3 (a) (i) With reference to the first law of thermodynamics, explain why there is considerable difference in magnitude between the specific latent heats of fusion and vaporisation for the same material.

……..…….....

……..…….....

……..…….....

……..…….....

……..……..... [4]

(ii) Ethanol has a melting point of -120 °C and a boiling point of 78 °C. The specific latent heat of fusion is 110 J g^{-1} and specific latent heat of vaporisation is 840 J g^{-1}. The density and specific heat capacity of liquid ethanol are 0.79 g cm^{-3} and 2.4 J g^{-1} K^{-1} respectively.

Calculate the minimum thermal energy required to fully vapourise 2.0 cm^3 of ethanol that is initially at 30 °C.

required thermal energy = …… J [4]

(b) Some gas, assumed to behave ideally, is contained within a cylinder which is surrounded by insulation to prevent loss of heat, as shown in Fig. 3.1.

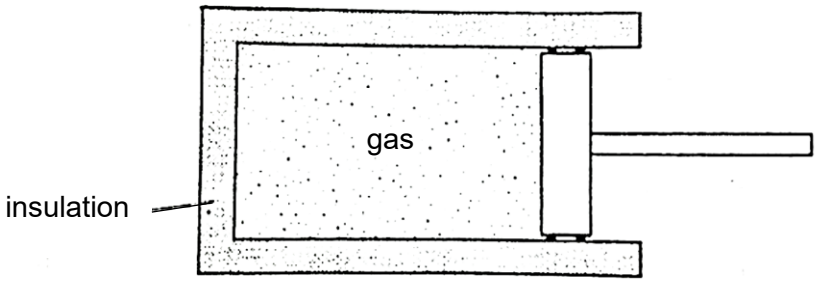

Fig. 3.1

Initially, the volume of gas is 2.9×10^{-5} m^3, its pressure is 2.6×10^6 Pa and its temperature is 790 K.

(i) The gas expands to a volume of 2.9×10^{-4} m^3 and its temperature decreases to 314 K. Calculate the pressure of the gas after this expansion.

pressure of gas after expansion = ... Pa [2]

(ii) The work done by the gas during the expansion is 91 J. Determine the change in the internal energy of the gas during the expansion.

change in internal energy = ……. J [1]

(iii) Explain the meaning of internal energy, and use your result in **(b)(ii)** to explain why a decrease in the temperature of the gas takes place during the expansion.

……..…….....

……..…….....

……..…….....

……..……..... [2]

[Total: 13]