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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Physics, 2014

90939 Demonstrate understanding of aspects of heat

2.00 pm Tuesday 25 November 2014
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 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 2–10 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.

Not Achieved

TOTAL 03

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QUESTION ONE: THE THERMOS FLASK DESIGN

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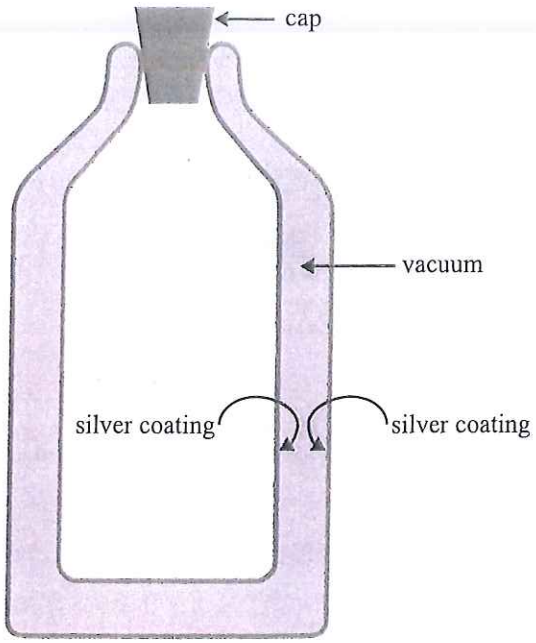

The diagram shows a thermos flask used for keeping hot liquids hot. It consists of two glass containers, placed one inside the other and sealed together at their necks. The air between the walls of the two glass containers is removed to create a vacuum. The inner and the outer glass layers are silvered, and the cap is made of thick plastic.

(a) Explain the purpose of removing the air from between the walls of the two glass containers.

Air is a very Poor Conductor of heat so it will take heat longer to pass through it.

a

(b) Explain why the inner and the outer walls of the thermos flask are silvered.

Silver objects reflect heat making them Poor Conductors and in this case it is making it hard for the heat to pass through it.

a

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(c) The thermos flask can also be used to keep cold things cold. To test the effectiveness of a thermos flask, the flask is initially cooled to 0°C and then 1.2 kg of ice at 0°C is placed inside the flask and the cap is replaced. The flask and its contents are left undisturbed. It is found that after exactly 11.6 hours, all of the ice inside the flask is melted to water at 0°C.

The latent heat of fusion of ice is 3.36×10^5 J kg^{-1}.

(i) Calculate the average rate at which the contents gain heat from the surroundings, in joules per second.

$P = \frac{E}{t}$

$3.36 \times 10^5 = 336.000$ J

11 hours = 660 min

660 min = 39.600

0.6 of a hour = 45 min

$\frac{336.000}{39.600} = 8.48$ Rate of heat gain: 8.48 J per second

(ii) After all the ice has melted, the thermos flask and its contents are left for a certain time. It is found that the **rate** of heat gain gradually decreases.

Explain why this is so.

Because the ice has melted it is now water. This causes the rate of heat gain to decrease.

(d) (i) Some hot water is placed in an **empty** thermos flask.

Explain why it is essential for the top of the flask to be closed for the liquid to remain hot over a long period of time.

If there was no lid then the heat could easily escape the thermos and the water would cool much faster.

(ii) In reality, the hot water in the thermos flask will lose heat over a 24-hour period, even if the top of the flask is closed.

Explain why this happens.

Even in a thermos the hot water will always be losing heat but the purpas of the thermos is to slow down the loss of heat as much as possible

N2

QUESTION TWO: HEATING WATER

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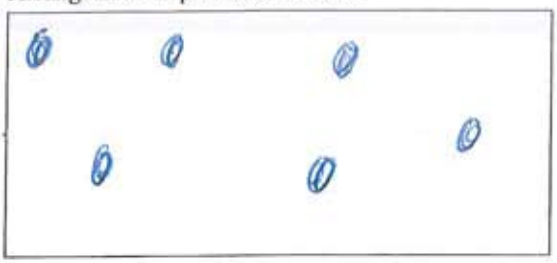
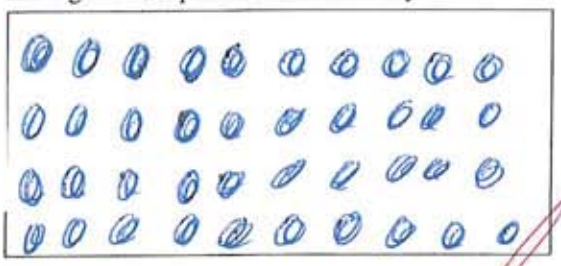
Arrangement of particles in steam



For copyright reasons, this image cannot be reproduced here.

Arrangement of particles in metal body



http://motivationnation.wordpress.com/2007/11/25/212-degrees/

(a) The photograph above shows water being heated in a container. As the water boils, steam is produced.

In the spaces given above, draw diagrams to show how the particles are arranged in:

(i) steam

(ii) the metal body of the gas burner.

(b) (i) The metal body of the gas burner is made from iron. When the metal body heats up, it expands.

In terms of the arrangement of particles in the metal body, explain why the metal body expands during heating.

Even packed as tight as the particles are in the pot when it is heated the particles move more causing the pot to expand

(ii) Explain why heat energy is needed to convert boiling water at 100°C to steam at 100°C, even though the temperature remains constant during the change of phase.

Because the boiling point of water is 100°C. This is the temprature of which water will change state to steam. water → gas

(c) Particles in water are in liquid state, and particles in steam are in gaseous state.

(i) State one similarity between the behaviour of the particles in liquid state and in gaseous state.

They are both moving

(ii) State one difference between the particles in liquid state and in gaseous state.

There are less particles in gas than liquid.

(d) A liquid is heated with a 150 W electric heater. When the liquid reaches the boiling point, only 85% of the power supplied is absorbed by the liquid to keep it boiling, and the rest is lost to the surroundings.

Calculate the value of the **latent heat of vaporisation** of the liquid, given that 0.0075 kg of the liquid has evaporated in 35 s.

$Q = mc\Delta T$

$0.0075 \times 150 \times 35$

$= 39.375\ J\ s^{-2}$

Latent heat of vaporisation: $39.375\ J\ s^{-2}$

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The examination continues on the following page.

QUESTION THREE: SOLAR HEATING

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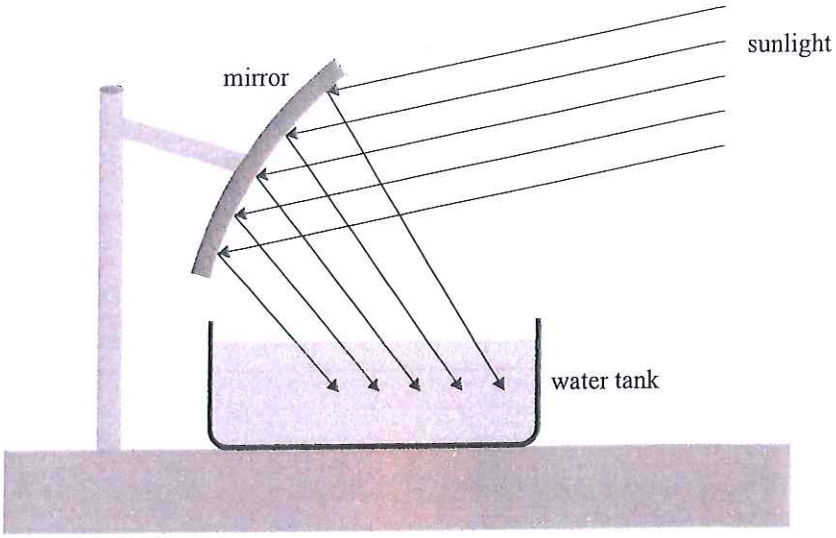
A curved mirror is used to heat water. The mirror focuses the heat energy from the Sun onto a small metal tank containing water, as shown in the diagram below. The mirror is made from a thin sheet of polished stainless steel and it is arranged so that all of the reflected energy is focussed onto the water and the tank.



(a) Name and describe the method of heat transfer from the Sun to the mirror in the above set-up.

Name: Reflection

Description: when the light bounces off of a surface it can not pass through

(b) Not all the energy incident on the mirror is actually used to heat the water.

Give TWO reasons why this is so.

Reason 1: It takes energy to be reflected.

Reason 2: It takes energy to pass through the water

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(c) On a particular day, the average amount of energy received from the Sun at the mirror is 630 joules per square metre per second. The area of the mirror is 1.5 m^2.

Specific heat capacity of water is 4200 J kg^{-1} $(°C)^{-1}$.

Calculate the minimum time taken to raise the temperature of 5.0 kg of water from 26°C to 90°C.

Assume that the entire heat energy incident on the mirror is used to heat the water.

$t = \frac{P}{E}$

5kg = 500g

500 ÷ 64 = 7.81min

90 − 26 = 64

Minimum time: 7.81min

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(d) State and explain TWO modifications to the set-up shown in the previous page that would increase the efficiency of heating of the water in the tank.

Setting up a mirror could increase the amount of Sun that the area trying to be heated recieves.

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If you were to have less water this will enable you to heat up the ~~leftover~~ remaining water faster.

NØ

Not Achieved exemplar for 90939 2014		Total score	03
Q	**Grade score**	**Annotation**	
1	N2	(a) **Achievement.** A pertinent method of (preventing) heat transfer (conduction) is described but not explained. (b) **Achievement.** Reflection is correctly described but not why silver is used as the mirror. (c) **Not Achieved.** For Achievement, there has to be an attempt to calculate the rate of heat energy gain using the information given or a description of why the rate of heat gain decreases. (d) **Not Achieved.** For Achievement, there has to be some Physics ideas used to explain heat loss.	
2	N1	(a) **Achievement.** Correct diagrams for steam particles and metal particles in solid form. (b) **Not Achieved.** For Achievement, there needs to be discussion of the metal particles vibrating more or a discussion about latent heat. (c) **Not Achieved.** For Achievement, there needs to be one valid similarity between the particles in liquid and gaseous state or one valid difference. (d) **Not Achieved.** For Achievement, there has to be a valid attempt to calculate the latent heat of vaporisation using the information given.	
3	N0	(a) **Not Achieved.** For Achievement, there needs to be identification of radiation as the method of heat transfer from the Sun. (b) **Not Achieved.** For Achievement, there needs to be at least one valid reason for loss of energy. (c) **Not Achieved.** For Achievement, there has to be a valid attempt to calculate the time taken using the information given. (d) **Not Achieved.** For Achievement, there need to be at least one valid modification described.	