6 **(a)** Convert the temperature of the boiling point of nitrogen, 77.30 K, to a temperature on the Celsius scale.

temperature = ... °C [2]

(b) State what is meant by saying that a temperature is on an *absolute* scale.

.....

..... [1]

(c) Explain what is meant by

(i) the *internal energy* of a gas,

.....

.....

..... [2]

(ii) an *ideal gas.*

.....

..... [1]

(d) **(i)** A car tyre has a fixed internal volume of 0.0120 m^3. On a day when the temperature is 25 °C the pressure in the tyre has to be increased from 2.62×10^5 Pa to 3.23×10^5 Pa. Assuming the air is an ideal gas, calculate the amount of air which has to be supplied at constant temperature.

amount of air = ... mol [3]

(ii) A portable supply of air used to inflate tyres has a volume of $0.0108\,m^3$ and is filled with air at a pressure of 8.72×10^5 Pa. Show that, at 25 °C, there is more than enough air in it to supply four tyres, as in **(i)**, without the pressure falling below 3.23×10^5 Pa.

[3]

(e) **(i)** Show that the internal energy of a molecule of air at a temperature of 25 °C is 6.17×10^{-21} J. Assume that the air behaves as an ideal gas.

[2]

(ii) Hence calculate the internal energy of one mole of the air at a temperature of 25 °C.

internal energy = ... J [1]

(iii) Calculate the increase in the internal energy of the air in the tyre in **(d)(i)** as a result of increasing its pressure.

increase = ... J [2]

(f) **(i)** Give a word equation stating the first law of thermodynamics.

.....

..... [2]

(ii) Apply this law to the pressure increase in **(d)(i)** in order to calculate the amount of work which has to be done to increase the pressure.

work done = ... J [1]