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90184

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 1 Physics, 2009

90184 Demonstrate understanding of heat transfer and nuclear physics

Credits: Three
2.00 pm Thursday 26 November 2009

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 2–7 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 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 30 minutes answering the questions in this booklet.

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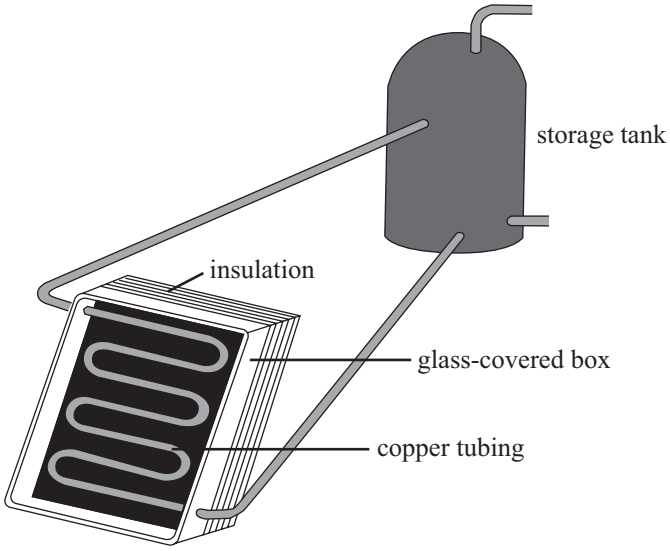
You may find the following formulae useful.

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

QUESTION ONE: SOLAR WATER HEATER



A solar water heater placed on the roof of a house consists of copper tubing placed inside a box and covered by a sheet of glass. The copper tubing is connected to a hot water storage tank. The cold water enters at the bottom of the solar heater and the hot water leaves from top of the heater.

(a) State the energy change that occurs in the solar heater.

(b) The solar water heater shown in the diagram has no mechanical device to move the water through it.

Explain how the hot water moves through the copper tubing to the storage tank.

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(c) The specific heat capacity of copper is 385 J kg^{-1} $°C^{-1}$.

Calculate the heat energy required to raise the temperature of 0.090 kg of copper by 80°C.

energy = _____

(d) The solar heater supplies 3.7×10^7 J of energy to heat 200 kg of water. The initial temperature of the water is 21°C. The specific heat capacity of water is 4200 J kg^{-1} $°C^{-1}$.

Calculate the final temperature of the water. (Assume that no heat is lost.)

temperature = _____

(e) A dishwasher uses some hot water from the storage tank. This is replaced with cold water, and it requires 9 800 000 J of energy to heat the warm water in the tank back to its original temperature. The solar water heater heats the water to its original temperature of 80°C in 90 minutes.

Calculate the **power** output of the solar water heater and give your answer in **kilowatts**.

power = _____

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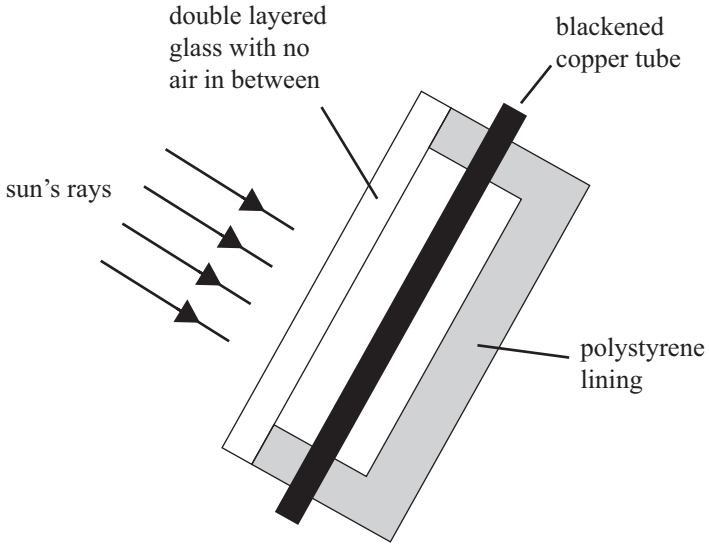
(f) The following modifications are made to the solar heater to make it more efficient.

1. The bottom and the sides of the box are lined with thick expanded polystyrene.
2. The top is now covered with two layers of glass, and the air in between the glass layers is removed to create a vacuum.
3. The copper tubing is now painted black.



Discuss why the new design helps the water to reach a higher temperature than the original design.

QUESTION TWO: NUCLEAR REACTIONS

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In the following reaction, two helium nuclei combine to form a beryllium nucleus. The equation for the reaction is:

$$ {}^{3}_{2}\mathrm{He} + {}^{4}_{2}\mathrm{He} \rightarrow {}^{a}_{b}\mathrm{Be} $$

(a) Name this type of nuclear reaction and explain the reason for the name.

Name: _____

Explanation: _____

_____

(b) There are TWO forms of helium in the above equation.

State the difference between the two helium nuclei and state the **scientific term** that describes them.

_____

_____

(c) Calculate the values of ***a*** and ***b*** in the above reaction.

_____

_____

(d) The power outputs of reactors in nuclear power stations are managed by controlling the speed and quantity of neutrons.

Discuss why neutrons are so important in nuclear reactions, and how they are controlled.

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QUESTION THREE: ICE PACKS

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Use the following data for this question:

Specific heat capacity of water	= 4200 J kg^{-1} $°C^{-1}$
Specific heat capacity of ice	= 2100 J kg^{-1} $°C^{-1}$
Latent heat of fusion of ice	= 340 000 J kg^{-1}
Latent heat of vaporisation of steam	= 2 300 000 J kg^{-1}

Bags of ice are commonly sold in petrol stations. Gerry buys a few 2.0 kg bags of ice for her birthday party.

(a) When she reaches home, some of the ice has melted.

Calculate the heat energy required to melt 0.10 kg of ice at 0°C into water at 0°C.

energy _____

(b) Although the bag is sealed, some water forms on the outside of the bag as a result of condensation from the air.

Calculate the mass of water, **in grams**, that will condense if 5000 J of energy was given out during the condensation process.

mass _____ grams

(c) An unused 2.0 kg bag of ice melts overnight and the morning after her party, the temperature of the water inside the bag is 6.0°C.

Calculate the energy required to convert 2.0 kg of ice at 0°C into water at 6.0°C.

energy _____

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

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Question number	

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