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Level 1 Physics, 2019

90939 Demonstrate understanding of aspects of heat

2.00 p.m. Tuesday 19 November 2019
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 2–12 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.

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QUESTION ONE: HOUSE HEATING

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Useful information:
Specific Heat Capacity of dry air = 1006 J kg^{-1} $°C^{-1}$
Specific Heat Capacity of water = 4200 J kg^{-1} $°C^{-1}$

(a) State the meaning of the phrase "the Specific Heat Capacity of water is 4200 J kg^{-1} $°C^{-1}$".

During winter Abi uses an electric heater to heat her house. She has a house that contains 600 kg of dry air.

(b) Calculate the amount of heat energy required to raise the temperature of all the air in Abi's house from 16°C to 21°C.

(c) Abi's house has poor ventilation. During the course of the day, the amount of water vapour in the air increases, and the humidity in her house increases.

Explain why it would take more energy to raise the temperature of humid air from 16°C to 21°C than it did for dry air.

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(d) On a cold day Abi uses a heater to keep the air in the house at a constant temperature. Every 5 minutes the house loses 150 kJ of heat to the outside environment through the roof, windows, walls, and gaps. The efficiency of the heater is 85%.

(i) Calculate the total power used by the heater to keep the air in the house at a constant temperature.

(ii) Abi installs insulation in the ceiling of her house.

If the same power heater is used, explain how the temperature inside the house after insulation is installed would compare to the temperature inside the house before insulation was installed.

QUESTION TWO: CURTAINS

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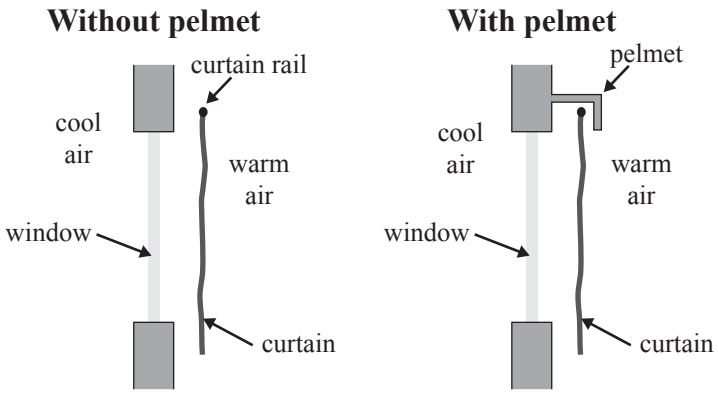
(a) Explain what causes a convection current.

(b) A pelmet is a barrier usually made out of wood, and is hung above a window to reduce the loss of heat from a warm room.

Below is a picture of a pelmet, along with drawings of how a pelmet is installed above a window.



Explain how the warm air in the room can be cooled when the curtain is closed, and how the addition of a pelmet reduces the loss of heat from a warm room.

You may annotate the above diagrams to help with your explanation.

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(c) There are several different types of blinds. Two types are the venetian blind and the honeycomb style, as shown.

Venetian blind

Honeycomb blind

The venetian blind has thin, flat slats with small gaps between them. The honeycomb style has enclosed air-filled sections with no gaps between them.

Explain which type of blind, venetian or honeycomb, would be more effective at reducing the amount of heat loss through the window.

(d) Abi is making tea. She starts by boiling 200 g of water. The initial temperature of the water was 20°C.

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Calculate the amount of energy required to turn all 200 g of water at a temperature of 20°C into steam at a temperature of 100°C.

Useful data is provided on the resource sheet.

QUESTION THREE: HEATING CURVE

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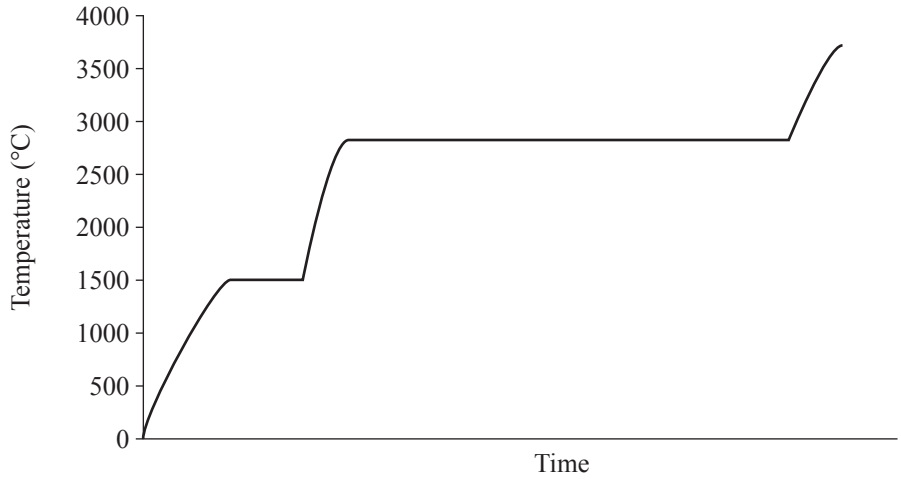
Useful information:
Latent heat of fusion of iron = 272 000 J kg^{-1}
Latent heat of vaporisation of iron = 6 243 000 J kg^{-1}

The graph below is a heating curve for iron.



(a) Name the processes occurring at the temperatures 1500°C and 2850°C on the graph above.

1500°C: _____

2850°C: _____

(b) Using the information about latent heat given above, explain why it takes longer for iron to go from liquid to gas than it did to go from solid to liquid.

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Question Three continues on the following page.

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(c) (i) In the space below, draw the arrangement of iron particles at 1000°C, and the arrangement of iron particles at 2000°C.

Arrangement of iron particles at 1000°C	Arrangement of iron particles at 2000°C

(ii) Compare the **motion** of iron particles at 1000°C to the **motion** of iron particles at 2000°C.

(d) Railway tracks are made of steel, which is a mixture of iron and other elements. On hot summer days the effects of the high temperature can cause railway tracks to bend as shown.

Railway tracks are designed to prevent bending on hot days. One way the design of railway tracks has been modified to prevent them from bending on hot days is to build each rail in sections with small gaps in between each section as shown.

Source (top photo): https://tinyurl.com/y59rvpox

Explain how the addition of a small gap between sections prevents the bending of the track on hot days.

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As part of your answer you should:

- describe how the motion of particles in a solid metal changes when the temperature of the metal increases
- state the effect this has on the metal
- explain how this causes the track to bend
- explain how a gap between each section of track reduces bending.

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

QUESTION NUMBER

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