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90184

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 1 Physics, 2005

90184 Demonstrate understanding of heat transfer and nuclear physics

Credits: Three
9.30 am Tuesday 29 November 2005

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 answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

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

For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles. ☐	Give descriptions or explanations in terms of phenomena, concepts, principles and/or relationships. ☐	Give concise explanations that show clear understanding in terms of phenomena, concepts, principles and/or relationships. ☐
Solve straightforward problems. ☐	Solve problems. ☐	Solve complex problems. ☐
Overall Level of Performance (all criteria within a column are met) ☐		

You are advised to spend 35 minutes answering the questions in this booklet.

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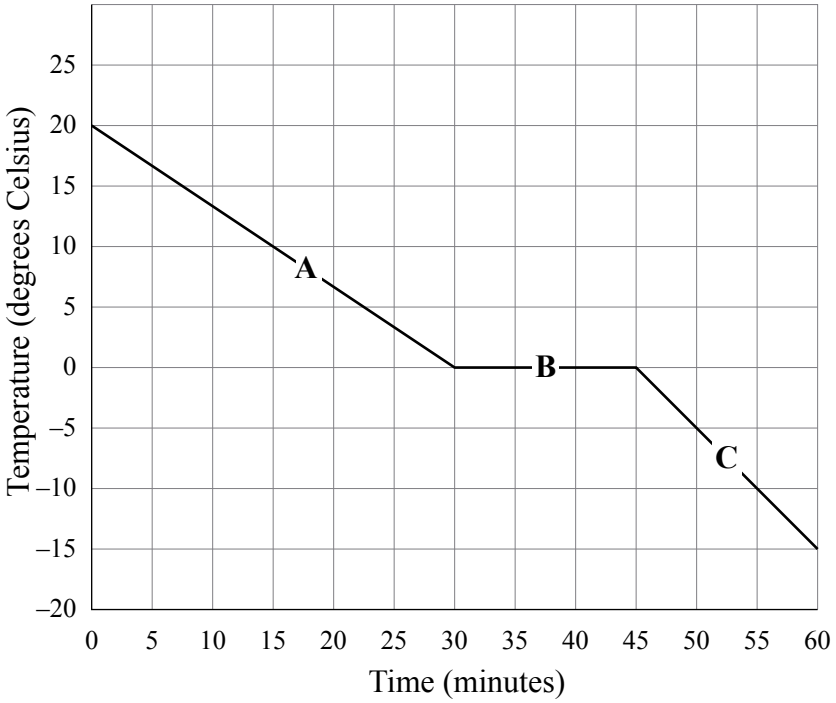
You may find the following formulae useful.

$$Q = mc\Delta T \qquad Q = mL \qquad P = \frac{E}{t}$$

QUESTION ONE

Moana places a bottle of orange drink in a freezer and records the temperature of the drink every five minutes. Her results are shown in the graph below.



(a) The mass of the drink is **0.150 kg**. The specific heat capacity of the drink is **4100 J kg^{-1}(°C)$^{-1}$**. Calculate the amount of heat energy lost by the drink during **section A** of the graph.

Heat energy = _____

(b) Name the **phases (states of matter)** of the drink during **section B** of the graph.

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(c) Explain how the change in **energy** is related to the **change** of phase of the drink during Section B of the graph.

The next day Moana goes to the beach. She takes the frozen drink with her and leaves it in the sun. The drink changes from ice at –15°C to a liquid at 10°C.

Data:
Mass of the frozen drink = 0.15 kg
Specific heat capacity of the frozen drink = 1900 $Jkg^{-1}(°C)^{-1}$
Latent heat of fusion of the drink = 320 000 Jkg^{-1}

(d) Use the above data to calculate the **amount** of heat energy required to heat the frozen drink from **–15°C** to the liquid state at **0°C**.

Heat energy = _____

QUESTION TWO

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Brian boils some water in an electric jug to make some jelly for a school party.

(a) While the water is heating, Brian warms his hand by holding it a few centimetres away from the sides of the jug. State the **type** of heat transfer from the jug to his hand.

_____

(b) The electric jug has a power rating of **2200 W.** Calculate the amount of **heat energy** produced by the jug in **60 seconds.**

_____

_____

_____

Heat energy = _____

(c) The water boils at 100°C. Calculate the amount of **heat energy** required to convert **0.0050 kg** of water at 100°C to steam.

The latent heat of vapourisation of water is **2 260 000 Jkg^{-1}.**

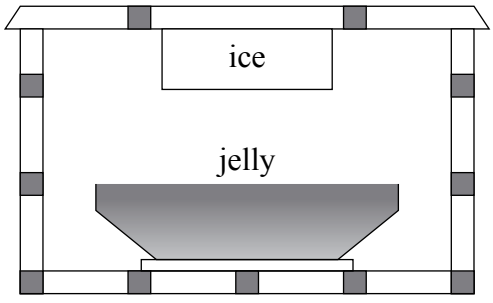
_____

_____

_____

Heat energy = _____

The next day Brian transports the jelly to the school in a cooler. The cooler consists of a plastic box that contains ice placed under the lid of the box, as shown in the diagram.



(d) Explain why the ice is placed at the **top** of the box rather than at the bottom of the box.

_____

_____

_____

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(e) Explain why the jelly keeps cold **longer** if the walls of the box are made of rigid **plastic** rather than of metal.

(f) Explain why the jelly keeps cold **longer** if the box is made with a **double wall** with air between the walls.

The ice under the lid has a mass of **0.93 kg**. It took **50** minutes for the ice at **0°C** to turn into water at **0°C**.

Latent heat of the ice is **340 000 Jkg^{-1}**.

(g) Calculate the **rate** at which heat energy is being absorbed by the ice during its change of state. Give the correct **unit** with your answer.

Rate of energy = _____ _____ (unit)

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QUESTION THREE

Strontium has several isotopes. Two of the isotopes are: $^{88}_{38}Sr$ and $^{94}_{38}Sr$.

(a) Explain why these are both **isotopes** of strontium.

The following equation represents a nuclear reaction.

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{72}_{30}Zn + ^{160}_{X}Sm + Y\,^{1}_{0}n$$

(b) Calculate the **numbers** represented by the letters **X and Y** in the above nuclear equation.

Number X

Number Y

(c) There are **more neutrons** produced than used in this fission reaction. Explain the importance of these **neutrons** in a nuclear reactor.

(d) The above reaction is a fission reaction. State the meaning of the term **fission reaction**.

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In the sun a nuclear reaction takes place between a deuterium ${}^{2}_{1}H$ nucleus and a tritium ${}^{3}_{1}H$ nucleus. The products of this reaction are a helium nucleus and a neutron.

(e) Complete a **balanced** equation for this nuclear equation. Give the correct symbols for the products of the reaction.

$${}^{2}_{1}H + {}^{3}_{1}H \longrightarrow \boxed{} + \boxed{} + \text{energy}$$

(f) **Name** this type of reaction.

_____

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number