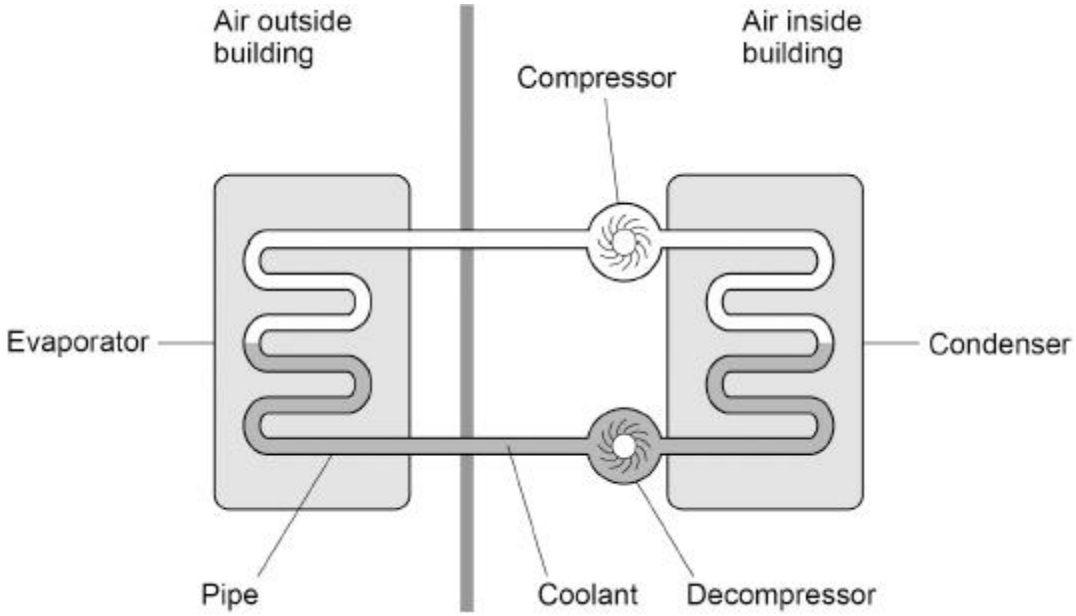
Name of the Student:_____
Max. Marks : 26 Marks **Time : 26 Minutes**

Q1.

An air source heat pump transfers energy from the air outside a building to increase the temperature of the air inside the building.

The figure below shows an air source heat pump.



The compressor is connected to the mains electricity supply.

The pipe in the heat pump contains a substance called coolant.

In the evaporator, energy is transferred from the air outside the building to the liquid coolant.

The temperature of the coolant increases and it evaporates.

(a) Explain what happens to the internal energy of the coolant as its temperature increases.

_____

_____

_____

_____

(2)

(b) What name is given to the energy needed to change the state of the liquid coolant?

_____

(1)

(c) What happens to the mass of the coolant as it evaporates and becomes a vapour?

Tick (✓) **one** box.

Decreases	☐
Stays the same	☐
Increases	☐

(1)

(d) The compressor increases the density and temperature of the coolant vapour inside the pipe.

Explain why the pressure in the pipe increases.

_____

_____

_____

_____

(2)

(e) The condenser transfers energy from the coolant to the air in the building.

When the total energy input to the heat pump system is 1560 kJ the temperature of the air in the building increases from 11.6 °C to 22.1 °C.

The efficiency of the heat pump system is 87.5%.

The mass of the air inside the building is 125 kg.

Calculate the specific heat capacity of the air in the building.

Give your answer in standard form.

_____

_____

_____

_____

_____

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_____

_____

_____

_____

Specific heat capacity (standard form) = _____ J/kg °C

(6)

(f) The air in the building gains 400 J for every 100 J of energy transferred from the mains electricity supply to the compressor.

An advertisement claims that the heat pump system has an efficiency of 400%.

Explain why the advertisement is **not** correct.

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)

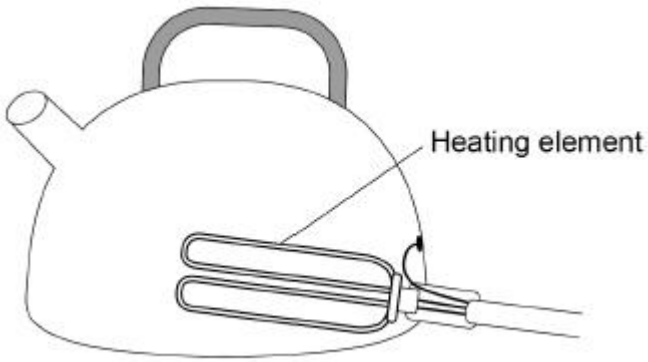
Q2.

A student investigated how the mass of water in an electric kettle affected the time taken for the water to reach boiling point.

The kettle switched off when the water reached boiling point.

Figure 1 shows the kettle.

Figure 1



(a) The heating element of the kettle was connected to the mains supply.

Explain why the temperature of the heating element increased.

_____

_____

_____

_____

_____

_____

(2)

(b) Give **one** variable that the student should have controlled.

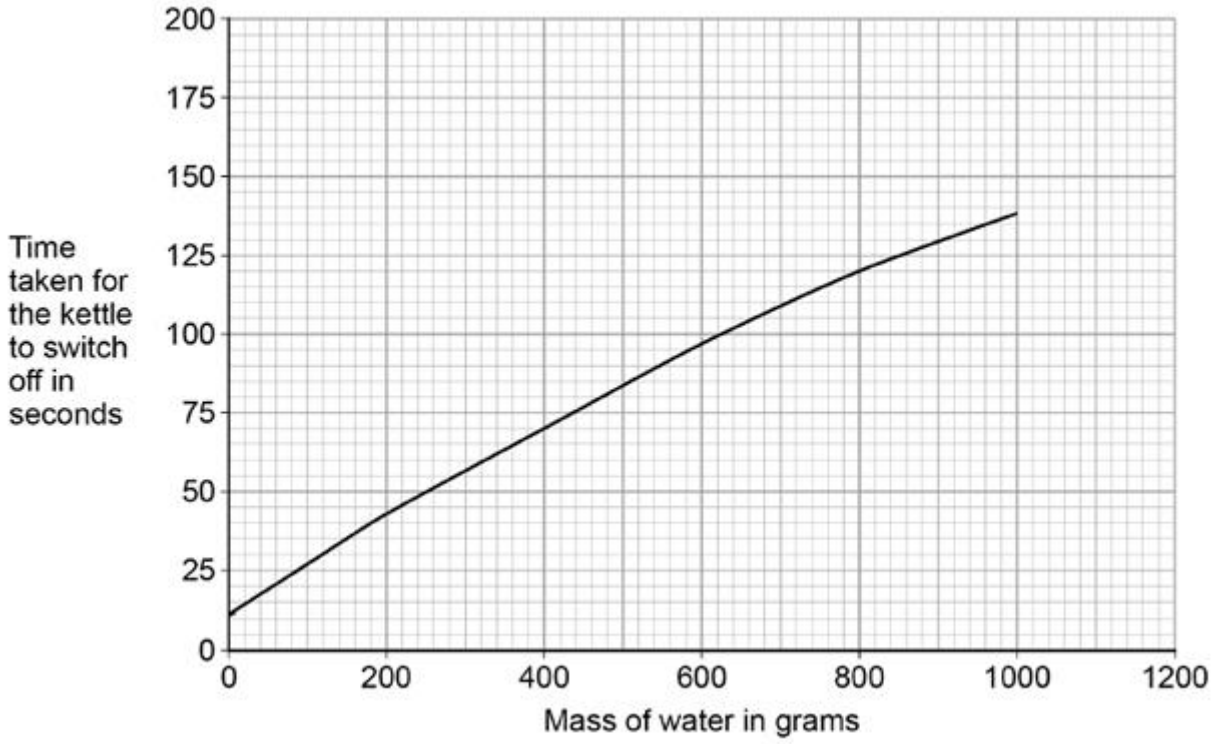
_____

_____

(1)

Figure 2 shows how the mass of water in the kettle affected the time taken for the kettle to switch off.

Figure 2



(c) Suggest why the line on **Figure 2** does **not** go through the origin.

_____

_____

(1)

(d) Suggest why the results give a non-linear pattern.

_____

_____

(1)

(e) The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

Specific heat capacity = _____ J/kg °C

(6)

(Total 11 marks)