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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 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.

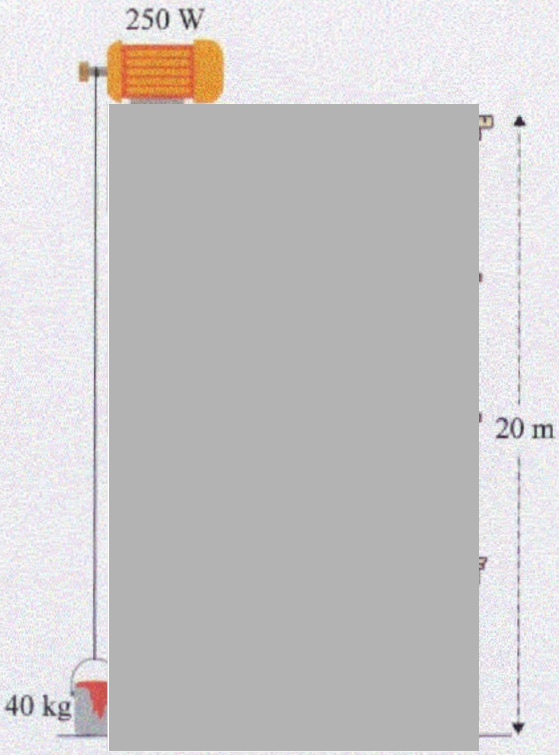
Do not write in the margins (▨). This area will be cut off when the booklet is marked.

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

Achievement TOTAL 12

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.

The energy changes that takes place are that it changes from kinetic energy as it lifts to gravitational potential energy when its on the top. (height)

(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.

$E_p = mg\Delta h$ $E = P \times t$

gravitation energy $= 40 \times 10 \times 20$ $= 250w \times 35$ → electric energy

$= 8000\,J$ $= 8750\,J$

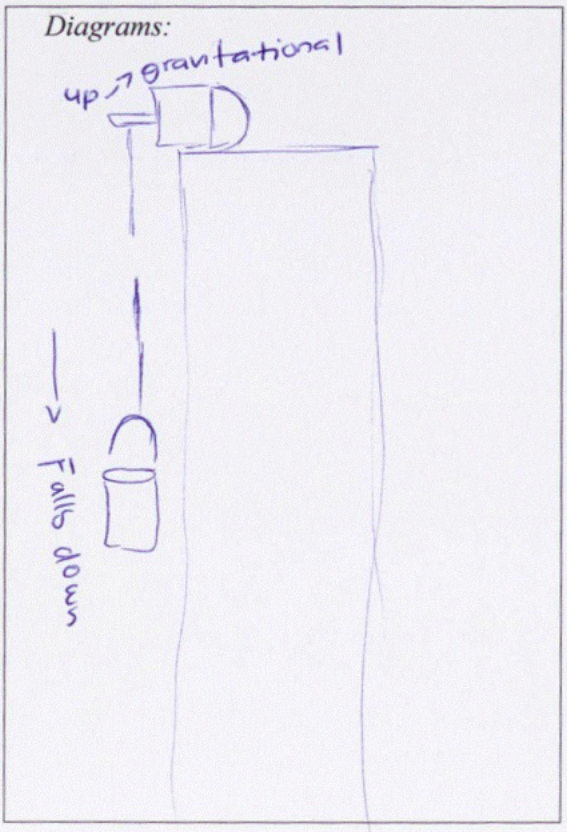
There are some differences in this numbers because gravitational potential & formulae uses the mass, the gravity $10N^{-1}$ and the height. The electrical energy formulae uses the power and the time taken for it to fall. The difference is because 2 different formulaes are used to find the gravitational potential and the electrical energy. The electrical energy was for the motor to see the amount of energy provided by it and the gravitational energy was for the paint bucket to see how much it gained.

(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:



The energy transfer from the paint pot, from the top of the building when the rope breaks is that the energy changes from gravitational potential (height) energy to kinetic energy (movement) as it falls down to the ground.

(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.

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

$v = \sqrt{\frac{2\,ek}{m}}$ so: $\sqrt{\frac{2 \times 8000}{40}} = 20^{s-1}$

Since ep = ek, the ek therefore will be 8000J

- Some assumptions that have been made are that the the paint pot is exactly the weight that has been mentioned. and that it has been dropped from exactly 20 m.

- The paint pot will not reach this speed because the ~~gravity~~ gravitational force will be acting upon it. forcing it to decrease the speed.

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.

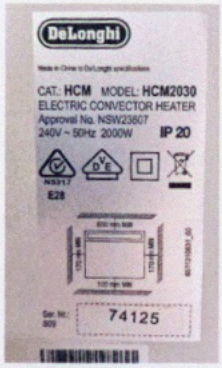
(a) Compare the concepts of temperature and heat energy.

The difference between this 2 concepts are that temprature is used to measure the heat energy and heat energy is used to ~~to meers~~ calculate/ measue the spcific heat capacity

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

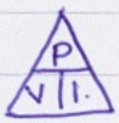
The voltage supply in her house is 240 V.

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



Calculate the current in the heater circuit.

Include the correct units.



$= I = P/V$

$= \frac{2000}{240} = 8.3\text{A}$

$8.3 \times \frac{50}{100} = 4.15$

$8.3 + 4.15 =$ 12.45 A

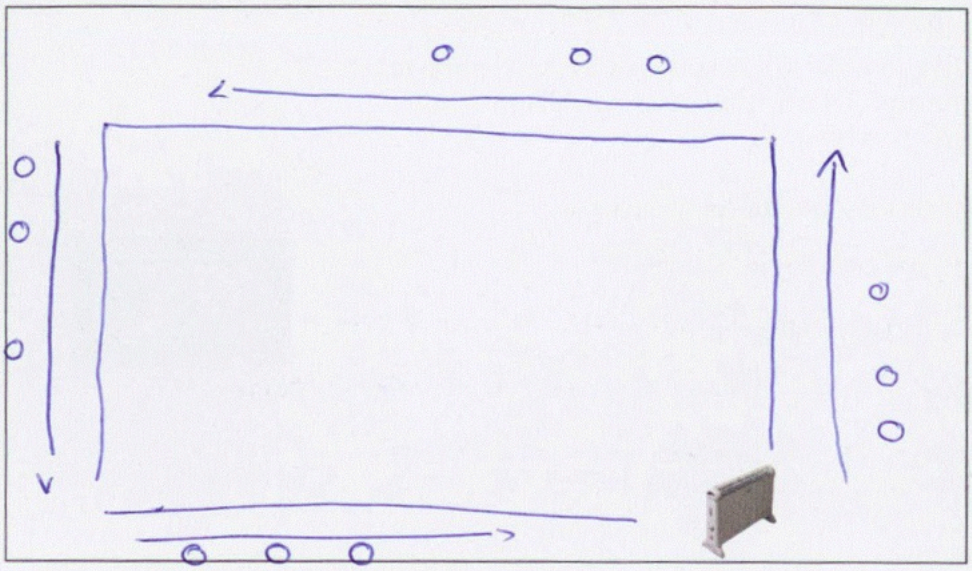
(c) Loa turns the dial on the heater, which increases the current in the heater.

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.

the increase in the current in the circuit affects the amount of thermal energy released by the heater. is by increasing the amount of ~~heat~~ ~~heat~~ Thermal energy. As the circuts increase the current it heats up the wire and the components, and if the current increases than the thermal energy emitting from the ~~circt~~ circuit would also increase. Since the ~~Components~~ and the wire would emit heat from it.

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



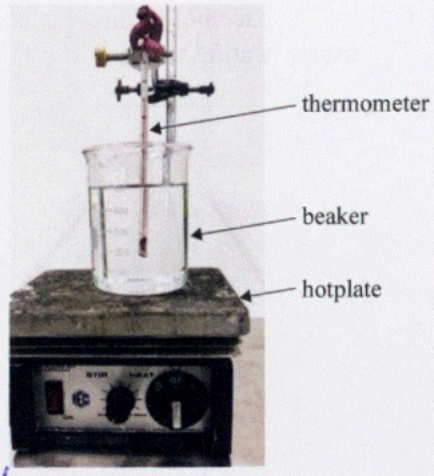
Discuss particle movement in various parts of your diagram, and how this results in the pattern you have drawn in your diagram.

The particles in this shows a convection current. The particles gain energy and the heated particles that gain energy becomes less dense or lightweighted. This makes the less dense particles to rise upwards and go to the top. Than the ~~cold~~ unheated particles do the same and float upwards once gained energy But the ~~heated~~ First heated particles goes back down.wards as its particles lose energy. ~~and go back down for the particles to gain energy. This cycle that Repeats all the time, this is called the convectional current. where~~ and going down-wards heats up the particles making them gain energy and this ~~can~~ ~~repeats~~ a cycle repeats all the time

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 the measured tempreture, or the maximum amount of tompreture ^ heat energy a item can store.

e.g water = 4200 J $4200 Kj^{-1} J$

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

① $P = VI$

P = voltage x current

~~24V x 120~~

$P = VxI$

$= 24 \times 5.0$

$= 120 W$

$V = 24 \times 5.0$

$= 120$

② $\Delta E = Pt$

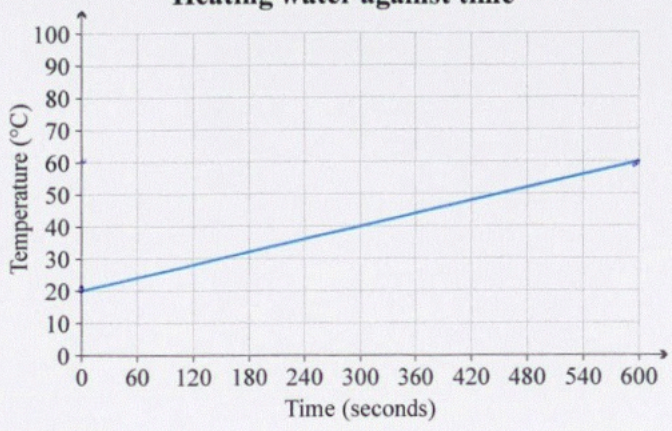
$E = 120 \times 600$

$= 72000 J$

72000 J

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

Heating water against time



(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.

$= mc\Delta t$

$= 0.5 \times 72000 \times 40^{\circ}C \times 600s$

$= 1440000\ J$

$= 1440000\ kJ^{-1}\ J$

Final - inital

60 - 20

$= 40^{\circ}C$

$60^{\circ}C - 20^{\circ}C$

$= 40^{\circ}C$

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

Discuss why her value and the textbook value are different.

Cecelia's value and the text books values are different because she might have kept the beaker on ~~for too long and the temprature~~ the hot plate after turning it off. This would make the heating process to still take place since the hot plate would still be hot. This might be why they both have different values.

Question Three continues on the following page.

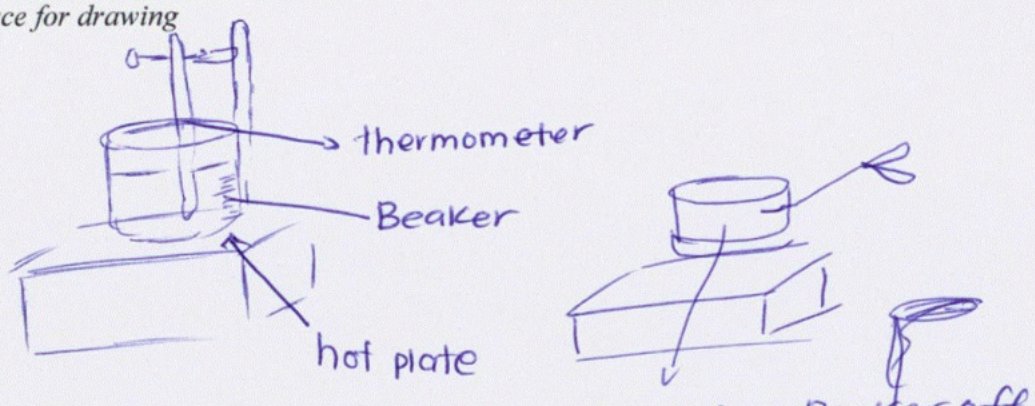
(d) Cecelia's value for the specific heat capacity of water is different from the value given in a textbook.

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.

Space for drawing



. This change would give a more accurate answer because if the ~~She~~ reaches the desired tempreture and turns off the hotplate and leaves the Bealer on it. The tempreture than ~~was~~ would keep on increasing because since the hot plate is still hot it can transfer heat to the Beaker by conduction. and The water particles ~~would get~~ (convection) keep gaining energy and and continues to heat the water, because the hot plate would heat up the Beaker as well, (conduction). ~~Convec~~ Conduction is used to heat up the Beaker and convection is used to heat up the water from the heated Beaker.

Convection

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

QUESTION NUMBER

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

QUESTION NUMBER

92047

Achievement

Subject: L1 Physics, Earth and Space Science

Standard: 92047

Total score: 12

Q	Grade score	Marker commentary
One	5	There was no mention of electrical energy being transferred to kinetic energy and gravitational energy. Correct description of energy loss and calculation of energy used by motor and gravitational energy gained. However, this student did not explain that these two values differ, due to energy lost from the motor. Mentions E_p to E_k but did not state that halfway down there is still some E_p. The velocity and assumptions were correct, but there was no mention that the thermal energy came from particles of air hitting the bottom of the pot, and this stopped the pot reaching its maximum speed.
Two	4	The concepts of temperature and heat energy were not explained. The correct equation was used to find the current in the heater from the power; however, this student did not take 50% of this value. The equations $P = VI$ and $E = Pt$ were not used to explain how an increase in current causes an increase in thermal energy. The diagram of convection currents was not labelled, but this student did mention a change in density to explain air rising, but did not explain why the air falls.
Three	3	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. To calculate c (the specific heat capacity), the correct value for the change in temperature was identified, however the equation was not rearranged correctly. The difference between these two values was not suggested, nor a legitimate way to improve this experiment was explained.