2 **(a)** The first law of thermodynamics may be given by the expression

$$\Delta U = Q + W$$

State the meaning of positive values for each of the symbols in this equation.

.....

..... [1]

(b) The specific latent heat of vaporization of water at atmospheric pressure of 1.0×10^5 Pa is 2.3×10^6 J kg^{-1}. A mass of 0.37 kg of liquid water at 100 °C is provided with thermal energy needed to vaporize all of the water at atmospheric pressure.

(i) Calculate the thermal energy Q supplied to the water.

Q = ... J [1]

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(ii) The mass of 1 mole of water is 18 g. Assume that water vapour can be considered to behave as an ideal gas.
Show that the volume of water vapour produced is 0.64 m^3. [2]

(iii) Assume that the initial volume of liquid water is negligible compared with the volume of water vapour produced.
Determine the magnitude of the work done by the water in expanding against the atmosphere when it vaporizes.

work done = ... J [2]

(iv) Use your answers in **(b)(i)** and **(b)(iii)** to determine the increase in internal energy of the water when it vaporizes at 100 °C. Explain your reasoning.

Increase in internal energy = ... J [2]

(v) State and explain at the molecular level what contributes to this increase in internal energy of the water when it vaporizes at 100 °C.

.....

.....

..... [2]

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