

You are provided with the following:

- 3.3g metal carbonate,  $\text{MCO}_3$ , labeled solution Q
- 2M hydrochloric acid, labeled solution P
- Sodium hydroxide, labeled solution R containing 40g/L of solution

You are required to determine the relative atomic mass of metal M

**Procedure**

- Measure accurately  $100\text{cm}^3$  of solution P into clean  $250\text{cm}^3$  conical flask and add all the 3.3g of solid Q,  $\text{MCO}_3$
- Shake the mixture well and wait for effervescence to stop. Label the resulting solution as S
- Pipette  $25\text{cm}^3$  of solution R into a conical flask and add 2-3 drops of phenolphthalein indicator.
- Fill the burette with solution S and titrate against the solution R until the end point.
- Record your results in the table below. Repeat the procedure at least two times to complete the table.

(4 mks) use the student's value. (Assuming A.V =  $20\text{cm}^3$ )

	i	ii	iii
Final burette reading ( $\text{cm}^3$ )	20.0	40.0	20.1
Initial burette reading ( $\text{cm}^3$ )	0.0	20.0	0.0
Volume of solution S used ( $\text{cm}^3$ )	20.0	20.0	20.1

- a) What is the average volume of solution S used? (1mk)

$$\frac{20.0 + 20.0 + 20.1}{3} = 20.0\text{cm}^3$$

- b) Calculate the moles of sodium hydroxide, solution R used. (2mks)

$$\frac{40\text{g}}{40} = 1\text{M}$$

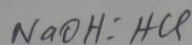
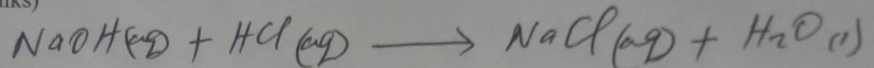
$$1\text{mole} - 1000\text{cm}^3$$

$$x\text{moles} - 25\text{cm}^3$$

$$x = \frac{1 \times 25}{1000}$$

$$= 0.025\text{moles}$$

- c) Calculate the moles of hydrochloric acid in the average volume of solution S used. (2mks)



$$0.025 : 0.025 = \underline{0.025 \text{ moles}}$$

- d) Calculate the moles of hydrochloric acid in 100cm<sup>3</sup> of solution S. (2mks)

$$\frac{0.025 \text{ moles}}{20 \text{ cm}^3} = \frac{x \text{ moles}}{100 \text{ cm}^3} \quad \left| \quad \frac{0.025 \times 100}{20} = \underline{0.125 \text{ moles}}$$

- e) Calculate the moles of hydrochloric acid in the 100cm<sup>3</sup> of the original solution P. (2mks)

$$\frac{2 \text{ moles}}{1000 \text{ cm}^3} = \frac{x \text{ moles}}{100 \text{ cm}^3} \quad \left| \quad \underline{0.2 \text{ moles}}$$

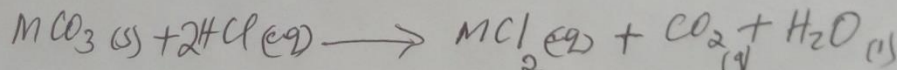
$$x = \frac{2 \times 100}{1000}$$

- f) Calculate the moles of hydrochloric acid, solution P that reacted with solid Q, MCO<sub>3</sub>. (2mks)

$$0.2 \text{ moles} - 0.125 \text{ moles}$$

$$= \underline{0.075 \text{ moles}}$$

- g) Calculate the moles of MCO<sub>3</sub> that reacted. (2mks)



$$= \frac{0.075}{2} = \underline{0.0375 \text{ moles}}$$

- h) Calculate the relative formula mass (RFM) of MCO<sub>3</sub>. (2mks)

$$\text{moles} = \frac{\text{mass}}{\text{RFM}}$$

$$x = \frac{3.3}{0.0375}$$

$$0.0375 = \frac{3.3}{x}$$

$$x = 88$$

i) Calculate the relative atomic mass (RAM) of metal M. (1mk)

$$88 = MCO_3$$

$$88 = M + 12 + 48$$

$$\begin{array}{r} 88 = M + 60 - 60 \\ - 60 \\ \hline M = 28 \end{array}$$

$$M = \underline{\underline{28}}$$