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NZQA

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Tick this box if there is no writing in this booklet

Level 1 Physics 2020

90939 Demonstrate understanding of aspects of heat

9.30 a.m. Thursday 3 December 2020
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: OUT ON THE PADDOCK

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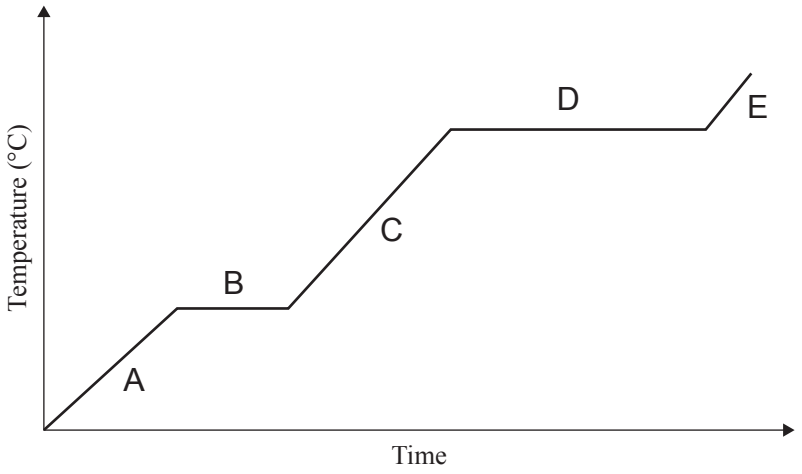
https://en.wikipedia.org/wiki/Frost#/media/File:Saint-Amant_16_Gel%C3%A9e_blanche_2008.jpg

Martha lives in a small house on a farm. One early morning, before leaving the house for work, she looks out of her window and sees frost on the paddock. The frost consists of small ice crystals. Martha observes that the frost melts in the morning sun.

(a) What is the name of the process by which heat is transferred from the sun to the paddock?

(b) The graph below shows the heating curve of water.



Referring to sections B and D of the graph above, explain why there is no change in temperature, although the water is being continuously heated.

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(c) If every square metre of frosty paddock receives 750 W of solar energy, calculate the maximum amount of frost that could be melted on one square metre of paddock in one minute.

The latent heat of fusion of ice (water) is 330 000 J kg^{-1}

(d) Eventually the melted water will evaporate in the sunlight.

Explain, in terms of **kinetic theory**, why the latent heat of vaporisation of water is much greater than the latent heat of fusion of water.

In your answer, you should:

- define the term 'latent heat'
- compare the arrangements of particles and the forces in all relevant states of matter
- explain why energy is required to achieve the relevant phase changes.

QUESTION TWO: IT'S COLD INSIDE

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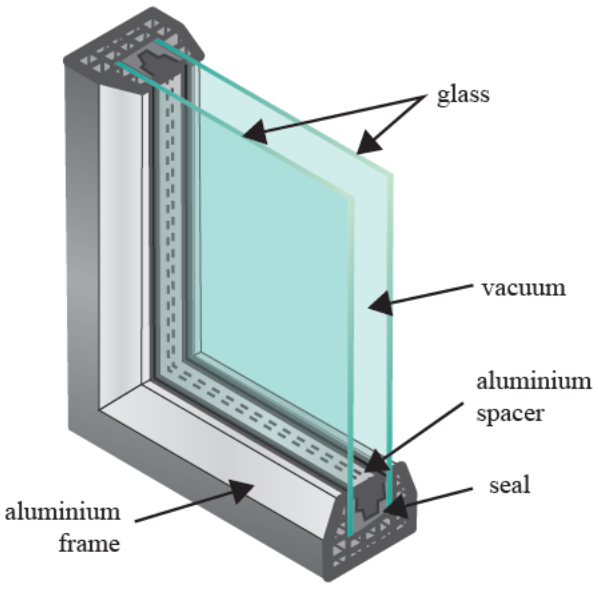
Martha's house is poorly insulated, and gets very cold overnight. On many mornings, moisture in the air has condensed to water on her windows.

https://i.ytimg.com/vi/652EVswcbhU/maxresdefault.jpg

(a) State how the average kinetic energy and the average speed of the water particles changes when steam undergoes condensation on the cold windowpane.

(b) To help insulate her home, Martha plans to get her windows fitted with double glazing. A typical double-glazed windowpane is shown in the diagram. It consists of a strong aluminium frame that holds two sheets of glass with a vacuum between them.

Describe the process of heat loss through the windows, and explain, in terms of relevant types of heat transfer, how double glazing would minimise this heat loss.



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(c) Martha has TWO small 1000 W heaters to heat her home. On a normal morning, Martha's home contains 172 kg of damp air.

Martha runs her TWO heaters for 45 minutes.

Show that the most the temperature in her home would increase is 17.4 °C.

The specific heat capacity of damp air is 1800 J kg^{-1} $°C^{-1}$.

(d) In actual fact, Martha's home increased in temperature by only 12 °C.

(i) Calculate how much energy was lost.

(ii) Explain possible reasons for the energy loss.

QUESTION THREE: GROWING GRAPES

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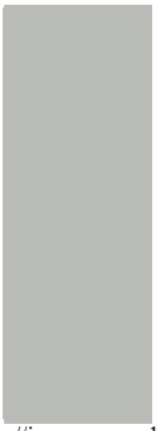
Martha manages a small vineyard on her property. Her grapes grow on trellises close to the ground. On calm, windless mornings, a layer of very cold air can build up near the ground. In extreme cases, this can lower the temperature down to the freezing point of water, causing a frost and potentially damaging the crops.

Martha's success as a grape grower depends on her ability to protect her crops from frost. Therefore, she has invested in equipment that helps her observe and manage heat transfer on her vineyard.



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(a) Martha measures the air temperature with a simple thermometer. It consists of a very thin glass tube that contains a coloured liquid. When the liquid warms up, it pushes up the tube and Martha can read its temperature off a scale.

Explain, in terms of kinetic theory, why the liquid rises up the tube when it warms up.

(b) Explain the term 'convection'.

(c) Explain why the convection currents can cause damage to the crops.

(d) Martha operates a selective inverse sink (SIS) frost-protection system. The SIS consists of a large fan that is built into the lower part of a tall, chimney-like tower. When switched on, the fan draws in cold air from the ground, pushes it up through the tower, and out into the atmosphere.

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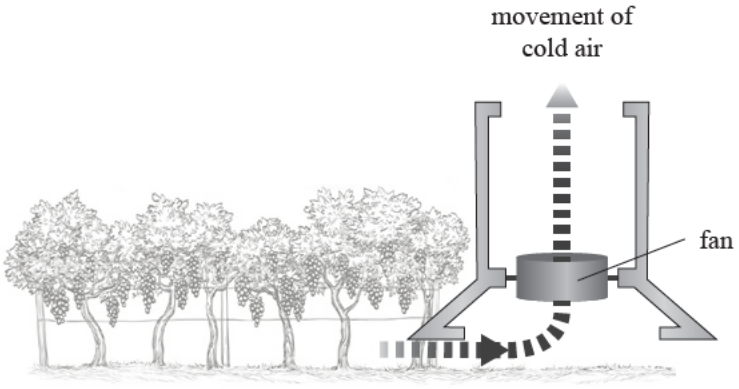

selective inverse sink

Explain how the SIS warms the vineyard at ground level.

In your answer, you should:

- explain why a layer of very cold air can build up near the ground when Martha does not run the SIS
- discuss, in terms of relevant types of heat transfer, how the SIS helps to achieve a net flow of heat energy to the ground.

You should draw and label the movement of air on the above diagram to support your written answer.

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

QUESTION NUMBER

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