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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Physics, 2011

90939 Demonstrate understanding of aspects of heat

2.00 pm Thursday 24 November 2011
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of heat.	Demonstrate in-depth understanding of aspects of heat.	Demonstrate comprehensive understanding of aspects of heat.

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.

Make sure that you have Resource Sheet L1–PHYSR.

In your answers use clear numerical working, words and / or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

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 2–10 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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE: THE BARBECUE

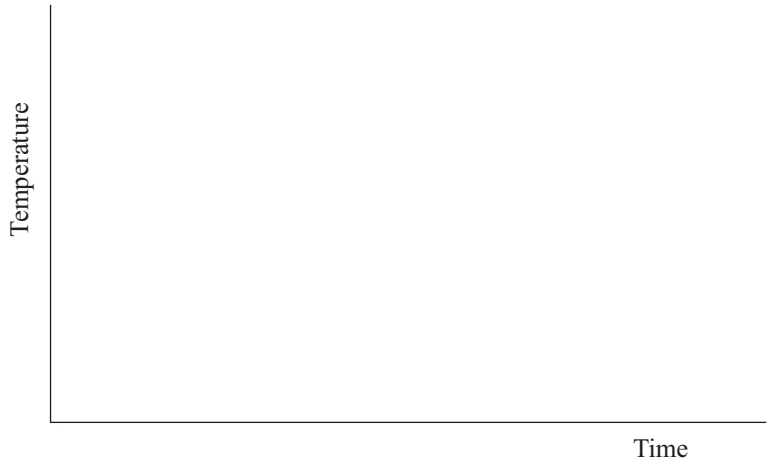
Todd is having a barbecue for his friends to celebrate his birthday.

The cooking plate on the barbecue is made of aluminium, which has a specific heat capacity of 897 J kg^{-1} $°C^{-1}$. The burner on the barbecue is made of cast iron, which has a specific heat capacity of 460 J kg^{-1} $°C^{-1}$.

(a) Use the above information to describe the heat-absorbing abilities of aluminium compared to cast iron.

(b) Todd starts the barbecue, and the aluminium plate becomes hot. He throws a small piece of ice on the aluminium plate to see how hot it is. The initial temperature of the ice is −4.0°C. First it slowly melts, and then boils into steam.

On the axes below sketch a graph to show how the temperature changes when ice is heated until it turns to steam.



(c) On your sketch, **label** the parts of the graph that represent 'melting' and 'boiling'.

(d) The plate reaches a temperature of 300°C. Todd tells his friends that even though the barbecue plate is 300°C, the water in his outdoor swimming pool, which is 20°C, has a lot more thermal energy in it than the barbecue plate.

State the meaning of the terms **thermal energy** and **temperature**, and explain why Todd thinks that the swimming pool water has a lot more thermal energy in it than the barbecue plate.

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QUESTION TWO: THE BARBECUE DESIGN

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Todd puts 0.050 kg of oil onto the hot aluminium plate. The initial temperature of the oil is 15°C, and it heats up to 250°C. The energy absorbed by the oil to reach this temperature is 23.2 kJ.

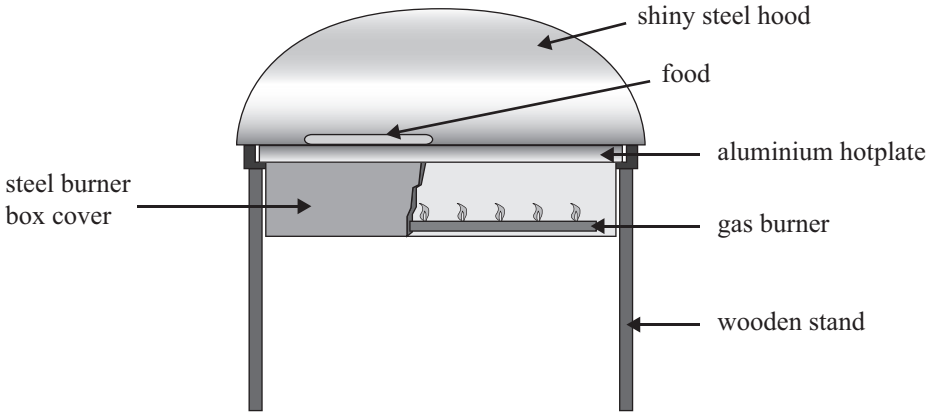
(a) Calculate the specific heat capacity of the oil.

Specific heat capacity _____

(b) The diagram below shows the structure of the barbecue.

Some of the main heat efficiency features of the barbecue are:

- the burner box cover
- the shiny steel hood
- the wooden stand.



Use your knowledge of heat transfer to explain how any TWO of the three features mentioned above help the efficient heating of the barbecue.

(1)

(2)

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The aluminium hotplate on the barbecue has a mass of 1.65 kg. Its initial temperature is 20°C and after heating the temperature reaches 300°C. The specific heat capacity of aluminium is 897 J kg^{-1} $°C^{-1}$. The power provided by the gas flame is 1.38 kW.

(c) Calculate the minimum time that it would take for the aluminium hotplate to reach the correct temperature. Give your answer in minutes.

Tme in minutes _____

(d) Explain why, in reality, the aluminium hotplate would take longer than this to heat up to 300°C.

QUESTION THREE: KEEPING COOL

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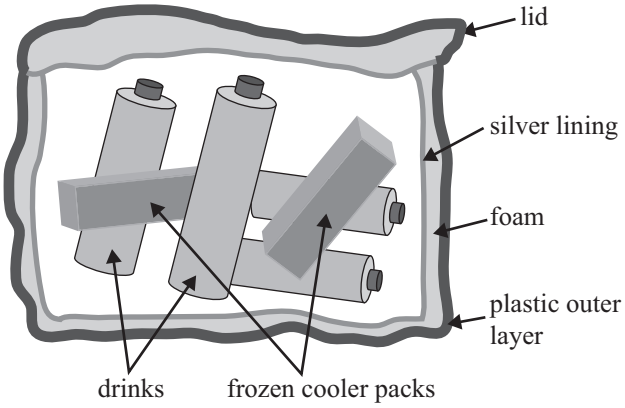
You may use the following data for this question.

Data

Specific heat capacity of water = 4 200 J kg^{-1} $°C^{-1}$
Latent heat fusion of water = 330 000 J kg^{-1}
Latent heat vaporisation water = 2 300 000 J kg^{-1}

The bottles of drinks for the barbecue are kept in a cooler bag. The cooler bag consists of an outer layer of thick plastic material, the middle is filled with foam, and the inner lining is made from silver material.



(a) Explain how the foam layer helps to keep the contents of the bag cool.

(b) Amy puts 4 drink bottles at room temperature into the cooler bag, which contains some frozen cooler packs.

Explain, using the concept of latent heat, how the cooling of the drinks is related to the melting of the cooler packs.

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(c) Amy puts 35 g of ice cubes at 0°C into a glass containing 300 g of lemonade, at 14°C. When the ice has melted completely the drink has cooled down to 5°C.

Calculate the amount of the energy that has to be absorbed to change the ice to water at a temperature of 5°C.

Energy _____

(d) As Amy is leaving the swimming pool, a gentle breeze blows across her. Amy notices that she feels cooler when the breeze is blowing, even though a nearby thermometer shows no change in temperature.

Explain why Amy feels cooler in the breeze even though the temperature is unchanged.

QUESTION FOUR: THE BARBECUE AREA

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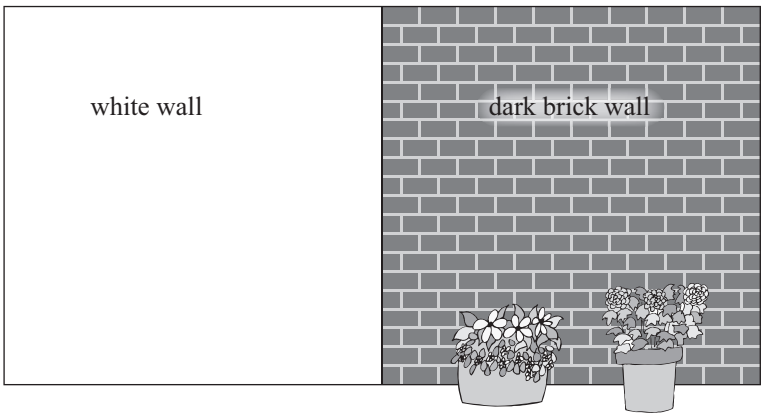
There is a wall on one side of the barbecue area. One half of the wall is painted white and the other half of the wall has exposed dark bricks, as shown in the diagram below. The whole wall is in full sun during the day.



(a) Describe how the whole wall gets warm during the day.

(b) Explain why the rate of heating of the white and dark-coloured parts of the wall are different during the day.

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(c) Compare how the surface temperature of each half of the wall would change:

- as the day progresses
- during the night

Explain why.

(d) The surroundings of the swimming pool are paved with tiles. The mid-day sun delivers about 60 000 J of energy in one minute to a square metre of the tiles, of which only 80% is absorbed by the tiles. One square metre of tiles has a mass of 68 kg and its specific heat capacity is 920 J kg^{-1} $°C^{-1}$.

Calculate the rise in temperature of a square metre of the tiled area in one minute.

Temperature rise _____

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

QUESTION NUMBER

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