4 **(a)** In a space, such as a swimming pool enclosure, water at 30 °C and water vapour, also at 30 °C coexist.

(i) State what is meant by *internal energy* of a system.

……

…… [1]

(ii) With reference to your answer in **(a)(i)**, compare the internal energy per unit mass of water and water vapour at the same temperature.

……

……

……

…… [2]

(b) A helium balloon containing 15000 m^3 of helium at a temperature of 288 K was launched from sea level until it reaches an altitude of 32.0 km. Data concerning atmospheric conditions are given in table 4.1.

Table 4.1

	sea level altitude = 0	equilibrium altitude = 32.0 km
pressure of helium	101 kPa	0.890 kPa
temperature	288 K	228 K
density of air	1.23 kg m^{-3}	0.0134 kg m^{-3}

Assuming that the helium gas behaves as an ideal gas, calculate

(i) the volume of helium at an altitude of 32.0 km,

volume of helium = …… m^3 [2]

(ii) the average translational kinetic energy of one helium atom in the balloon when it is at an altitude of 32.0 km,

average kinetic energy = ... J [1]

(iii) the change in internal energy of the balloon.

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

[Total: 8]