6 A fixed mass of gas occupies a volume V. The temperature of the gas increases so that the root mean square velocity of the gas molecules is doubled.
What will the new volume be if the pressure remains constant?

A $\frac{V}{2}$ ⬭

B $\frac{V}{\sqrt{2}}$ ⬭

C $2V$ ⬭

D $4V$ ⬭

(Total 1 mark)

7 (a) 'The pressure of an ideal gas is inversely proportional to its volume', is an incomplete statement of Boyle's law.

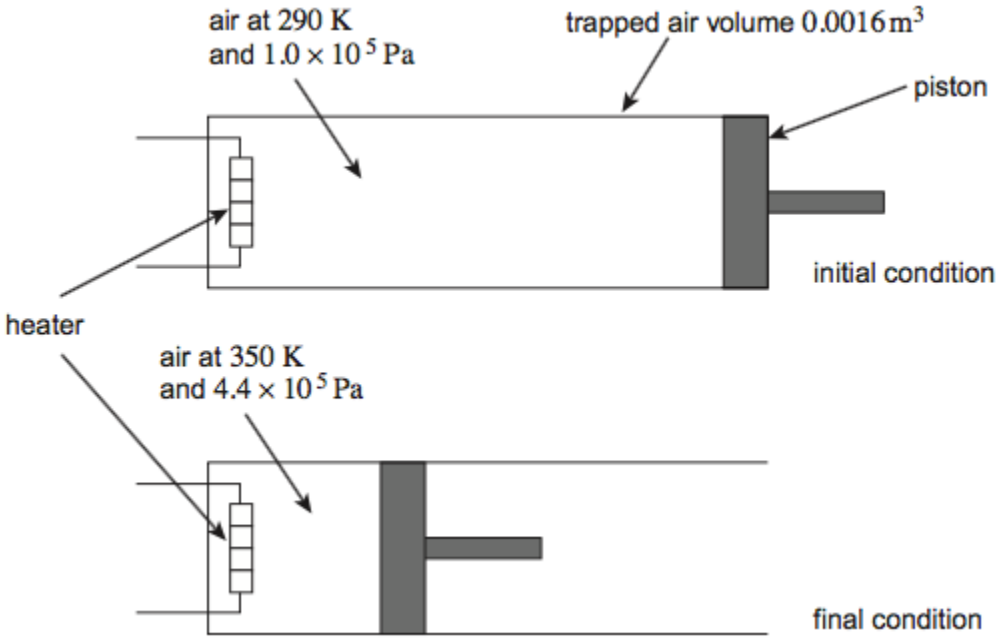
State **two** conditions necessary to complete the statement.

1. _____

2. _____

(2)

(b) A volume of 0.0016 m^3 of air at a pressure of 1.0×10^5 Pa and a temperature of 290 K is trapped in a cylinder. Under these conditions the volume of air occupied by 1.0 mol is 0.024 m^3. The air in the cylinder is heated and at the same time compressed slowly by a piston. The initial condition and final condition of the trapped air are shown in the diagram.



In the following calculations treat air as an ideal gas having a molar mass of 0.029 kg mol^{-1}.

(i) Calculate the final volume of the air trapped in the cylinder.

volume of air = _____ m^3

(2)

(ii) Calculate the number of moles of air in the cylinder.

number of moles = _____

(1)

(iii) Calculate the initial density of air trapped in the cylinder.

density = _____ kg m^{-3}

(2)

(c) State and explain what happens to the speed of molecules in a gas as the temperature increases.

_____

_____

_____

_____

_____

_____

_____

(2)

(Total 9 marks)

8 (a) Lead has a specific heat capacity of 130 J kg^{-1} K^{-1}.

Explain what is meant by this statement.

_____

_____

_____

_____

(1)

(b) Lead of mass 0.75 kg is heated from 21 °C to its melting point and continues to be heated until it has all melted.

Calculate how much energy is supplied to the lead.
Give your answer to an appropriate number of significant figures.

melting point of lead = 327.5 °C
specific latent heat of fusion of lead = 23 000 J kg^{-1}

energy supplied _____ J

(3)

(Total 4 marks)

9 (a) Define the Avogadro constant.

_____

_____

_____

(1)

(b) (i) Calculate the mean kinetic energy of krypton atoms in a sample of gas at a temperature of 22 °C.

mean kinetic energy _____ J

(1)

(ii) Calculate the mean-square speed, $(c_{rms})^2$, of krypton atoms in a sample of gas at a temperature of 22 °C.
State an appropriate unit for your answer.

mass of 1 mole of krypton = 0.084 kg

mean-square speed_____ unit _____

(3)

(c) A sample of gas consists of a mixture of krypton and argon atoms.
The mass of a krypton atom is greater than that of an argon atom.
State and explain how the mean-square speed of krypton atoms in the gas compares with that of the argon atoms at the same temperature.

_____

_____

_____

_____

_____

(2)

(Total 7 marks)

10 (a) Define the specific latent heat of vaporisation of water.

_____

_____

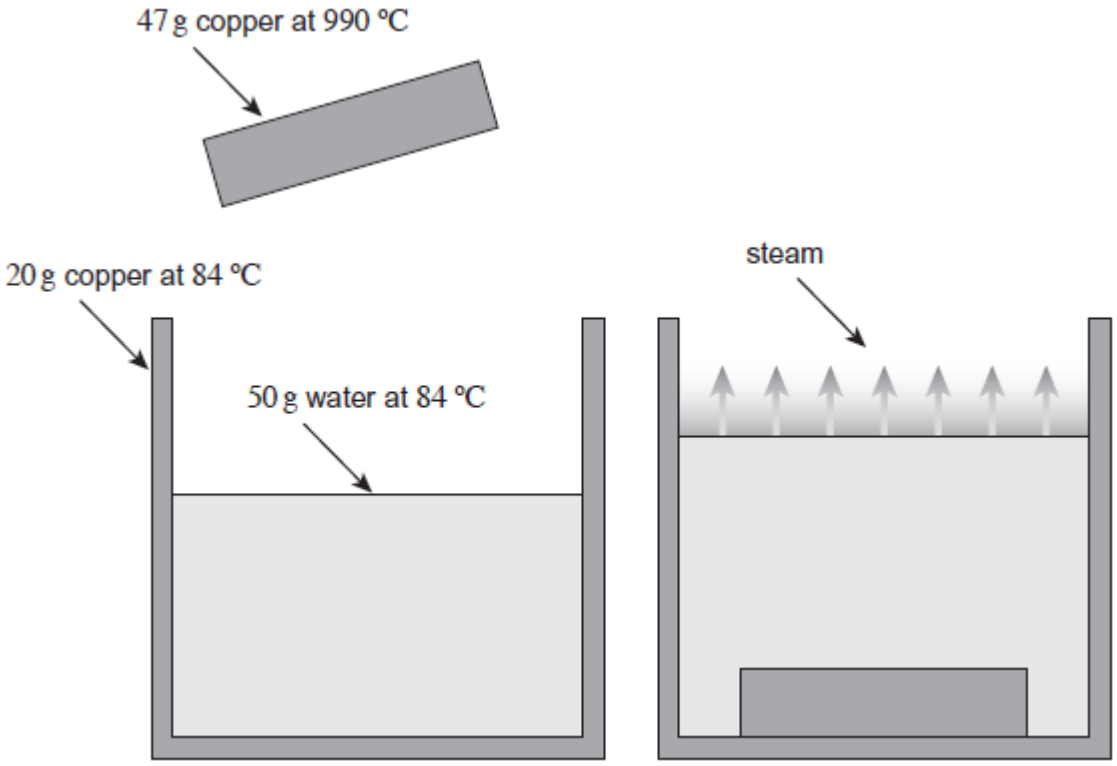
_____

_____

(2)

(b) An insulated copper can of mass 20 g contains 50 g of water both at a temperature of 84 °C. A block of copper of mass 47 g at a temperature of 990 °C is lowered into the water as shown in the figure below. As a result, the temperature of the can and its contents reaches 100 °C and some of the water turns to steam.

specific heat capacity of copper = 390 J kg^{-1} K^{-1}
specific heat capacity of water = 4200 J kg^{-1} K^{-1}
specific latent heat of vaporisation of water = 2.3 × 10^6 J kg^{-1}



(i) Calculate how much thermal energy is transferred from the copper block as it cools to 100 °C.
Give your answer to an appropriate number of significant figures.

thermal energy transferred _____ J

(2)

(ii) Calculate how much of this thermal energy is available to make steam.
Assume no heat is lost to the surroundings.

available thermal energy _____ J

(2)

(iii) Calculate the maximum mass of steam that may be produced.

mass _____ kg

(1)

(Total 7 marks)

1 A student measures the power of a microwave oven. He places 200 g of water at 23 °C into the microwave and heats it on full power for 1 minute. When he removes it, the temperature of the water is 79 °C.

The specific heat capacity of water is 4200 J kg^{-1} K^{-1}.

What is the average rate at which thermal energy is gained by the water?

A 780 W ⬭

B 840 W ⬭

C 1.1 kW ⬭

D 4.6 kW ⬭

(Total 1 mark)

You may use a diagram to help make clear aspects of your answer.

(Total 6 marks)

3 An ice cube of mass 0.010 kg at a temperature of 0 °C is dropped into a cup containing 0.10 kg of water at a temperature of 15 °C.

What is the maximum estimated change in temperature of the contents of the cup?

specific heat capacity of water = 4200 J kg^{-1} K^{-1}
specific latent heat of fusion of ice = 3.4×10^5 J kg^{-1}

A 1.5 K ⬭

B 8.7 K ⬭

C 13.5 K ⬭

D 15.0 K ⬭

(Total 1 mark)