

- 6 (a) By reference to the first law of thermodynamics, explain why, when a liquid is boiling, thermal energy must be supplied to the liquid during the boiling process.

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[4]

- (b) A student carries out an experiment to determine the specific latent heat of vaporisation of a liquid. He is given two electric heaters marked "9.00 V, 75.0 W" and "9.00 V, 20.0 W" respectively. The liquid is boiled in a beaker by means of each electric heater at its normal rating.

When the liquid is boiling at a constant rate, the mass m of liquid evaporated in 5.0 minutes is determined. Data for the power P and the mass m for the two different values of P are shown in Fig. 6.1.

P / W	m / g
75.0	80.0
20.0	23.7

Fig. 6.1

- (i) Suggest why, in order to obtain a reliable result for the specific latent heat, the mass m is determined for two different values of P .

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[2]

- (ii) Calculate the value for the specific latent heat L of vaporisation.

$$L = \dots \text{ J kg}^{-1} \quad [2]$$

- (c) A cylinder of nitrogen gas, at a temperature of $20.0 \text{ }^{\circ}\text{C}$ and pressure of $1.01 \times 10^5 \text{ Pa}$, occupies a volume of 1000 cm^3 . It then undergoes a two-stage change.

- (i) In stage A, the gas expands at constant pressure to a volume of 1500 cm^3 . Assuming that the nitrogen gas is ideal and given that the specific heat capacity at constant pressure of nitrogen is $1.03 \text{ kJ kg}^{-1} \text{ K}^{-1}$ and mass of 1 mole of nitrogen gas is 28.0 g , calculate

1. the final temperature of the gas,

$$\text{final temperature} = \dots \text{ K} \quad [2]$$

2. the work done by the gas in expanding,

$$\text{work done} = \dots \text{ J} \quad [1]$$

3. the number of moles of gas,

$$\text{number of moles} = \dots \text{ mol} \quad [1]$$

4. the quantity of heat supplied.

$$\text{heat supplied} = \dots \text{ J} \quad [2]$$

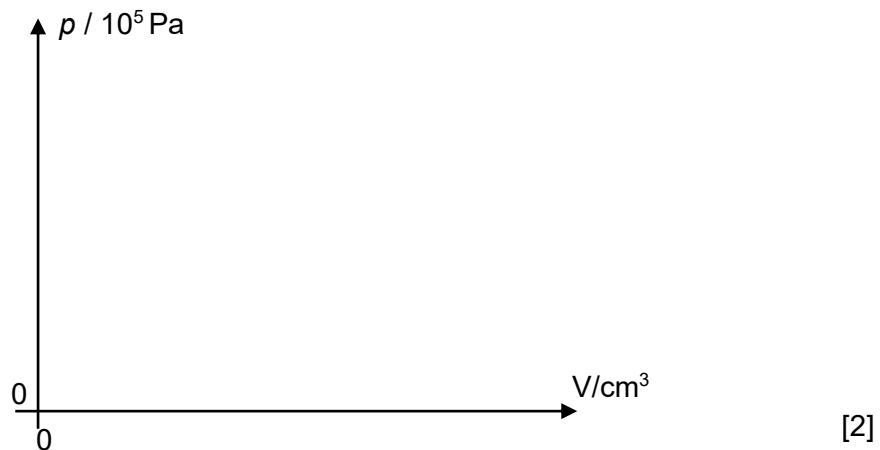
(ii) In stage B, the gas is compressed isothermally to its original volume.

1. State and explain the change in internal energy in stage B.

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[2]

2. Sketch a labelled $p - V$ diagram showing stages A and B.



- (iii) Determine the change in internal energy of the gas at the end of its two-stage change.

change in internal energy = J [2]

[Total: 20]

