accurate result.

In your answer, you will need to:

- draw a labelled diagram showing an experimental setup with ONE suggested improvement
- explain why this change would give you a more accurate answer
- discuss the idea of heat transfer linked to this improvement.



have the thermometer higher up
to make sure it doesn't touch the
bottom because it would measure the
temp of the hot plate and not the
water.

Merit

Subject: L1 Physics, Earth and Space Science

Standard: 92047

Total score: 16

Q	Grade score	Marker commentary
One	6	<p>Correct description of energy loss and calculation of energy used by motor and gravitational energy gained. However, this student did not explain why these two values differ.</p> <p>No mention that E_p transfers to E_p plus E_k plus E_T.</p> <p>The calculation for the velocity at the bottom of the building was calculated correctly, however, the assumptions around why this value would be a maximum was incorrect, and there was no mention of air particles hitting the bottom of the pot.</p>
Two	5	<p>The concepts of temperature and heat energy were not explained.</p> <p>The current, with correct unit, was calculated correctly for the heater set at 50%.</p> <p>A discussion around how an increase in current would affect the thermal energy was started using the correct equation. However, the link between power and energy using $E = Pt$ was not given.</p> <p>In the discussion of convection currents, there was no labelled diagrams, but this student did mention a change in density to explain air rising and falling.</p>
Three	5	<p>A definition of specific heat capacity was stated, as well as showing the electrical energy produced by the hotplate was 72 000 J. This included equations and correct substitutions.</p> <p>The specific heat capacity for this experiment was calculated correctly, but the unit for c was incorrect.</p> <p>For a way to explain the difference in the two values, incorrect equipment was mentioned, but there was no follow-on from this.</p> <p>An improvement to this experiment was mentioned, however there was no link to heat transfer.</p>