14 Natural gas produced from landfill consists of a mixture of methane and carbon dioxide gases.

(a) At a temperature of 20.0 °C and a pressure of 1.01×10^5 Pa the volume occupied by 1 mole of carbon dioxide is 0.0241 m^3.

Show that the number of molecules in 1 mole of carbon dioxide is about 6.0×10^{23}

(3)

(b) In a sample of natural gas, the r.m.s. velocity of the carbon dioxide molecules is 60.5 % of the r.m.s. velocity of the methane molecules.

$$\text{r.m.s. velocity} = \sqrt{\langle c^2 \rangle}$$

Deduce the ratio $\dfrac{\text{mass of carbon dioxide molecule}}{\text{mass of methane molecule}}$.

(3)

$$\frac{\text{mass of carbon dioxide molecule}}{\text{mass of methane molecule}} = \ldots\ldots$$

(Total for Question 14 = 6 marks)