

Thermal Properties & Temperature

Question Paper

Course	CIE IGCSE Physics
Section	2. Thermal Physics
Topic	Thermal Properties & Temperature
Difficulty	Hard

Time Allowed	50
Score	/34
Percentage	/100

Question 1a

State and explain any effect on the sensitivity of a liquid-in-glass thermometer of reducing the diameter of the capillary tube.

[2 marks]

Question 1b

State and explain any effect on the sensitivity of a liquid-in-glass thermometer of increasing the volume of the liquid-filled bulb.

[2 marks]

Question 2a

Extended

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

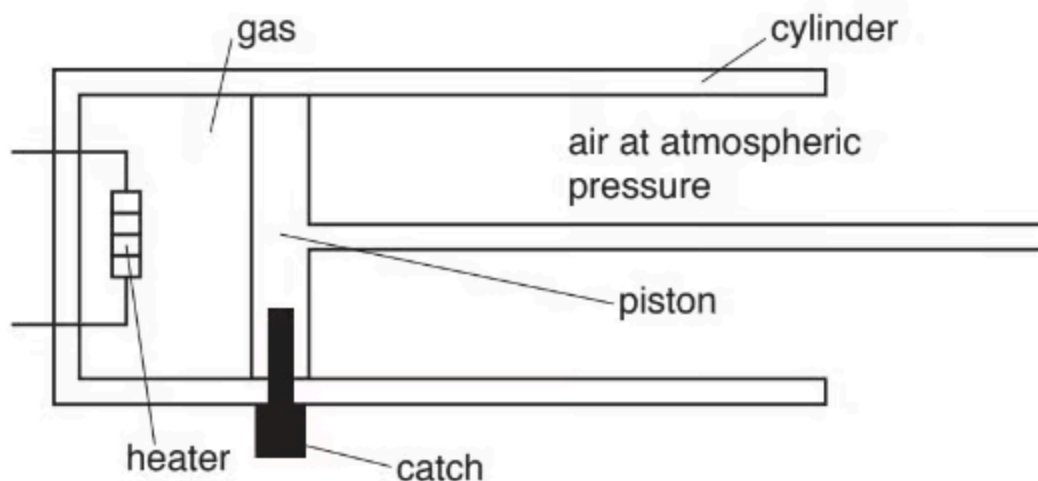


Fig. 4.1

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

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

The specific heat capacity of the gas is $0.72 \text{ J / (g } ^\circ\text{C)}$.

- (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 $550\text{ }^{\circ}\text{C}$ using the heater.

Suggest **one** reason for this.

[1]

[5 marks]

Question 2b

Extended

When the temperature of the gas has increased by $550\text{ }^{\circ}\text{C}$, its pressure is $2.9 \times 10^5\text{ Pa}$. 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 = [3]

[5 marks]

Question 3a

Extended Tier Only

A beaker contains some water at room temperature. A student places a mercury-in-glass thermometer in the water with the bulb of the thermometer just beneath the surface of the water.

Fig. 4.1 shows the arrangement.

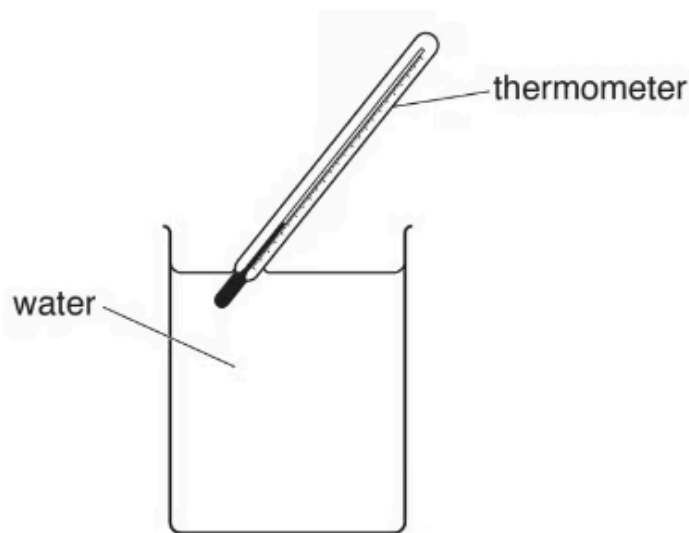


Fig. 4.1

The student uses an electric fan to blow air across the open top of the beaker. She notices that the reading on the thermometer begins to decrease.

Explain, in terms of water molecules, why the temperature of the water at the surface begins to decrease.

[3 marks]

Question 3b

The student places the thermometer near the bottom of the beaker. The electric fan continues to blow air across the top of the beaker. After some time, the student observes that the temperature of the water at the bottom of the beaker is decreasing.

State the name of the thermal transfer method causing this and explain what is happening in the water.

[3 marks]**Question 3c**

The thermometer used in this experiment has a small range and a large sensitivity.

(i) State what is meant by:

1. range

[1]

2. sensitivity

[1]

(ii) State and explain the effect on the range of the thermometer of using a smaller bulb that contains less mercury.

[1]

[3 marks]

Question 4a**Extended**

A group of students were given the equipment shown in Fig. 1.1 and were asked to identify an unknown clear liquid by its specific heat capacity.

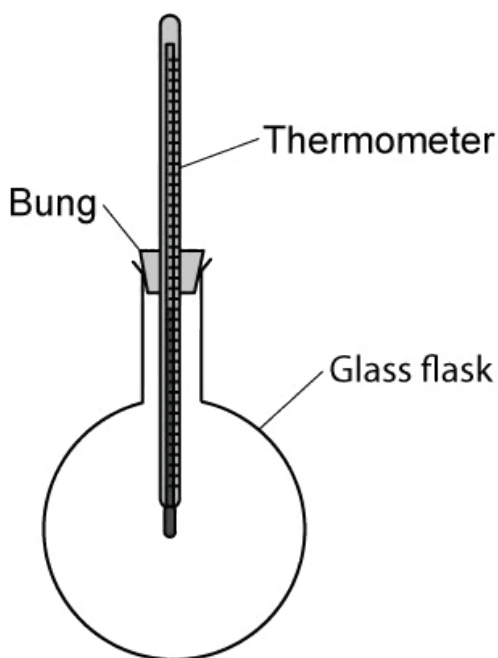


Fig. 1.1

The students were provided with the unknown substance, an electric water bath, and were allowed to use water from the tap.

Suggest why the students were given an electric water bath rather than a Bunsen burner.

[1 mark]

Question 4b**Extended**

List the quantities that the students must measure to determine the specific heat capacity of the unknown liquid.

[3 marks]**Question 4c****Extended**

The students are given Table 1.2 to help with their investigation.

Substance	Specific heat capacity (J/kg °C)
water	4190
ethanol	2460
salt water	3930
acetic acid	2180
glycerine	2430

Table 1.2

Suggest a method for measuring the energy transferred from the water bath to the unknown substance.

[2 marks]

Question 4d**Extended**

The student recorded the following measurements.

Initial temperature of unknown substance = 22°C

Final temperature of unknown substance = 34°C

Mass of unknown substance = 0.41 kg

Energy transferred = $11\,070\text{ J}$

- (i) Identify the unknown substance.
- (ii) Suggest a reason why the value calculated is different to the value given in the table.

[4]

[1]

[5 marks]