2.2 Thermal properties and temperature

01. 0625_s23_qp_41 Q: 3

A rubber balloon is inflated with helium and sealed so that no helium escapes.

The balloon is positioned immediately below the ceiling in a room.

Heaters are switched on and the temperature of the air in the room increases.

(a) When the heaters are first switched on, the temperature of the air immediately below the ceiling increases more quickly than the temperature of the air in the rest of the room.

Explain why this happens.

.....

.....

..... [2]

(b) The temperature of the helium in the balloon increases and as the rubber stretches, the volume occupied by the helium increases.

(i) State what happens to the motion of the helium particles as the temperature increases.

.....

..... [1]

(ii) As the rubber stretches and the volume of the helium increases, the pressure of the helium remains constant.

Explain, in terms of the particles of helium, how the pressure of the helium remains constant.

.....

.....

.....

..... [3]

02. 0625_s23_qp_41 Q: 4

A student investigates the efficiency of a filament lamp. Fig. 4.1 shows the filament lamp with its glass bulb immersed in water in a beaker.

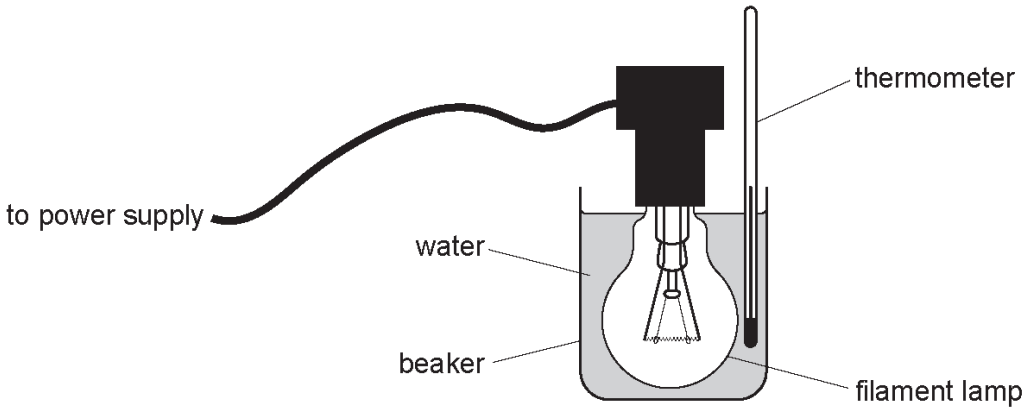

Fig. 4.1

The reading on the thermometer in the water is 19.0 °C.

Only the glass of the lamp is in contact with the water and the electrical connections are completely insulated.

The lamp is switched on.

At the end of the experiment, the temperature of the water is 21.5 °C.

(a) The mass of the water in the beaker is 600 g and the specific heat capacity of water is 4200 J/(kg °C).

(i) Show that the increase in the internal energy of the water is 6300 J.

[3]

(ii) In the experiment, the lamp is switched on for 500 s. The power supplied to the filament lamp is 13 W. The useful energy from the lamp is transferred as light. The energy that increases the temperature of the water is wasted energy.

Determine the maximum possible efficiency of the filament lamp.

maximum possible efficiency = ... [4]

(b) The efficiency of the lamp is less than the value determined in **(a)(ii)**.

Suggest **one** reason for this.

.....

.....

..... [1]

---

03. 0625_s23_qp_43 Q: 3

(a) **(i)** State which state of matter, solid, liquid or gas, has the greatest thermal expansion and which has the least.

greatest expansion .....

least expansion .....

[2]

(ii) Describe, in terms of the motion and arrangement of particles, the structures of solids and gases.

solids .....

.....

gases .....

.....

[3]

(b) **(i)** Define specific heat capacity.

.....

.....

[2]

(ii) A student carries out an experiment to determine the specific heat capacity of a metal. A cylinder of the metal is heated by a 12 W electrical heater.

State the readings that the student takes.

.....

.....

..... [3]

---

04. 0625_w23_qp_42 Q: 2

Fig. 2.1 shows an electric tumble dryer used to dry wet clothes.

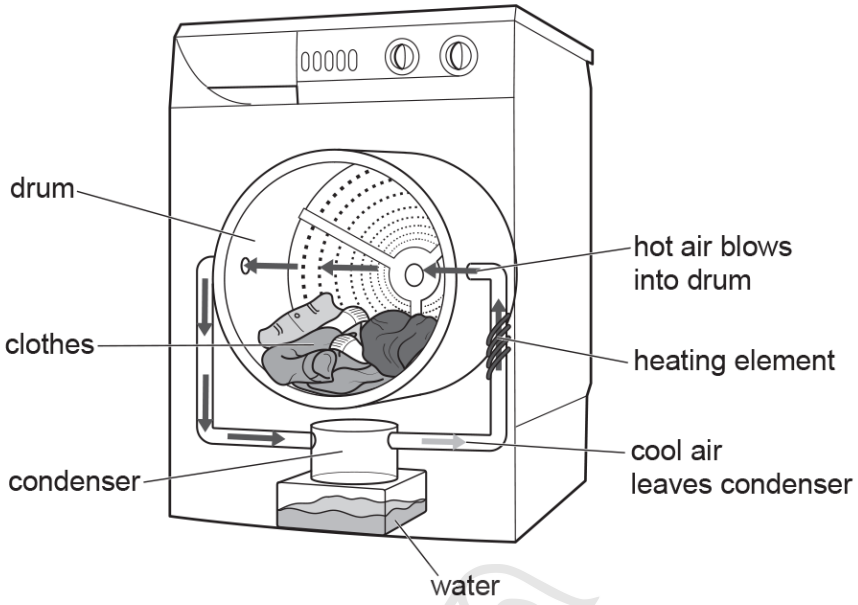

Fig. 2.1

(a) Hot air blows into the drum. The air gains water vapour from the clothes and then leaves the drum. The moist air enters the condenser. Cool air leaves the condenser, passes through the heating element and enters the drum again.

(i) State the process by which the hot air removes water from the wet clothes.

..... [1]

(ii) The air is cooled as it passes through the condenser.

Describe and explain **one** other way in which the air leaving the condenser is different from the air entering the condenser.

description .....

explanation .....

.....
[2]

(b) The drum of the tumble dryer rotates, lifting up the wet clothes which then fall down through the hot air.

(i) Name the force that causes the clothes to fall down.

..... [1]

(ii) When the drum rotates too fast the clothes remain in contact with the wall of the drum.

State the direction of the resultant force on the clothes during the circular motion.

..... [1]

(c) Suggest why using a clothesline to dry clothes in the open air is better for the environment than using an electric tumble dryer.

.....

..... [1]

---

05. 0625_w23_qp_42 Q: 4

Fig. 4.1 shows a bottle part-filled with water. The air inside the bottle is at the same pressure as the air outside the bottle. The bottle and its contents are at room temperature.

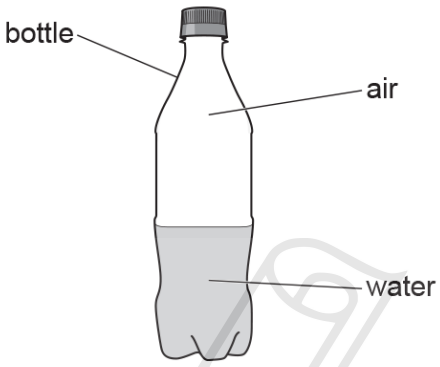

Fig. 4.1

(a) The temperature of the bottle and its contents are increased.

(i) Explain, in terms of particles, how the air pressure inside the bottle changes as the temperature increases.

.....

.....

.....

..... [3]

(ii) The lid is removed from the bottle.

State and explain how the air pressure inside the bottle changes.

statement .....

explanation .....

.....

[2]

(b) The mass of water in the bottle is 0.18 kg. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy needed to increase the temperature of the water by 20 °C.

thermal energy = ... [2]

(c) Another plastic bottle is filled to the top with water. The height of the bottle is 40.0 cm. The density of water is 1.0×10^3 kg/m^3.

Calculate the pressure difference between the top and bottom of the water.

pressure difference = ... [2]

06. 0625_m22_qp_42 Q: 3

Fig. 3.1 and Fig. 3.2 show how a puddle of water changes on a warm windy day.

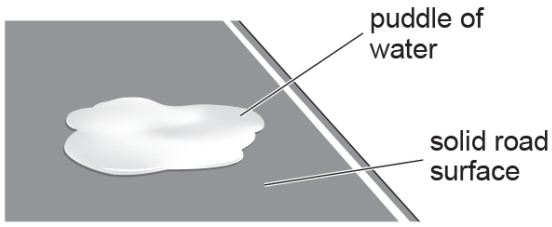

Fig. 3.1

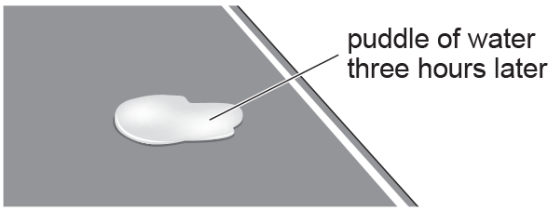

Fig. 3.2

(a) Describe the process by which the volume of water in the puddle decreases.

.....

.....

..... [2]

(b) State and explain **one** change in the weather that would cause the volume of water in the puddle to decrease more slowly.

statement .....

explanation .....

.....

[2]

(c) Explain, in terms of molecules, how sweating helps to cool your body on a hot day.

.....

.....

.....

..... [3]

07. 0625_s22_qp_41 Q: 4

A thermocouple is a device that is used as a thermometer.

(a) Fig. 4.1 shows a beaker that contains molten sulfur at an initial temperature greater than 400 °C.

(i) On Fig. 4.1, sketch and label a diagram of a thermocouple that is used to determine the temperature of the sulfur as it cools to room temperature.

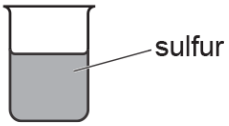

Fig. 4.1

[4]

(ii) Describe briefly how the temperature of the sulfur in the beaker is deduced.

.....

.....

..... [2]

(b) State **one** advantage of using a thermocouple to measure temperature rather than using a liquid-in-glass thermometer.

.....

..... [1]

08. 0625_s22_qp_42 Q: 4

(a) State and explain the **two** features of a liquid-in-glass thermometer that are necessary for linearity.

statement 1 .....

explanation .....

statement 2 .....

explanation .....

[4]

(b) The value of the heat capacity of the hot junction of a thermocouple thermometer is important in ensuring that it can measure temperature changes very rapidly.

Explain why.

.....

.....

.....

..... [2]

(c) The hot junction of a thermocouple thermometer has a heat capacity of 0.11 J/°C.

Calculate the thermal energy required to increase the temperature of the hot junction from 20 °C to 345 °C.

energy = ... [3]

09. 0625_s22_qp_43 Q: 5

(a) Define specific heat capacity.

.....

..... [2]

(b) A bowl contains 500 cm^3 of water at a temperature of 5.0 °C. The bowl of water is placed in a freezer for several hours. When the bowl is removed from the freezer, it contains ice at a temperature of –18.0 °C. The density of water is 1000 kg/m^3.

(i) Calculate the mass of water in the bowl when it is placed in the freezer.

mass = ... [2]

(ii) The specific heat capacity of water is 4200 J/(kg °C). The specific heat capacity of ice is 2100 J/(kg °C). The specific latent heat of fusion of water is 3.3×10^5 J/kg.

Calculate the energy given out as the water cools from 5.0 °C to ice at –18.0 °C.

energy = ... [5]

10. 0625_w22_qp_41 Q: 4

A quantity of gas is trapped by a piston in a cylinder with thin metal walls. The piston is free to move without friction within the cylinder.

Fig. 4.1 shows the cylinder and piston.

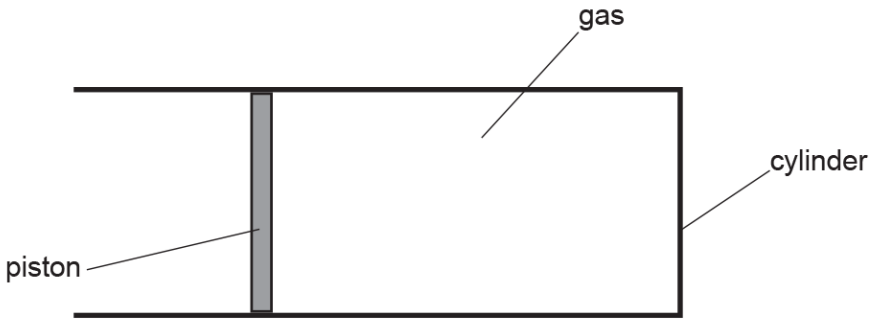

Fig. 4.1

The cylinder is placed inside a freezer.

(a) The air in the freezer is at atmospheric pressure, which is 1.0×10^5 Pa. The area of the piston in contact with the air in the freezer is 2.4×10^{-3} m^2.

(i) Calculate the force exerted on the piston by the air in the freezer.

force = ... [2]

(ii) When the cylinder is first placed into the freezer, the temperature of the gas in the cylinder decreases and the air pushes the piston into the cylinder.

Calculate the work done on the piston by the air in the freezer as the air pushes the piston a distance of 0.021 m into the cylinder.

work done = ... [2]

(b) The initial temperature of the cylinder and the gas is 21 °C and, in the freezer, the temperature of the cylinder decreases to –18 °C.

The thermal capacity of the cylinder is 89 J / °C.

Calculate the change in the internal energy of the cylinder.

change in internal energy = ... [2]

(c) When the temperature reaches –18 °C, the pressure of the gas in the cylinder is still equal to that of the atmosphere.

Explain, in terms of the particles of the gas, how the pressure remains equal to its original value.

.....

.....

.....

.....

.....

..... [3]

(d) As the temperature of the metal cylinder decreases, the volume of the metal decreases. The decrease in the volume of the metal is much less than the decrease in the volume of the gas.

Explain, in terms of the particles of the metal, why the decrease in the volume of the metal is less than that of the gas.

.....

.....

..... [2]

11. 0625_w22_qp_43 Q: 4

(a) Fig. 4.1 shows a liquid-in-glass thermometer labelled thermometer X.

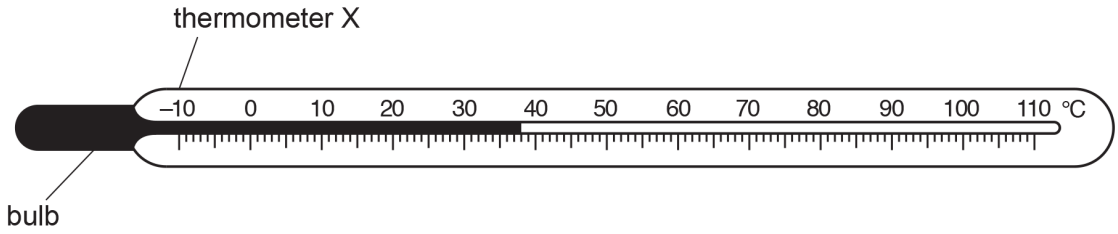

Fig. 4.1

(i) State the physical property which varies with temperature in a liquid-in-glass thermometer.

..... [1]

(ii) Thermometer Y has a bulb that contains twice the volume of liquid compared to thermometer X.

State and explain how the sensitivity of thermometer Y compares with the sensitivity of thermometer X.

statement .....

explanation .....

.....
[2]

(iii) State and explain **one** change that can be made to the design of thermometer X to increase its range.

statement .....

explanation .....
[2]

(b) A liquid-in-glass thermometer cannot measure a temperature of 1300 °C.

State a physical property which varies with temperature in a thermometer which can measure a temperature of 1300 °C.

..... [1]

12. 0625_w22_qp_43 Q: 5

(a) Three identical dishes, A, B and C, contain an equal volume of water.

Dish A is outside in sunlight and experiences no wind during the day. Dish B is outside in sunlight and experiences a strong wind during the day. Dish C is in a dark room.

Water evaporates from each dish. After 12 hours, a student measures the volume of water in each dish. Dish C contains the largest volume of water and dish B contains the smallest volume of water.

Explain, in terms of particles, why the three dishes have different volumes of water.

.....

.....

.....

.....

.....

.....

..... [4]

(b) Define specific latent heat of vaporisation.

.....

.....

..... [2]

(c) Fig. 5.1 shows an insulating beaker, crushed ice, an immersion heater and a thermometer.

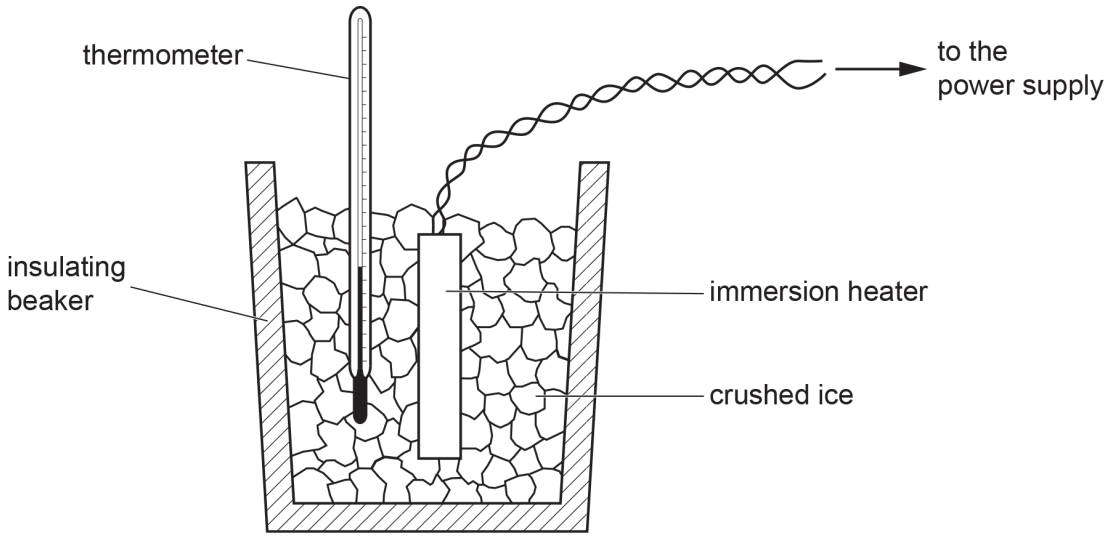

Fig. 5.1

The initial temperature of the ice is –60 °C.
The immersion heater is switched on and the temperature is recorded at equal intervals of time.
Fig. 5.2 shows the temperature–time graph.

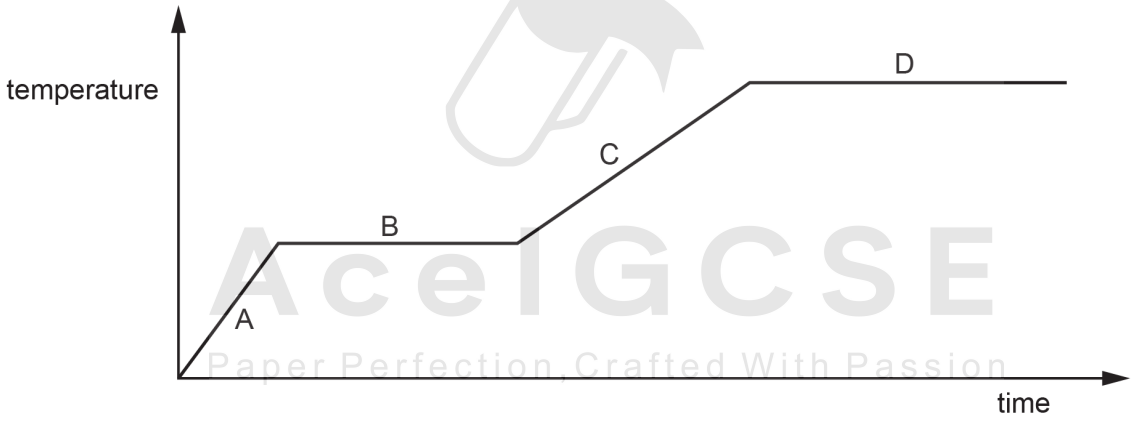

Fig. 5.2

Describe what occurs in each of the sections A, B, C and D.

A .....

B .....

C .....

D .....

[3]

13. 0625_s21_qp_41 Q: 5

Fig. 5.1 shows the structure of a liquid-in-glass thermometer.

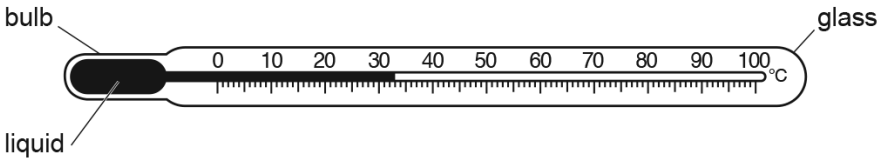

Fig. 5.1

The bulb of the thermometer is placed into a beaker of warm water. As the liquid expands, it moves along the tube.

(a) Explain, in terms of molecules, why a liquid expands when heated.

.....

.....

..... [2]

(b) Explain, in terms of molecules, why a liquid expands more than a solid when heated.

.....

.....

..... [2]

(c) A second thermometer has a larger bulb that contains more of the same liquid than the thermometer shown in Fig. 5.1. It has a different scale. In every other way, it is identical.

(i) Explain how the sensitivity of the second thermometer compares with the sensitivity of the thermometer in Fig. 5.1.

.....

.....

..... [2]

(ii) Explain how the range of the second thermometer compares with the range of the thermometer in Fig. 5.1.

.....

..... [1]

(d) **(i)** State **one** everyday problem that is a result of thermal expansion.

.....

..... [1]

(ii) Suggest and explain **one** way of solving this problem.

.....

.....

..... [2]

[Total: 10]

---

14. 0625_s21_qp_42 Q: 4

(a) Pollen particles are mixed into a liquid. They are seen to move when observed through a microscope.

(i) Describe this movement.

..... [1]

(ii) Explain this movement in terms of the molecules of the liquid and the pollen particles.

.....

.....

..... [3]

(b) **(i)** Medical professionals sometimes rub ethanol over the skin of a patient. Ethanol evaporates readily at room temperature and has a high specific latent heat of vaporisation.

State whether the patient experiences heating, cooling or neither at the site where the ethanol is applied. Explain your answer.

statement .....

explanation .....

.....

..... [3]

(ii) State any effect on the rate of evaporation of ethanol when a fan blows air over the patient's skin.

..... [1]

[Total: 8]

---

15. 0625_s21_qp_43 Q: 4

(a) (i) Define *specific latent heat of fusion*.

.....

..... [2]

(ii) A cup of water contains 250 cm^3 of water at a temperature of 0 °C. An identical cup contains 250 cm^3 of a mixture of ice and water at a temperature of 0 °C.

The temperature of the surrounding air is 20 °C.

State and explain which cup contains the liquid with the lower temperature after 10 minutes.

statement .....

explanation .....

..... [2]

(b) (i) On a hot day, sweat forms on a person's skin and then evaporates.

Explain, in terms of molecules, how the evaporation of sweat cools the person.

.....

.....

.....

.....

..... [3]

(ii) Explain why this process is more effective when a wind is blowing.

.....

..... [1]

[Total: 8]

16. 0625_w21_qp_41 Q: 2

A student carries out an experiment using a plastic beaker that contains 0.24 kg of water at 17 °C. The thermal capacity (heat capacity) of the beaker is negligible.

(a) Define *thermal capacity*.

.....

.....

..... [2]

(b) Several ice cubes are at a temperature of 0 °C. The ice cubes are dropped into the water and the internal energy of the water decreases.

(i) Give a simple molecular account of this decrease in internal energy.

.....

.....

..... [2]

(ii) The specific heat capacity of water is 4200 J / (kg °C).

Calculate the decrease in the internal energy of the water as its temperature decreases from 17 °C to 0 °C.

decrease in internal energy = ... [2]

(c) As the temperature of the water decreases, some of the ice melts.

(i) Explain why this ice melts.

.....

.....

..... [2]

(ii) Describe how to determine the specific latent heat of fusion of ice using this experiment. State any other measurements that the student needs to make.

.....

.....

.....

.....

..... [3]

---

17. 0625_w21_qp_42 Q: 5

(a) A thermocouple thermometer is used to determine the temperature difference between a mixture of ice and water and liquid mercury at approximately 600 °C.

Complete Fig. 5.1 with a labelled diagram to show how the thermocouple thermometer can be used in this way.

Fig. 5.1

[3]

(b) State **two** other physical properties that can be used to measure temperature.

1 .....

2 .....

[2]

(c) State **two** benefits of using a thermocouple thermometer instead of a liquid-in-glass thermometer.

1 .....

2 .....

[2]

---

18. 0625_m20_qp_42 Q: 4

(a) Define the *specific latent heat of fusion* of a substance.

.....

.....

..... [2]

(b) Small pieces of ice at 0 °C are added to 0.35 kg of water. The initial temperature of the water is 24.5 °C. The temperature of the water decreases to 0 °C. The water loses 35 000 J of thermal energy as it cools. All of the ice added to the water melts.

The specific latent heat of fusion of ice is 3.3×10^5 J / kg.

Calculate:

(i) the specific heat capacity of water

specific heat capacity = ... [2]

(ii) the mass of ice added to the water.

mass = ... [3]

[Total: 7]

19. 0625_s20_qp_41 Q: 4

Water has a specific heat capacity of 4200 J/(kg °C) and a boiling point of 100 °C.

(a) State what is meant by *boiling point*.

.....

..... [1]

(b) A mass of 0.30 kg of water at its boiling point is poured into a copper container which is initially at 11 °C. After a few seconds, the temperature of the container and the water are both 95 °C.

(i) Calculate the energy transferred from the water.

energy transferred = ... [2]

(ii) Calculate the thermal capacity of the copper container.

thermal capacity of the copper container = ... [2]

(iii) Water from the container evaporates and the temperature of the remaining water decreases slowly.

Explain, in terms of molecules, why evaporation causes the temperature of the remaining water to decrease.

.....

.....

.....

..... [3]

[Total: 8]

20. 0625_s20_qp_42 Q: 3

(a) A solar panel receives energy from the Sun at a rate of 5.0 kW.

Thermal energy is transferred from the solar panel to water with an efficiency of 20%.

Cold water of mass 15 kg enters the solar panel every hour.

The specific heat capacity of water is 4200 J/(kg °C).

Calculate the temperature increase of the water.

temperature increase = ...°C [4]

(b) State and explain **one** advantage and **one** disadvantage of heating the water in a solar panel compared with heating the water in a coal-burning boiler.

advantage .....

explanation .....

.....

disadvantage .....

explanation .....

..... [4]

[Total: 8]

21. 0625_s20_qp_42 Q: 4

Fig. 4.1 shows a liquid-in-glass thermometer without a temperature scale.
The liquid inside the thermometer has a melting point of –39 °C.

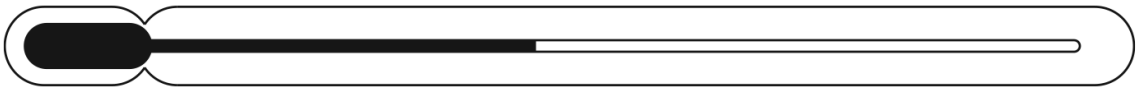

Fig. 4.1

(a) Describe simple experiments to mark the positions of the fixed points on this liquid-in-glass thermometer.

.....

.....

.....

.....

.....

..... [4]

(b) A scientist is measuring temperatures at the South Pole. These temperatures have a minimum value of –90 °C.

State why the liquid used in the thermometer in Fig. 4.1 would **not** be suitable for this scientist.

..... [1]

(c) State a design change that:

(i) increases the sensitivity of a liquid-in-glass thermometer

..... [1]

(ii) increases the range of a liquid-in-glass thermometer.

..... [1]

(d) State the property of the liquid which ensures that the scale on a liquid-in-glass thermometer is linear.

..... [1]

[Total: 8]

22. 0625_s20_qp_43 Q: 4

(a) Describe, in terms of molecules, what happens when a liquid evaporates.

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 4.1 shows wet clothes drying on a washing line in an outside area.

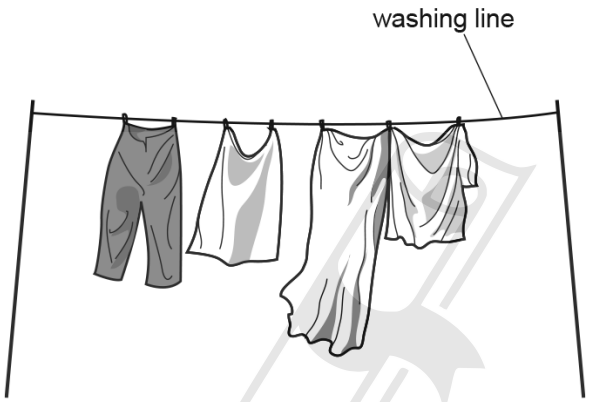

Fig. 4.1

State **two** changes in the weather that help the wet clothes to dry more quickly.

1. .....

2. .....

[2]

[Total: 6]

23. 0625_w20_qp_41 Q: 4

A large test-tube contains a liquid at room temperature. An electric heater is immersed in the liquid and is switched on. Thermal energy is supplied to the liquid by the heater. The temperature of the liquid increases until it reaches its boiling point. The liquid then starts to change into gas.

(a) Describe, in terms of molecules and their motion, how a liquid differs from a gas.

.....

.....

.....

.....

..... [3]

(b) Describe what happens to molecules of the liquid as its temperature begins to increase.

.....

.....

..... [2]

(c) **(i)** Explain, in terms of molecules, why a supply of thermal energy is needed to change the liquid into a gas.

.....

..... [1]

(ii) The density of the liquid in the test-tube is $0.86\,g/cm^3$. The volume of liquid in the test-tube is $50\,cm^3$.

The liquid reaches its boiling point. It now absorbs 18 000 J of thermal energy and all of the liquid changes into a gas.

Calculate the specific latent heat of vaporisation of this liquid.

specific latent heat = ... [3]

24. 0625_w20_qp_42 Q: 4

Fig. 4.1 shows a thermometer.

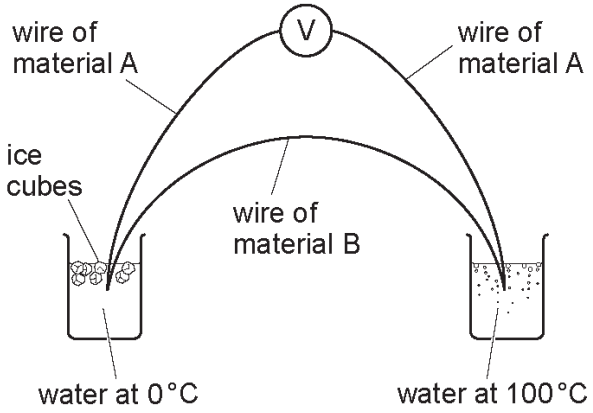

Fig. 4.1

The voltmeter reading is 5.4 mV.

(a) State the name of this type of thermometer.

..... [1]

(b) Fig. 4.2 shows the same thermometer used to measure the temperature of liquid X.

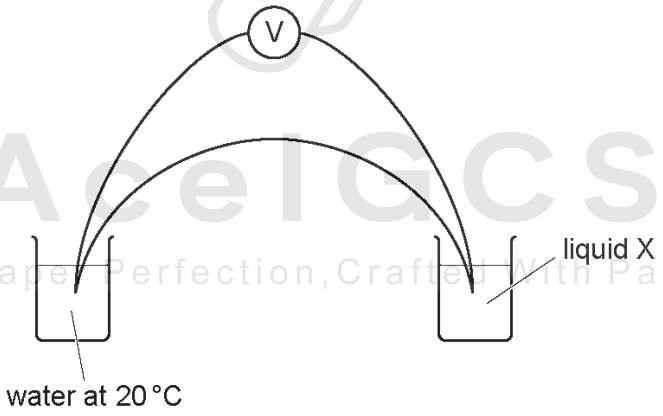

Fig. 4.2

With the setup in Fig. 4.2, the voltmeter reading is 1.7 mV.

Calculate the temperature of liquid X measured by the thermometer.

temperature = ... [2]

(c) Suggest an application for which this type of thermometer is more suitable than a liquid-in-glass thermometer.

..... [1]

25. 0625_w20_qp_42 Q: 5

(a) (i) Define specific latent heat.

.....

..... [2]

(ii) Explain the melting of a solid in terms of molecules and energy.

.....

.....

.....

..... [2]

(b) An electrical heater is used to heat a liquid to its boiling point. Fig. 5.1 shows the apparatus.

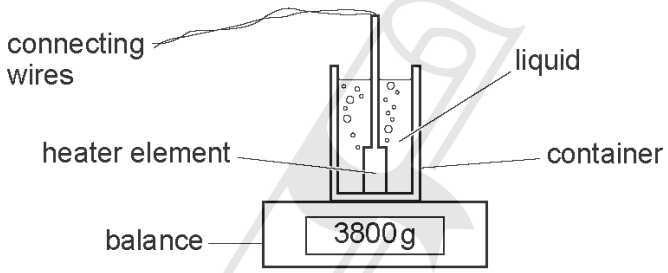

Fig. 5.1

When the liquid is boiling, the heater supplies 1.26 MJ of thermal energy. The mass reading shown on the balance decreases from 3800 g to 2300 g.

Calculate the specific latent heat of vaporisation of the liquid.

specific latent heat = ... [3]

(c) State and explain a precaution to improve the accuracy of the value of specific latent heat calculated in **(b)**.

.....

.....

.....

..... [2]

[Total: 9]

26. 0625_s19_qp_41 Q: 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.

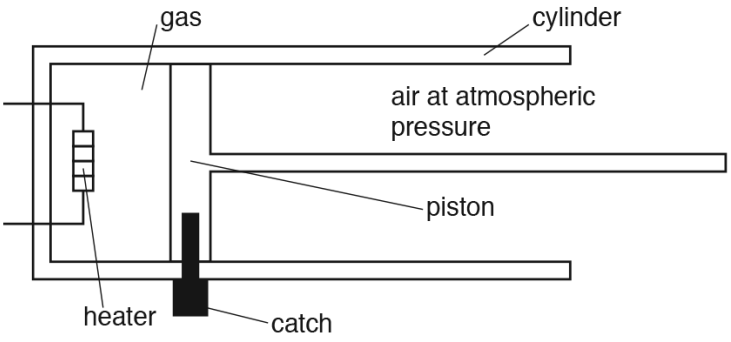

Fig. 4.1

The volume of the trapped gas is 1.9×10^{-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]

27. 0625_s19_qp_41 Q: 5

Liquids and gases are two states of matter.

(a) In both boiling and evaporation, a liquid changes into a gas.

(i) State **two** ways in which boiling differs from evaporation.

1. .....

.....

2. .....

.....

[2]

(ii) Before injecting a patient, a doctor wipes a small amount of a volatile liquid on to the patient's skin.

Explain, in terms of molecules, how this procedure cools the patient's skin.

.....

.....

.....

.....

..... [4]

(b) Gases can be compressed but liquids are incompressible.

Explain, in terms of molecules, why liquids are incompressible.

.....

.....

..... [2]

[Total: 8]

28. 0625_s19_qp_42 Q: 4

(a) State and explain, in terms of molecules, any change in the pressure of a gas when the volume is reduced at a constant temperature.

Statement .....

Explanation .....

.....

.....

.....

.....

.....

[3]

(b) Complete Table 4.1 to give the relative order of magnitude of the expansion of gases, liquids and solids for the same increase of temperature.

Write one of these words in each blank space:

gas **liquid** **solid**

Table 4.1

expands most	
expands least	

[2]

[Total: 5]

29. 0625_s19_qp_42 Q: 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.

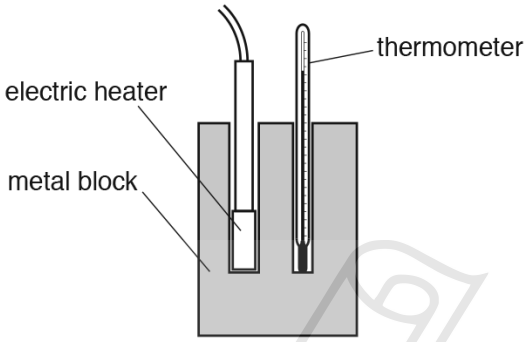

Fig. 5.1

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]

30. 0625_s19_qp_43 Q: 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.

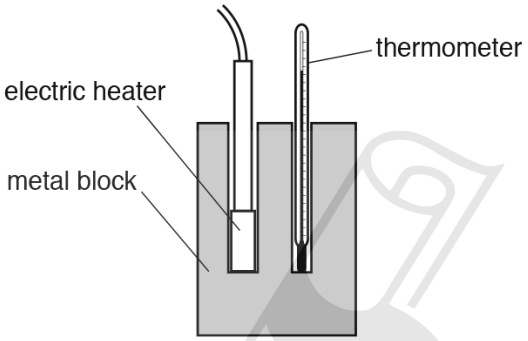

Fig. 4.1

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]

31. 0625_w19_qp_43 Q: 5

An electric kettle contains water at a temperature of 19 °C. The kettle has a power rating of 3.0 kW and is switched on for 3.5 minutes.

(a) Calculate the energy supplied to the kettle by the electricity supply.

electrical energy = ... [3]

(b) At 3.5 minutes, the temperature of the water reaches 100 °C. The volume of the water in the kettle is 1700 cm^3 and its density is 1.0 g/cm^3. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy gained by the water.

thermal energy = ... [5]

(c) Calculate the efficiency of the kettle.

efficiency = ... [2]

[Total: 10]

32. 0625_s18_qp_41 Q: 8

In a laboratory at normal room temperature, 200 g of water is poured into a beaker. A thermometer placed in the water has a reading of 22 °C.

Small pieces of ice at 0 °C are added to the water one by one. The mixture is stirred after each addition until the ice has melted. This process is continued until the temperature recorded by the thermometer is 0 °C.

The total mass of ice added to the water is found to be 60 g.

(a) The specific heat capacity of water is 4.2 J/(g °C).

Calculate the thermal energy lost by the water originally in the beaker.

thermal energy = ...[2]

(b) Assume that all the thermal energy lost by the water originally in the beaker is transferred to the ice.

Calculate the specific latent heat of fusion of ice.

specific latent heat of fusion of ice = ...[2]

(c) Suggest a reason for any inaccuracy in the value of the specific latent heat of fusion of ice calculated in **(b)**. Assume the temperature readings and the values for the mass of the water and the mass of the ice are accurate.

.....

.....[1]

[Total: 5]

33. 0625_w18_qp_41 Q: 5

(a) **(i)** In the space below, draw a labelled diagram of the structure of a thermocouple thermometer. Include the device from which a reading is taken.

[3]

(ii) A thermocouple thermometer is used to measure the temperature of the flame of a small candle.

State **two** reasons why the thermocouple thermometer is suitable for this application.

1. .....

.....

2. .....

.....

[2]

(b) State and explain any effect on the sensitivity of a liquid-in-glass thermometer of:

(i) reducing the diameter of the capillary tube

.....

.....

.....[2]

(ii) increasing the volume of the liquid-filled bulb.

.....

.....

.....[2]

[Total: 9]

34. 0625_w18_qp_41 Q: 6

(a) State **three** factors that determine the rate of evaporation of water.

1. .....

2. .....

3. .....

[3]

(b) A person climbs out of a swimming pool and stands in the open air.

Explain why evaporation of water from the surface of the person's body causes the person to feel cold.

.....

.....

.....

.....[2]

[Total: 5]

35. 0625_w18_qp_42 Q: 4

Fig. 4.1 shows apparatus used by a student to measure the specific heat capacity of iron.

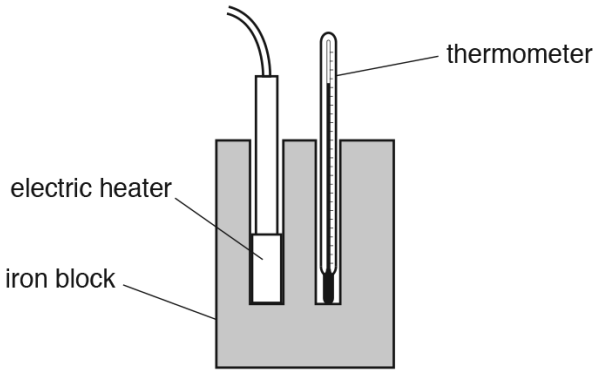

Fig. 4.1

(a) The student improves the accuracy of the experiment by placing material around the block, as shown in Fig. 4.2.

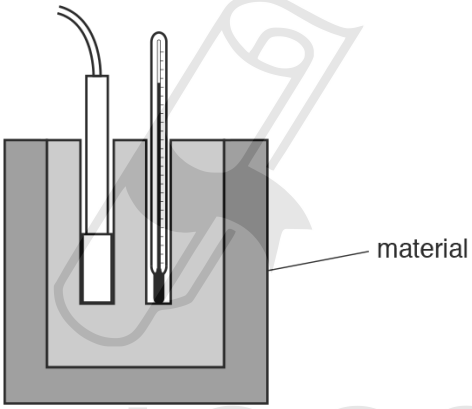

Fig. 4.2

(i) Suggest the name of a possible material the student could use and explain how it improves the accuracy of the experiment.

suggestion .....

explanation .....

.....

.....

[3]

(ii) State how the student could further improve the accuracy of the experiment by using more of the material used in Fig. 4.2.

.....

.....

.....[1]

(b) The current in the heater is 3.8 A and the potential difference (p.d.) across it is 12 V. The iron block has a mass of 2.0 kg. When the heater is switched on for 10 minutes, the temperature of the block rises from 25 °C to 55 °C.

Calculate the specific heat capacity of iron.

specific heat capacity = ...[4]

[Total: 8]

36. 0625_w18_qp_43 Q: 5

(a) A student is supplied with a small block of iron, a thermometer and an electrical heater of power *P*.

There are two holes drilled in the iron block. The heater fits tightly into one hole and the student places the thermometer into the other hole.

Fig. 5.1 shows the equipment.

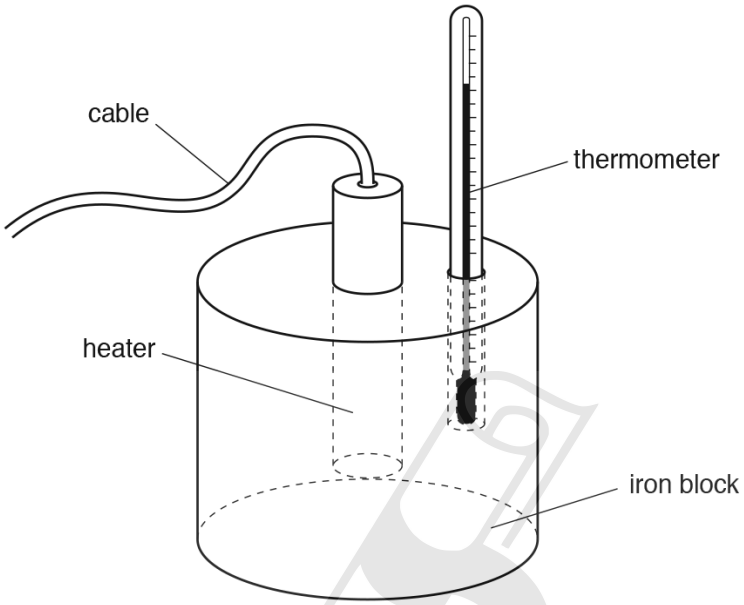

Fig. 5.1

The student uses this equipment when determining the specific heat capacity of iron.

State:

- the other equipment the student will need
- the measurements the student needs to take
- the equation used when calculating the value of the specific heat capacity of iron.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) In the student's home there is a wood-burning stove, which is also made of iron. The mass of the wood-burning stove is 85 kg.

(i) State what is meant by the *thermal capacity* of an object.

.....

.....[1]

(ii) The specific heat capacity of iron is 460 J/(kg °C).
Calculate the thermal capacity of the wood-burning stove.

thermal capacity = ...[2]

[Total: 7]

37. 0625_m17_qp_42 Q: 5

(a) **(i)** State **two** ways in which *evaporation* is different from *boiling*.

1 .....

.....

2 .....

.....

[2]

(ii) Give **one** example of a change of state which does not involve boiling or evaporation.

.....[1]

(b) The graph in Fig. 5.1 shows the variation of temperature with time for a substance that is initially liquid.

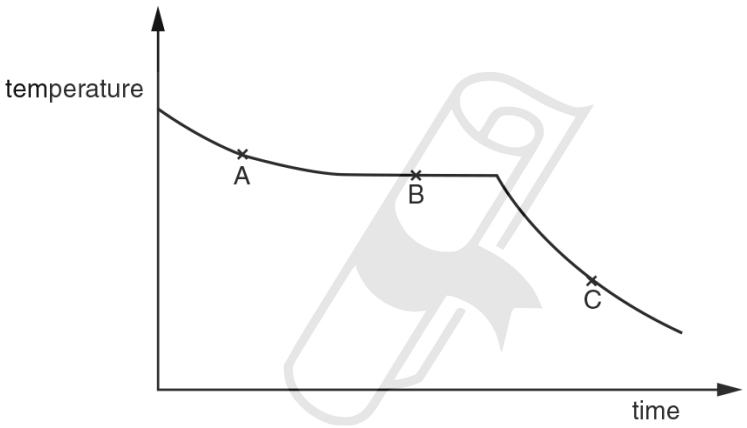

Fig. 5.1

(i) State what is taking place at points A, B and C. You should say what changes of state, if any, are taking place.

point A .....

point B .....

point C .....

[3]

(ii) Suggest why the graph is steeper at point C than at point A.

.....

.....[1]

[Total: 7]

38. 0625_s17_qp_41 Q: 5

Fig. 5.1 shows some gas trapped in a metal cylinder by a piston.

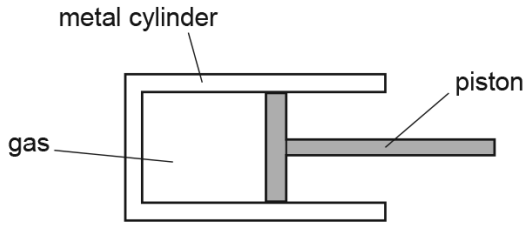

Fig. 5.1

(a) The position of the piston is fixed. The cylinder is moved from a cold room to a warm room.

Explain, in terms of molecules, what happens to the pressure of the gas in the cylinder.

.....

.....

.....

.....

.....

.....[4]

(b) The piston is now released. It moves to the right and finally stops.

Explain these observations in terms of the pressure and the volume of the gas in the cylinder.

.....

.....

.....

.....[2]

[Total: 6]

39. 0625_w17_qp_42 Q: 4

A beaker contains water at room temperature. Fig. 4.1 shows the beaker placed on a tripod above a Bunsen burner.

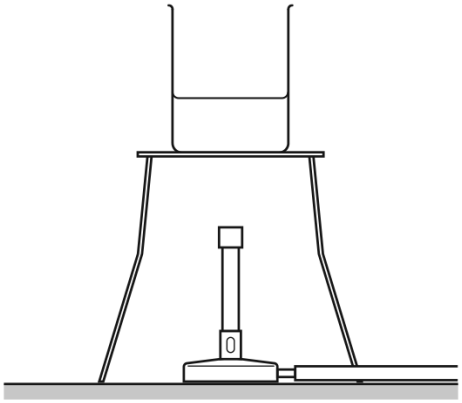

Fig. 4.1

The Bunsen burner is lit and the temperature of the water begins to increase.

(a) The water is evaporating.

(i) Describe **one** difference between evaporation and boiling.

.....

.....

.....[2]

(ii) State and explain what happens to the rate at which the water evaporates as its temperature increases.

.....

.....

.....[1]

(b) After a few minutes, the water reaches its boiling point temperature. The water continues to gain energy from the Bunsen burner.

(i) State what happens to the temperature of the water in the beaker.

.....

.....[1]

(ii) The specific latent heat of vaporisation of water is 2.3×10^6 J/kg. After the water reaches its boiling point, it takes 12 minutes for 0.095 kg of water to boil away.

Calculate the average rate at which energy is being supplied to the water by heating.

rate of energy supplied = ...[3]

[Total: 7]

40. 0625_w17_qp_43 Q: 5

A silver spoon has a thermal capacity of 7.2 J/°C.

(a) Explain what is meant by *thermal capacity*.

.....

.....

.....[2]

(b) The silver spoon is dropped into a saucepan of boiling water. The internal energy of the spoon increases as its temperature increases from 22 °C to 100 °C.

(i) Calculate the increase in the internal energy of the spoon.

increase in internal energy = ...[1]

(ii) State, in terms of the atoms, what is meant by *internal energy*.

.....

.....

.....[2]

(c) The spoon is removed from the boiling water and immediately it begins to transfer energy to the surroundings. The temperature of the surroundings is 22 °C.

On Fig. 5.1, sketch a graph to show how the temperature of the spoon changes with time from the instant that it is removed from the water. [3]

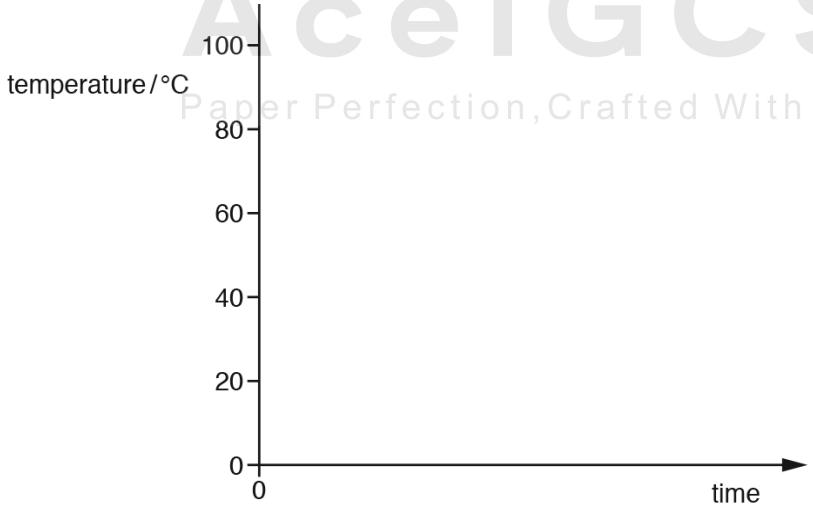

Fig. 5.1

[Total: 8]