You are provided with the following:

- 3.3g metal carbonate, 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

i. Measure accurately 100cm^3 of solution P into clean 250cm ^{3} conical flak and add all the 3.3g of solid Q, MCO^3
ii. Shake the mixture well and wait for effervescence to stop. Label the resulting solution as S
iii. Pipette 25cm^3 of solution R into a conical flask and add 2-3 drops of phenolphthalein indicator.
iv. Fill the burette with solution S and titrate against the solution R until the end point.
v. Record your results in the table below. Repeat the procedure at least two times to complete the table.
(4 mks) use the students value. (Assuming A.V = 20cm^3)

	i	ii	Iii
Final burette reading (cm^3)	20.0	40.0	20.1
Initial burette reading (cm^3)	0.0	20.0	0.0
Volume of solution S used (cm^3)	20.0	20.0	20.1

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

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

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

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

1 mole $-$ 1000 cm^3
x moles $-$ 25 cm^3

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

$= 0.025$ moles

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

$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

NaOH : HCl

1 : 1

0·025 : 0·025

= 0·025 moles

d) Calculate the moles of hydrochloric acid in 100cm3 of solution S. (2mks)

0·025 moles – 20cm³

x moles – 100cm³

$\frac{0·025 \times 100}{20}$ = 0·125 moles

e) Calculate the moles of hydrochloric acid in the 100cm3 of the original solution P. (2mks)

2 moles – 1000 cm³

x moles – 100cm³

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

0·2 moles.

f) Calculate the moles of hydrochloric acid, solution P that reacted with solid Q, MCO3. (2mks)

0·2 moles – 0·125 moles

= 0·075 moles

g) Calculate the moles of MCO3 that reacted. (2mks)

$MCO_{3(s)} + 2HCl_{(aq)} \longrightarrow MCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

$= \frac{0·025}{2}$ = 0·0375 moles

h) Calculate the relative formula mass (RFM) of MCO3. (2mks)

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

0·0375 = $\frac{3·3}{x}$

$x = \frac{3·3}{0·0375}$

x = 88

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

$88 = MCO_3$

$88 = M + 12 + 48$

$88 = M + 60$

$-60 \quad -60$

$M = 28$

$M = 40$