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92047

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Draw a cross through the box (☒)
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NZQA

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.

Excellence   TOTAL **21**

QUESTION ONE: LIFTING A PAINT POT

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

250 W

20 m

electric → grav + kinetic.

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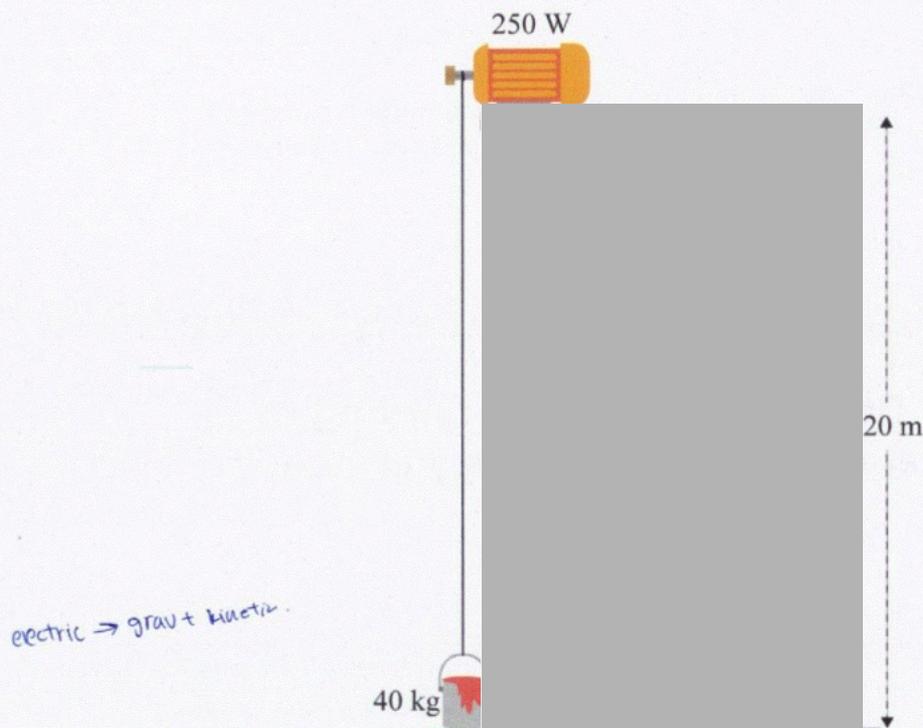
Adapted from: https://img.pikbest.com/png-images/qiantu/city-cartoon-vector-building-mbe-style-apartment-house_2583356.png!sw800

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

⊕ Electrical

The ~~gravitational~~ energy changed to kinetic energy and gravitational energy because the motor lifs the paint pot up the side of the building, and some energy was lost to heat and sound energy

(b) Compare the amount of energy provided by the motor with the <u>gain in gravitational potential</u> 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.

Electrical energy is provided by the motor

$$\Delta E = pt$$
$$= 250 \times 35 \qquad \Delta E = 8750 \text{ J}$$

Gravitational potential energy gained by the paint pot from the ground to a height of 20m

$E_p = mg \Delta h$
= 40 × 10 × 20
= 8000

8750 - 8000 = 750J
↳ friction / air resistance

There is a difference between these two numbers because of the friction and air resistance. Electrical energy provided by the motor didn't fully turned into gravitational energy by the paint and occur energy lost, and friction While ~~the~~ the motor was lifting up the paint pot, the air resist the energy. Also, the energy from the motor made energy lost, such as heat and sound energy, that is why it ~~~~ didn't fully transfer to gravitational energy.
↳continue in spare paper

(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.

Diagrams:

250W
~~350W~~
~~350W~~

40 kg

17.5 s

10m

40 kg

10m   20m

17.5 s
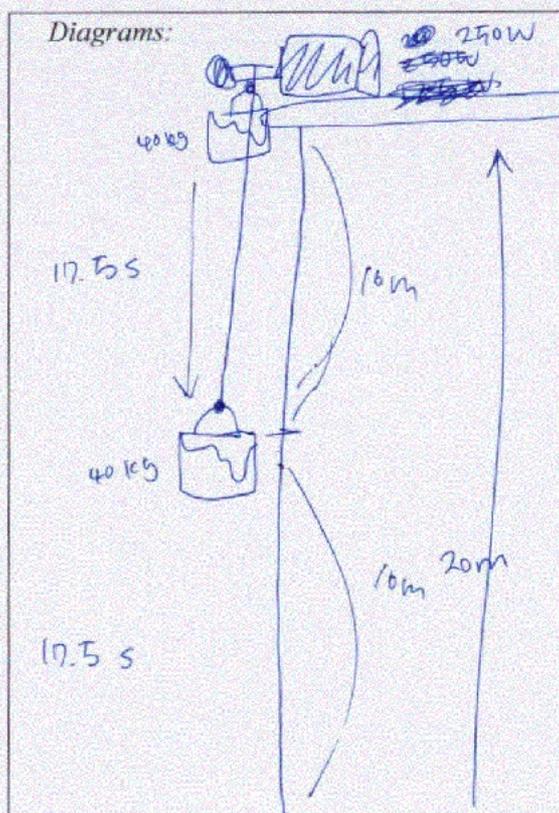
kinetic energy will not be done if the paint pot is not moving and stay in one place.
~~However, the gravitational energy~~
~~will be done because~~
And the gravitational energy also will ~~not~~ be done because there is not change in height

The half of the energy ~~too~~ will be transformed.

~~△E = P t~~
~~350 × 17.5~~
~~△E = Pt~~   △E = 125 × 17.5
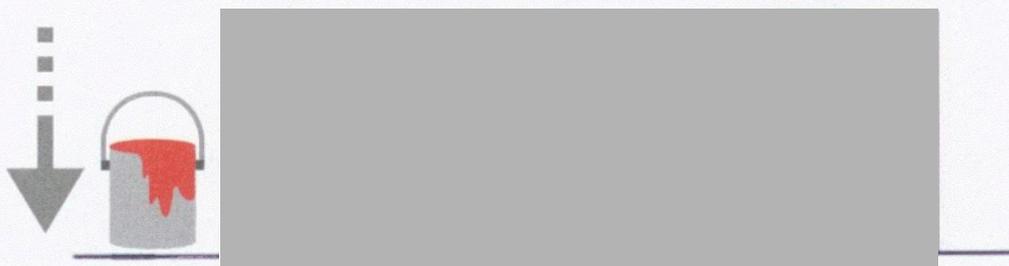~~= 2187.5~~

(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.

maximum speed at which the paint pot hits the ground.

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

$$8000 = \frac{1}{2} \times 40 \times v^2$$

$$v = \sqrt{\frac{2 \times 8000}{40}}$$

$$v = 20 \text{ m s}^{-1}$$

I assum that the paint pot might be ~~tilt t~~ tilt, and ~~som~~ it throw some of the paint away from the paint pot to the outside, and ~~it may~~ it's muss may be decreased.

Decreasing it's mass means it ~~would~~ will get more speed (velocity) while it was ~~t~~ falling down from the 20m height building, therefore it's speed reach more higher.

Or, it ~~might fea~~ will not reach the speed of 20 m s⁻¹ because of the friction ~~and~~ and air resistance while it was falling down from th buiding to the surface of Earth.

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.

> Temperature is the measurement of how much heat energy
> that the object absorbed or refused, (or have) can be measured
> by °C (celcious)
>
> However, heat energy cannot be measured. Heat energy is the energy
> that is added to an the object or state to increase or or decrease
> or lost
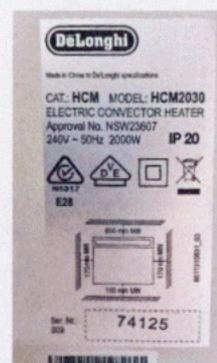>   temperature.

(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**.

dial to

Calculate the current in the heater circuit.

Include the correct units.

> $P = VI$ 50% maximum
>
> $2000 = 240 \times I$ $8.33 \div 2 = 4.165A$
>
> $I = 2000 \div 240$
>
> $I = 8.33 A$

(c) Loa 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.

current is amount of charged electron flow in the circuit.

An increase in current in the circuit means that there are more charged electrons flow in circuit, which means also the amount of thermal energy ~~reated~~ released by the heater will be increased.
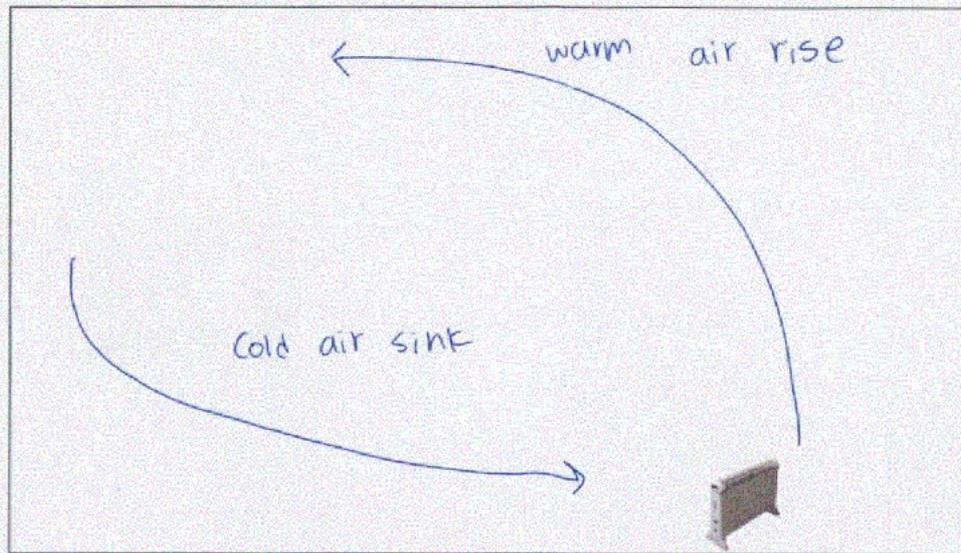
$(P = v \times I)$

It means there is more sources ✓ of current to turn into ~~thermal energy~~ power

And more power causes ~~##~~ more thermal energy released.

$(\Delta E = P t)$

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

warm air rise

Cold air sink

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

Warm air that got thermal energy by the heater through convection rise because it has less density. The heated air have less density because the particles move faster and further from each other because they are heated by heater and get thermal energy.

However, the cold air sink, because their particles don't really move and they don't go further, they stay together, closely. Therefore the cold air have more density, so they sink to the bottom.

As the heater is placed on the ground, it is easier to raise the temperature in the room because they can easily heat up the cold air because they also sink to the ground, and it can be changed to warm air and go up.

[handwritten top margin: ...kg⁻¹ °c⁻¹ / 400 kg °c⁻¹]
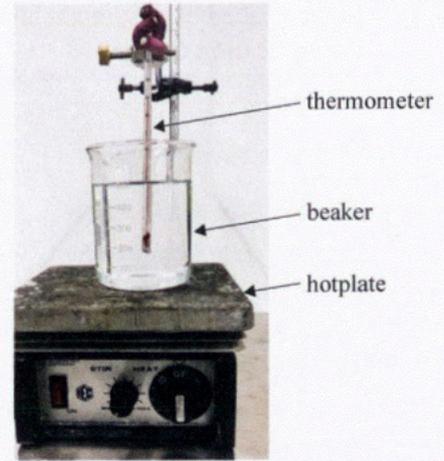
QUESTION THREE: HEATING WATER

Cecelia uses the equipment shown to measure the specific heat capacity (*c*) of water. *[handwritten: kg⁴ °C⁻¹]*

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.

[diagram labels: thermometer, beaker, hotplate]

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

[handwritten:] Specific heat capacity ~~refer~~ refers that the amount of energy required to change 1 kg of the substance's temperature ~~to~~ 1°c.

amount of
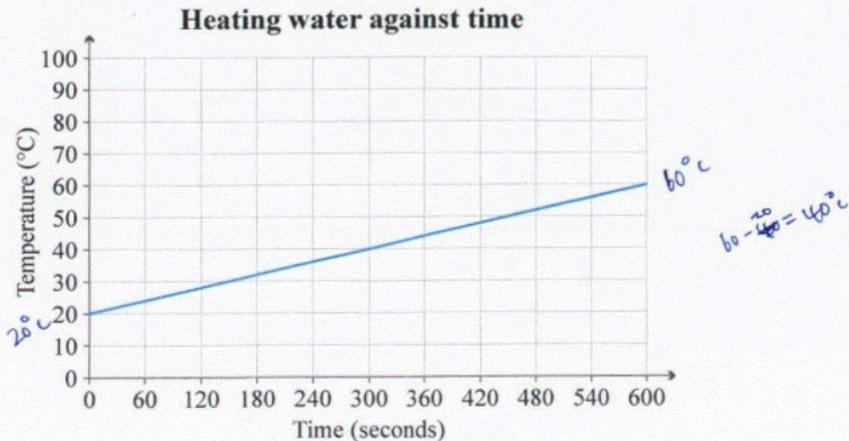Energy required for per kg of substance to change ~~to~~ (increase or decrease) ~~to 1°c~~ by 1°c

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

[handwritten:]
P = V I
  = 24 × 5.0
  = 120 W

ΔE = P t
  = 120 × 600
  = 72 000 J

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

Heating water against time

[graph: Temperature (°C) on y-axis from 0 to 100, Time (seconds) on x-axis from 0 to 600. Line rises from about 20°C at time 0 to 60°C at time 600.]

[handwritten: 60°c, 60 - 20 = 40°c, 20°c]

(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.

72000 J of electrical energy was used by the hotplate over 10 minutes to heat up water in a beaker. So, it will be transfer to thermal energy (72000 J)

Change in temperature: it was 20°C at 0 second (at first) and after 10 minutes, the temperature changed to 60°C. So 40°C was increased.

$E_{thermal} = mc\Delta T$

$72000 = 0.5 \times c \times 40$

$c = \dfrac{72000}{0.5 \times 40} = 3600 \text{ kg °C}^{-1}$ ← Cecelia's value for the specific heat capacity of water.

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

Discuss why her value and the textbook value are different.

Her value and the textbook value are different because during her experiment, heating the water in a beaker with hotplate, the thermal energy that water got could escape from the water throush convection.
Some of the energy

Because there is no cover on the beaker, so if the water is heated, the heat will escape to the air.

of water
If the temperature is not hot enough, more specific heat capacity will required to raise 1°c from 1kg.

the experiment that Cecelia did will say

→ Because less temperature will rise in 10minutes if heat is keep escaping from the water to the air.

(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.

Space for drawing

Cover made with Rubber

Thermometer

Beaker (water inside)

Hotplate
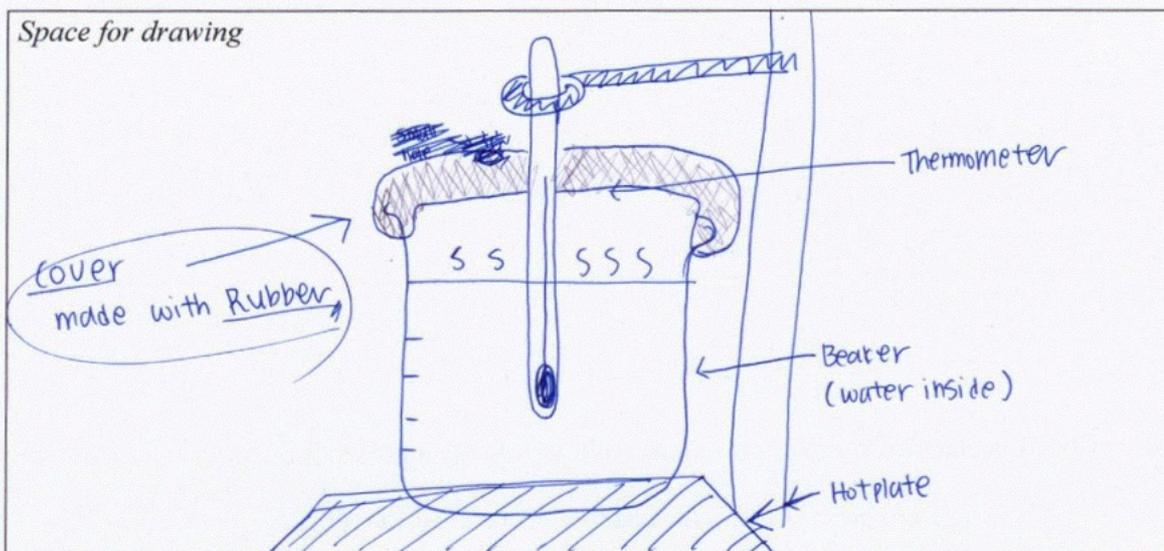
If I put a cover that is made with rubber would me a more accurate answer because it trap the heat from the water and prevent heat to escape and lose their temperature. It is more accurate because it will give me the answer of specific heat capacity of water when the water lose less heat during the experiment. It would tell me the more accurate temperature it has been rised in 10 minutes, letting me calculate more accurate specific heat capacity through tu experim

This improvement will resist the heat transfer, convection, by blocking the heat from the water to escape (also heated air).

Also, by using a cover that is made with rubber, it will resist tu heat transfer, conduction, because rubber is a good insulator and resist the flow of thermal - energy (heat) from the heated water escape. The particles in water and gas will be heated up, and the particles touches tu particles in rubber and transfer heat, but it would be hard to transfer heat because the gaps of particles in rubber are far apart and hard to transfer heat to tu neighbouring particles, therefore it traps tu thermal energy (heat) more efficently.

QUESTION NUMBER	
Q1 a)	Because the air push the paint pot. back.

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

QUESTION
NUMBER

92047

13797

Excellence

Subject: L1 Physics, Earth and Space Science

Standard: 92047

Total score: 21

Q	Grade score	Marker commentary
One	7	Correct description of energy loss and calculation of energy used by motor and gravitational energy gained. An explanation of the difference stated. No mention that E_p transfers to Ep plus E_k plus E_T. The velocity and assumptions were correct for the pot falling, but there was no mention that the thermal energy came from particles of air hitting the bottom of the pot.
Two	7	The concepts of temperature and heat energy were not explained. The current, with correct unit, was calculated correctly for the heater set at 50% A discussion around how an increase in current would affect the thermal energy was started using the correct equations. In the equation $P = VI$, there was a mention that voltage stayed constant however, there was no mention around which variables changed, and which stayed constant in the equation $E = Pt$. This student drew a diagram showing convection currents, and linked particle motion with these particles moving further apart and becoming less dense, and why the density of cold air should increase.
Three	7	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. The specific heat capacity for this experiment was calculated correctly, but the unit for c was incorrect. This student mentioned why the two numbers may be different, and could back this up with a diagram and description of improvements. This also included a link to a method of heat transfer.