1 **(a)** **(i)** Name the process by which thermal energy is transferred through a metal rod.

.... [1]

(ii) Describe how this process occurs.

....

....

....

.... [2]

(b) An iron rod and a copper rod of equal length are each held by hand at one end, with the other end in the flame from a Bunsen burner, as shown in Fig. 4.1.
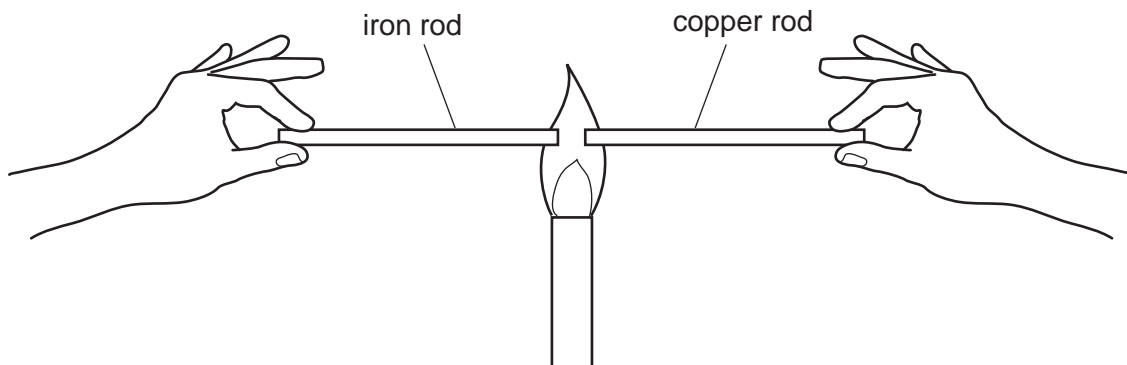

Fig. 4.1

The copper rod becomes too hot to hold much sooner than the iron rod.

What does this information tell you about iron and copper?

.... [1]

(c) Gas has to be above a certain temperature before it burns.

Fig. 4.2 shows two similar wire gauzes, one made of iron wire and one made of copper wire. Each is held over a Bunsen burner. When the gas supply is turned on and ignited below the gauze, the effect is as shown in Fig. 4.2.
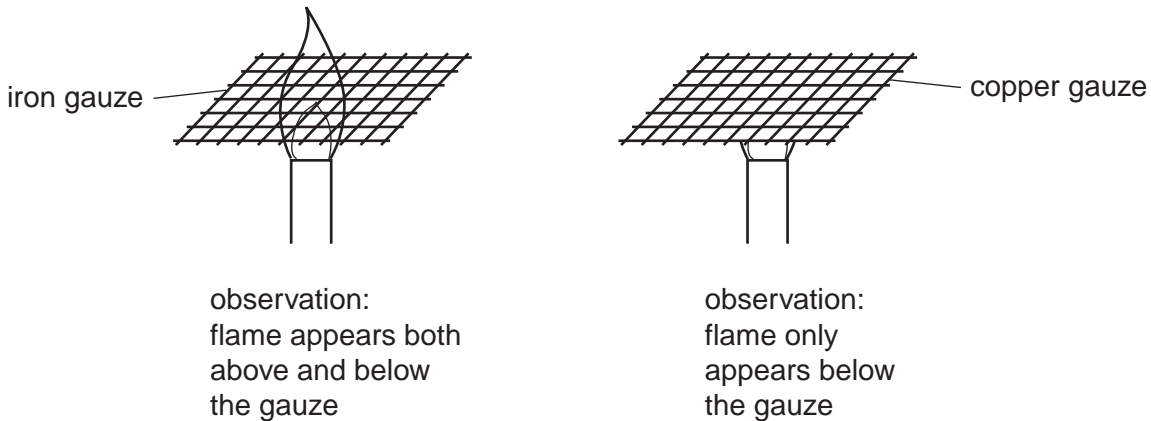

iron gauze

copper gauze

observation:
flame appears both
above and below
the gauze

observation:
flame only
appears below
the gauze

Fig. 4.2

How can these observations be explained?

....

....

....

....

.... [4]

[Total: 8]

2 **(a)** Define *specific heat capacity*.

....

.... [2]

(b) Solar energy is striking the steel deck of a ship.

(i) Describe how the colour of the deck affects the absorption of the solar energy.

....

.... [1]

(ii) The solar energy strikes the deck at the rate of 1400 W on every square metre.

The steel plate of the deck is 0.010 m thick.

Steel has a density of 7800 kg/m^3 and a specific heat capacity of 450 J/(kg°C).

13% of the solar energy striking the deck is absorbed and the rest is reflected.

Using these figures, calculate

1. how many joules of solar energy are absorbed by 1.0 m^2 of the deck in 1.0 s,

number of joules = ... [1]

2. the mass of 1.0 m^2 of deck,

mass = ... [2]

3. the rate of rise in temperature of the deck, stating the equation you use.

rate of rise = ... °C/s [3]

[Total: 9]

3 (a) A certain volume of water at room temperature and the same volume of ice in a freezer are each heated through the same temperature rise.

Which of them will have the greater expansion, and why?

Which? ....

Why? .... [1]

(b) For strength, concrete pillars are usually reinforced with metal rods, which are embedded in the concrete before it sets.

The list below shows how much a length of 1 m of each material expands when the temperature rises by 1 °C.

aluminium   0.03 mm

concrete   0.01 mm

steel   0.01 mm

Use this information to decide which metal should be used to reinforce concrete, why it is suitable, and why the other metal is not suitable.

Which metal should be used? ....

Why is it suitable? ....

Why is the other metal unsuitable? ....

.... [3]

[Total: 4]

4 Three wires and a meter are used to construct a thermocouple for measuring the surface temperature of a pipe carrying hot liquid, as shown in Fig. 7.1.
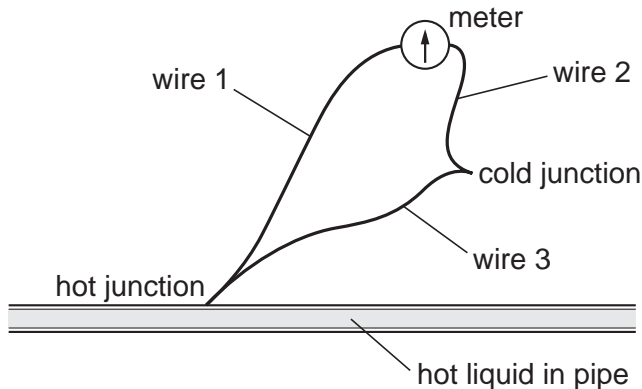

Fig. 7.1

(a) Copper wire and constantan wire are used in the construction of the thermocouple.

State which metal might be used for

wire 1 ....

wire 2 ....

wire 3 ....
[1]

(b) State what type of meter is used.

.... [1]

(c) State one particular advantage of thermocouples for measuring temperature.

.... [1]

[Total: 3]

5 **(a)** State what is meant by *specific heat capacity*.

....

.... [2]

(b) Water has a very high specific heat capacity.

Suggest why this might be a disadvantage when using water for cooking.

....

.... [1]

(c) Fig. 9.1 illustrates an experiment to measure the specific heat capacity of some metal.
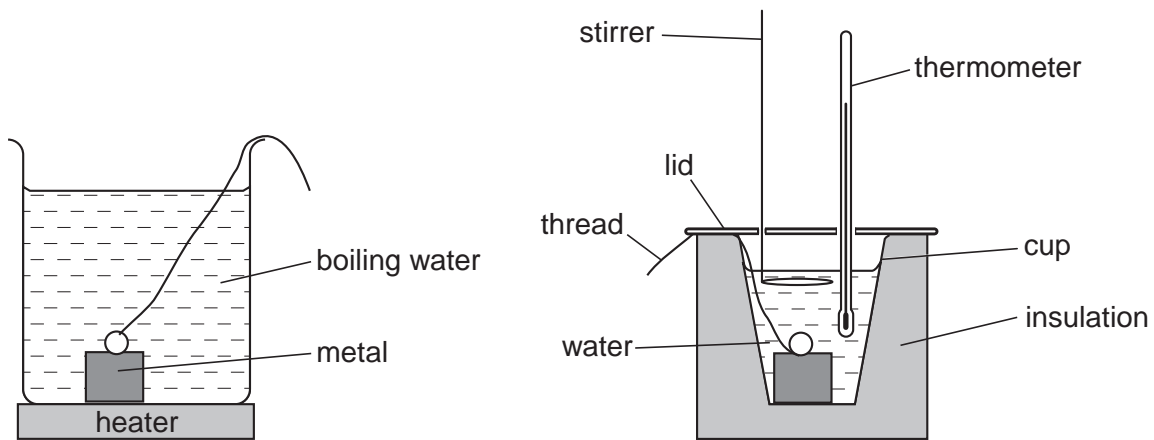

Fig. 9.1

The piece of metal is heated in boiling water until it has reached the temperature of the water. It is then transferred rapidly to some water in a well-insulated cup. A very sensitive thermometer is used to measure the initial and final temperatures of the water in the cup.

specific heat capacity of water = 4200 J/(kg K)

The readings from the experiment are as follows.

mass of metal = 0.050 kg
mass of water in cup = 0.200 kg
initial temperature of water in cup = 21.1 °C
final temperature of water in cup = 22.9 °C

(i) Calculate the temperature rise of the water in the cup and the temperature fall of the piece of metal.

temperature rise of water = ...

temperature fall of metal = ...

[1]

(ii) Calculate the thermal energy gained by the water in the cup. State the equation that you use.

thermal energy gained = ... [3]

(iii) Assume that only the water gained thermal energy from the piece of metal.

Making use of your answers to **(c)(i)** and **(c)(ii)**, calculate the value of the specific heat capacity of the metal. Give your answer to 3 significant figures.

specific heat capacity = ... [2]

(iv) Suggest one reason why the experiment might not have given a correct value for the specific heat capacity of the metal.

....

.... [1]

[Total: 10]