A sample of pure $Mg(NO_3)_2$ was decomposed upon heating as shown below:

$$2Mg(NO_3)_{2(g)} \longrightarrow 2MgO_{(s)} + 4NO_{2(g)} + O_{2(g)}$$

A 3.74×10^{-2}g sample of $Mg(NO_3)_2$ was completely decomposed in this way.

a) Calculate the total volume, in cm^3, of gas produced at 60.0°C and 100kPa. Give your answer to an appropriate number of significant figures.

① Calculate the moles of $Mg(NO_3)_2$:

Mr of $Mg(NO_3)_2$ = 148.3

$\Rightarrow$ moles = $\frac{3.74 \times 10^{-2}}{148.3}$

= 2.522×10^{-4} moles

moles = mass / Mr

② Calculate the moles of gas produced:

Gaseous products = NO_2 and O_2

$\Rightarrow$ ratio of $Mg(NO_3)_2$: gaseous products

2 : 5

$\Rightarrow$ moles of gas = $\frac{5}{2} \times 2.522 \times 10^{-4}$

= 6.305×10^{-4} moles

③ Convert values to SI units:

P = Pa = 100×10^3 Pa

R = 8.31 $Pa\,m^3\,mol^{-1}\,K^{-1}$

T = kelvin = 60.0 + 273 = 333K

④ Re-arrange the ideal gas equation for V:

$PV = nRT$

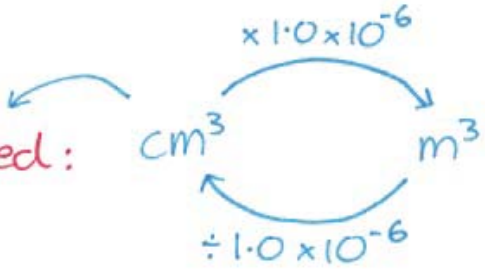
$\Rightarrow V = \frac{nRT}{P}$

⑤ Calculate V in m^3:

$$V = \frac{6.305 \times 10^{-4} \times 8.31 \times 333}{100 \times 10^{3}}$$

$\Rightarrow 1.745 \times 10^{-5} m^3$

⑥ Convert to cm^3, as required:



$$V = \frac{1.745 \times 10^{-5}}{1 \times 10^{-6}}$$

$= 17.45$

$\Rightarrow \underline{17.5\ cm^3}$ (3sf.)