Thermal Properties and Temperature – 2019 June

1. 0625/31/M/J/19/No.6

A liquid-in-glass thermometer is placed in some ice made from pure water. The ice is heated. It changes to water and then to steam.

The graph in Fig. 6.1 shows how the temperature varies with time. The values of temperature are missing from the y-axis.

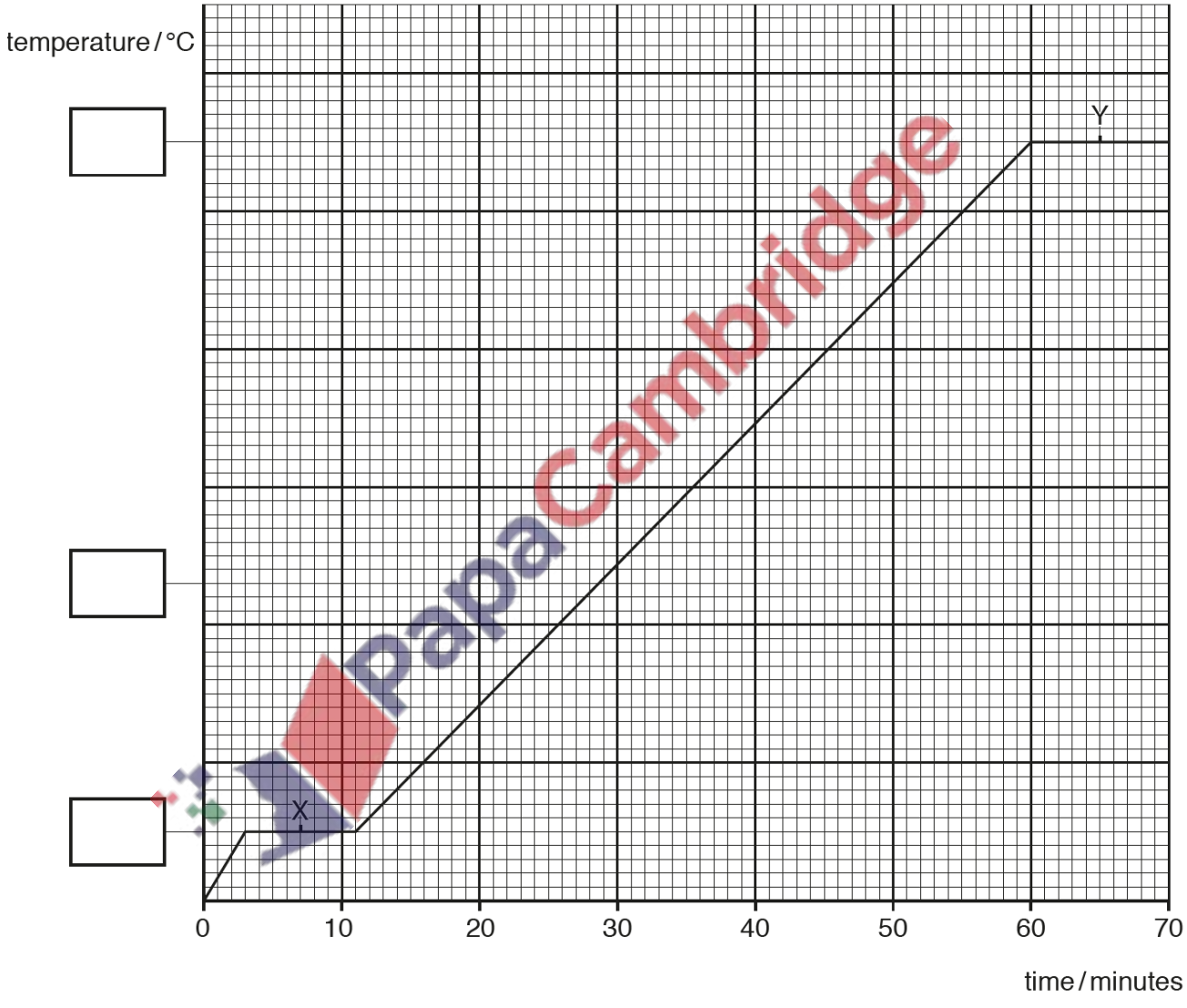

Fig. 6.1

(a) On Fig. 6.1, suggest a value for the temperature at each of the three points marked on the y-axis.

Write a value in each of the boxes. [2]

(b) In both section X and section Y the line on the graph is horizontal.

For each section, state the name for the process taking place and explain what is happening to the molecules.

(i) section X

name .....

explanation .....

.....

.....

.....

[2]

(ii) section Y

name .....

explanation .....

.....

.....

.....

[2]

[Total: 6]

2. 0625/41/M/J/19/No.4

Gas of mass 0.23 g is trapped in a cylinder by a piston. The gas is at atmospheric pressure which is 1.0×10^5 Pa. Fig. 4.1 shows the piston held in position by a catch.

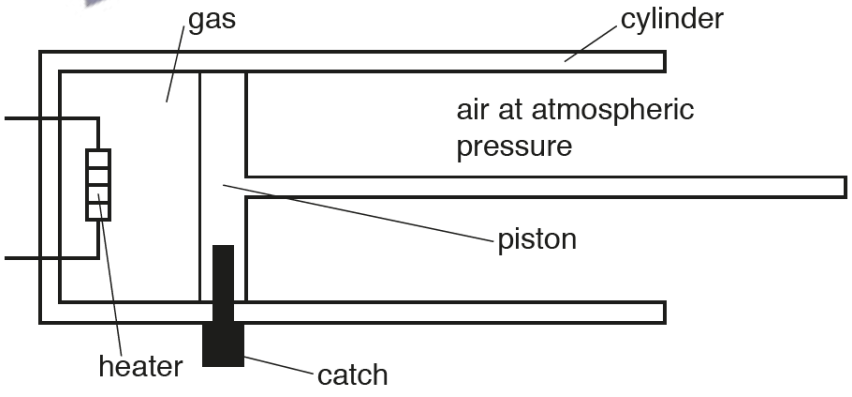

Fig. 4.1

The volume of the trapped gas is $1.9 \times 10^{-4}\,m^3$.

An electrical heater is used to increase the temperature of the trapped gas by 550 °C.

(a) The specific heat capacity of the gas is 0.72 J/(g °C).

(i) Calculate the energy required to increase the temperature of the trapped gas by 550 °C.

energy = ... [2]

(ii) The power of the heater is 2.4 W.

1. Calculate how long it takes for the heater to supply the energy calculated in **(a)(i)**.

time = ... [2]

2. In practice, it takes much longer to increase the temperature of the gas by 550 °C using the heater.

Suggest **one** reason for this.

.....

.....

..... [1]

(b) When the temperature of the gas has increased by 550 °C, its pressure is 2.9×10^5 Pa. The catch is then released allowing the piston to move. As the piston moves, the temperature of the gas remains constant.

(i) State and explain what happens to the piston.

.....

.....

..... [2]

(ii) Determine the volume of the gas when the piston stops moving.

volume = ... [2]

[Total: 9]

3. 0625/42/M/J/19/No.5

(a) **(i)** A liquid is heated so that bubbles of its vapour rise to the surface and molecules escape to the atmosphere.

State the name of this process ..... [1]

(ii) At a lower temperature than in **(a)(i)**, molecules escape from the surface to the atmosphere.

State the name of this process ..... [1]

(b) **(i)** Fig. 5.1 shows apparatus used to determine the power output of a heater.

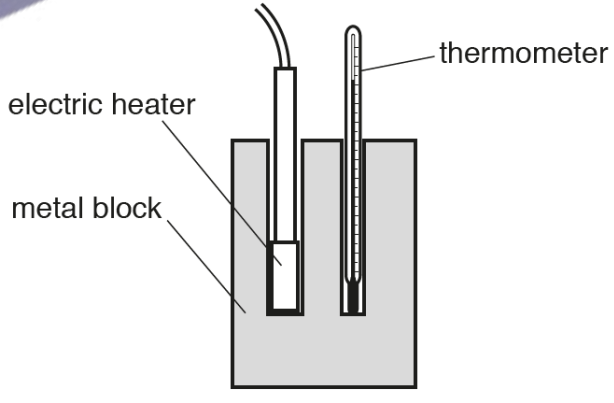

Fig. 5.1

The metal block has a mass of 2.7 kg. The metal of the block has a specific heat capacity of 900 J / (kg °C).

In 2 min 30 s, the temperature of the block increases from 21 °C to 39 °C.

Calculate the power of the heater.

power = ... [4]

(ii) State and explain a precaution that can be taken to improve the accuracy of the experiment.

Statement .....

Explanation .....

.....

[2]

[Total: 8]

4. **(a)** Water molecules escape to the atmosphere from water boiling in a pan. Water molecules evaporate from the surface of a bowl of cool water and also escape to the atmosphere.

State **two** ways in which boiling is different from evaporation.

1. .....

.....

2. .....

.....

[2]

(b) Fig. 4.1 shows a heater in a metal block.

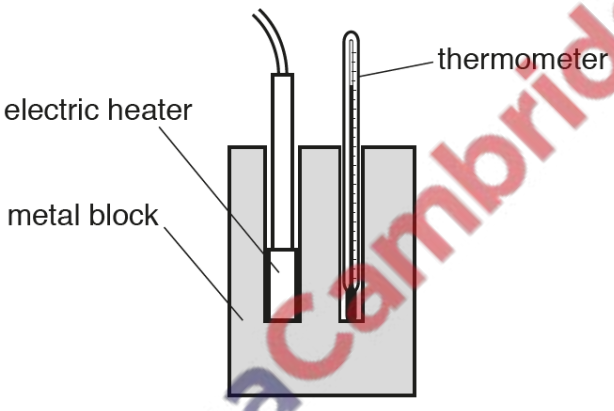

Fig. 4.1

The power of the heater is 370 W and it is switched on for 4.0 minutes. The metal block has a specific heat capacity of 420 J/(kg °C) and a mass of 5.0 kg.

Calculate the increase of temperature of the block. Assume all the thermal energy from the heater is transferred to the block.

temperature increase = ... [4]

[Total: 6]

5. 0625/42/F/M/19/No.5

(a) State the values of the *fixed points* of a temperature scale.

..... [1]

(b) **(i)** The graduations on a liquid-in-glass thermometer are equally spaced.

For the equal spacing of the graduations to be correct, state:

1. an assumption that is made about the liquid in the thermometer

.....

2. an assumption that is made about the structure of the thermometer.

.....

[2]

(ii) Liquid-in-glass thermometer A has a greater range than liquid-in-glass thermometer B.

State **one** way the design of thermometer A is different from thermometer B.

.....

..... [1]

(iii) Liquid-in-glass thermometer C has a greater sensitivity than liquid-in-glass thermometer D.

State **one** way the design of thermometer C is different from thermometer D.

.....

..... [1]

(c) **(i)** In the space provided, draw a labelled diagram of a thermocouple thermometer.

[3]

(ii) Suggest when a thermocouple thermometer is more suitable than a liquid-in-glass thermometer.

.....

..... [1]

[Total: 9]

6. 0625/42/F/M/19/No.6

An electrical heater is placed on the floor of a room in a house. The heater is switched on.

(a) State the main process by which thermal energy is transferred to the air in all parts of the room.

..... [1]

(b) The heater has a power of 1.5 kW. The air in the room has a mass of 65 kg. The specific heat capacity of air is 720 J/(kg °C).

(i) Calculate the time it takes for this heater to raise the temperature of the air in the room from 8.0 °C to 15.0 °C.

time = ... [4]

(ii) State **two** reasons why the time calculated in **(b)(i)** is smaller than the actual time taken to raise the temperature of the air in the room from 8.0 °C to 15.0 °C.

1 .....

.....

2 .....

.....

[2]

[Total: 7]