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Level 1 Physics, 2018

90939 Demonstrate understanding of aspects of heat

2.00 p.m. Friday 23 November 2018
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.

Useful information for calculation questions is available on the Resource Sheet.

If you need more space for any answer, use the extra space 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.

TOTAL

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QUESTION ONE: HEATING WATER

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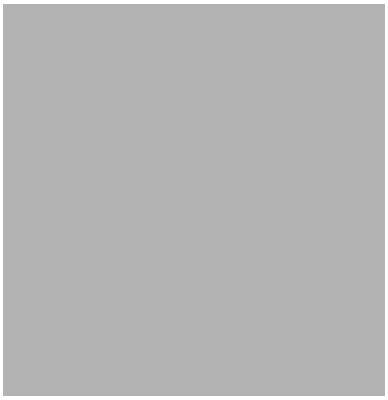
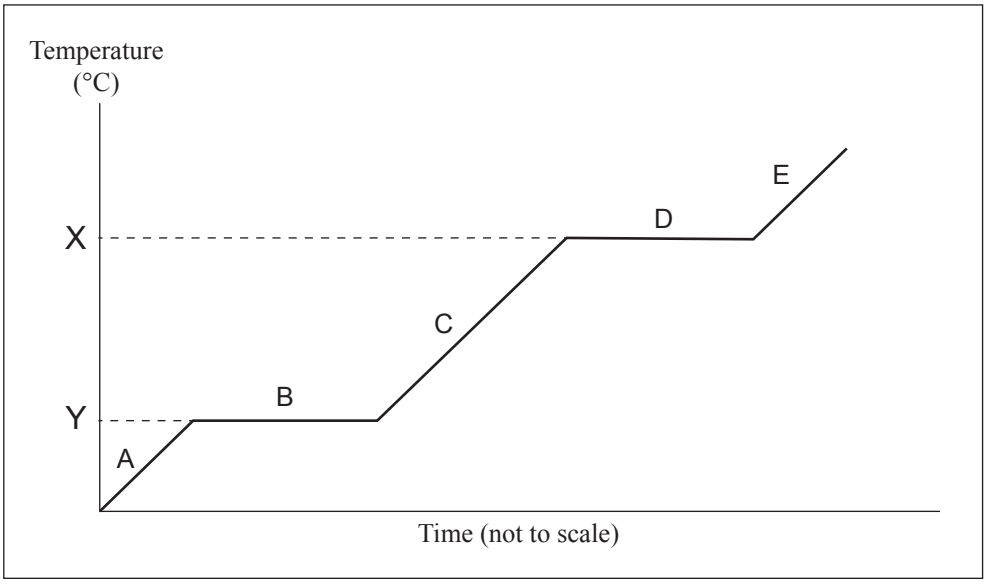
When camping in cold places where water is frozen, a camp stove can be used to melt ice to get liquid water for drinking and cooking.



https://waterandgravity.wordpress.com/2010/04/01/colvin-blake-nippletop-and-dial/7_8_melting_snow/

Over time the temperature of the water being heated in the camp stove changes, as shown on the graph below.



(a) State the values of the temperature of water at the points X and Y on the temperature axis, as shown on the graph above.

X: _____ Y: _____

(b) Referring to section B and section C of the graph above, complete the table below by stating:

(i) the name of the process occurring during each section, and

(ii) the phase/s of water present during each section.

	(i) Process	(ii) Phase/s of water present
Section B		
Section C		

(c) During section D, the temperature is not increasing, even though the camp stove is still adding heat.

Explain what the addition of heat does during section D, and why the addition of heat does not increase the temperature during this time.

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(d) The camp stove is used to heat 0.35 kg of ice. The camp stove provides heat at a constant rate of 930 W.

The time axis on the graph is not drawn to scale. Section B takes 120 s. Section D does not take the same amount of time as section B.

Explain whether section D will take more time or less time than section B.

As part of your answer you should:

- calculate the amount of energy transferred during section D
- calculate the time taken for section D
- use physical principles to explain why section B and section D take different amounts of time.

QUESTION TWO: STAYING WARM

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When living or working in a very cold environment such as Antarctica, it is important to wear clothing suited to the environment to stay warm.

One of the best ways to stay warm in a very cold environment is to "dress like an onion" with many layers.

www.antarcticanz.govt.nz/education/classroom-antarctica/for-students/clothing/

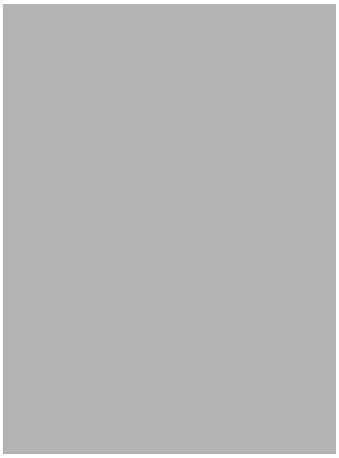
(a) State one property of a material that would help keep a person warm in a very cold environment.

(b) Explain why several thin layers of clothing are more effective at keeping a person warm than one thick layer.

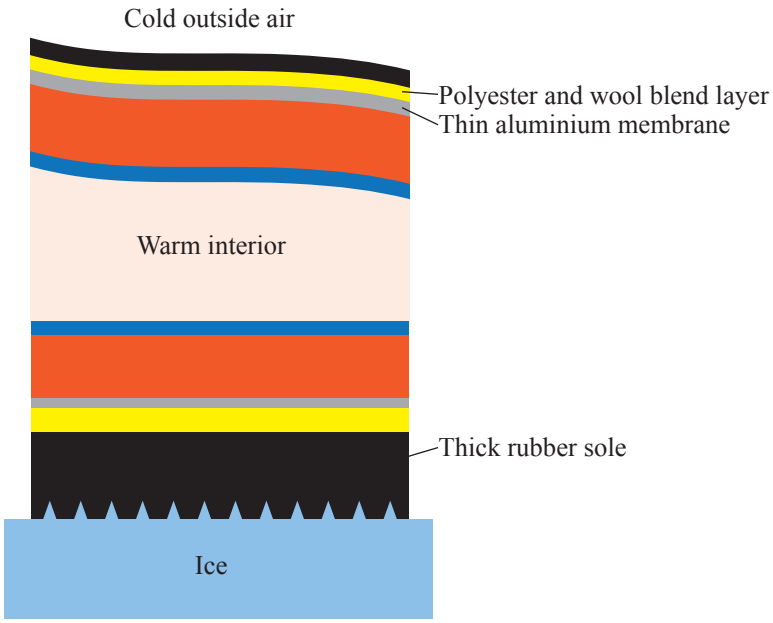
(c) An unexpected problem that can occur in a very cold environment is wearing too many layers. This can cause the person to sweat, which can make the person colder. To help prevent this problem, the layers next to the skin are made of materials that draw moisture away from the skin. This is known as "wicking".

Using the concept of latent heat, explain why having water next to the skin would make the person feel colder.

(d) Modern boots for very cold environments are designed to help keep the feet warm. They have very thick rubber soles, and have several layers made of different materials.



www.baffin.com/ProductDetails.asp?ProductCode=POLAM005



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Explain how each of the labelled layers will help keep the feet warm.

Your answer should refer to the relevant features of each layer and the heat-transfer methods involved.

(i) Thick rubber sole: _____

(ii) Thin aluminium membrane: _____

(iii) Polyester and wool blend layer: _____

QUESTION THREE: RODRIGUEZ WELL

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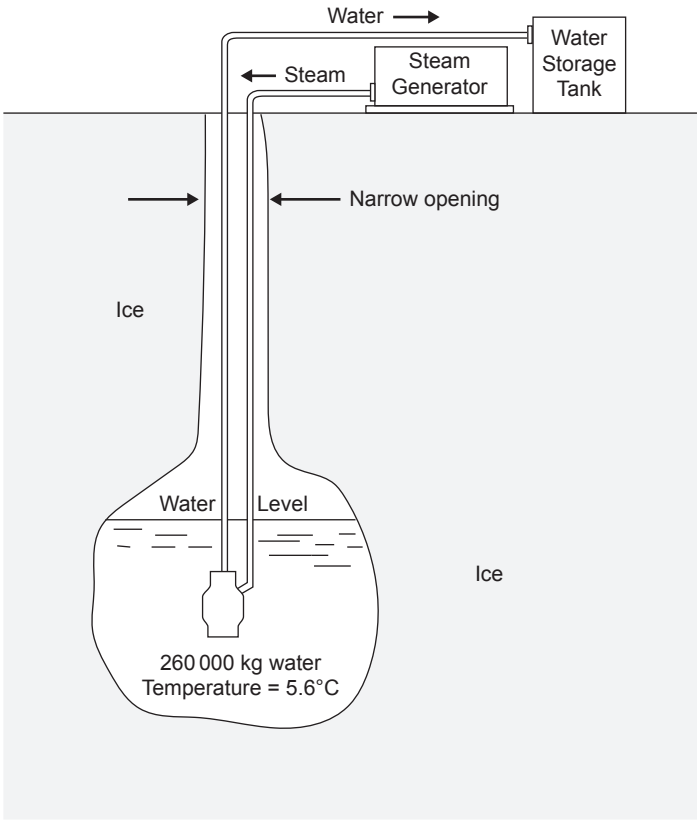
A Rodriguez well is used to produce large amounts of liquid water at camps in places such as Greenland and Antarctica where all the available water is frozen into thick ice sheets. Steam is produced by a steam generator, and is pumped below the surface to melt ice. The liquid water produced is then pumped back to the surface.



(a) The water in the well is warmer than the ice surrounding it.

Describe how the transfer of heat between the water and ice changes the temperature of the ice and the temperature of the water.

(b) Calculate the amount of energy required to raise the temperature of 260 000 kg of liquid water from 0°C to 5.6°C.

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(c) Explain why a Rodriguez well is made with a narrow opening at the top.

Your answer should refer to a relevant heat-transfer method.

(d) (i) The steam generator uses 220 000 W of power to turn liquid water into steam. After being heated to 100°C, the water is then converted to steam, also at a temperature of 100°C.

Calculate the maximum mass of water, initially at 100°C, that can be converted to steam, also at 100°C, in one minute by the steam generator.

(ii) Explain why the actual mass of steam produced by the steam generator in one minute would be less than the amount you calculated in (d)(i).

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

QUESTION NUMBER

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