WHAT TO FOCUS ON?

AS PRACTICAL SKILLS

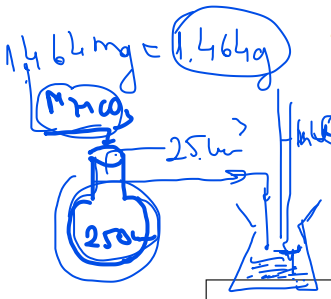
TAILORED TUTORS A LEVEL CHEMISTRY

WHAT TO FOCUS ON?

- ✓ METHOD/UNDERSTAND THE STEPS
- ✓ DIAGRAMS/DRAWING OF APPARATUS
- ✓ FOLLOW UP CALCULATIONS/MANIPULATING DATA/GRAPHS
- ✓ ERRORS
- ✓ CHEMICAL EQUATIONS
- ✓ IMPROVEMENTS
- ✓ RISK ASSESSMENT
- ✓ LIMITATIONS

3 This question is about a white solid, $MHCO_3$, that dissolves in water and reacts with hydrochloric acid to give a salt.

$$MHCO_3 + HCl \rightarrow MCl + H_2O + CO_2$$



A student was asked to design an experiment to determine a value for the M_r of $MHCO_3$. The student dissolved 1464 mg of $MHCO_3$ in water and made the solution up to 250 cm^3.

25.0 cm^3 samples of the solution were titrated with 0.102 mol dm^{-3} hydrochloric acid. The results are shown in **Table 1**.

Table 1

	Rough	1	2	3
Initial burette reading / cm^3	0.00	10.00	19.50	29.25
Final burette reading / cm^3	10.00	19.50	29.25	38.90
Titre / cm^3	10.00	9.50	9.75	9.65

0 3 . 1 Calculate the mean titre and use this to determine the amount, in moles, of HCl that reacted with 25.0 cm^3 of the $MHCO_3$ solution.

[3 marks]

$MHCO_3 + HCl \rightarrow MCl + H_2O + CO_2$

$V = 25 cm^3$ $\quad c = 0.102 mol\,dm^{-3}$

$V = 9.70$

$n = 9.894 \times 10^{-4} = \frac{c \times V}{1000}$

0 3 . 2 Calculate the amount, in moles, of $MHCO_3$ in 250 cm^3 of the solution.
Then calculate the experimental value for the M_r of $MHCO_3$.
Give your answer to the appropriate number of significant figures.

[3 marks]

$n(MHCO_3)$ in 25 $cm^3 = 9.894 \times 10^{-4}$ moles

$n(MHCO_3)$ in 250 $cm^3 = 9.894 \times 10^{-4} \times 10 = 9.894 \times 10^{-3}$ moles

$M_r = \frac{m}{n} = \frac{1.464}{9.894 \times 10^{-3}} = 148$ (3 sf)

0 3 . 3 The student identified use of the burette as the largest source of uncertainty in the experiment.

± 0.5 error

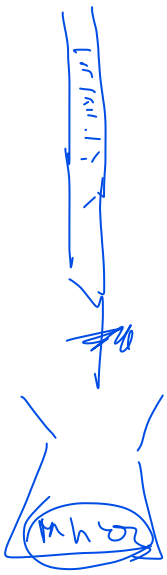
Using the same apparatus, suggest how the procedure could be improved to reduce the percentage uncertainty in using the burette.

Justify your suggested improvement.

[2 marks]

Suggestion increase the mass of $MHCO_3$ / decrease the conc of the,

Justification a larger reading for the V in the burette



% error = $\frac{\text{error} \times 2}{\text{reading}} \times 100 = \frac{\text{error}}{\text{measurement}}$

0 3 . 4 Another student is required to make up 250 cm^3 of an aqueous solution that contains a known mass of $MHCO_3$. The student is provided with a sample bottle containing the $MHCO_3$.

Describe the method, including apparatus and practical details, that the student should use to prepare the solution.

[6 marks]

m ($MHCO_3$)

0.00 → torr m =

• weigh the solid → beaker, tarr the scale, add the solid

•

m = 0.099 → 2.60

:00 m 6g

mole

$m_{wb} = 0.4\,g$ } m = 2.6 g

$m_{wb+s} = 3.0\,g$

Question	Marking Guidance	Mark	Comments
03.1	Selects correct titres mean titre $= \frac{9.75 + 9.65}{2}$ $= 9.7(0)\ cm^3$ mol HCL $= 0.102 \times {}^{9.70}/_{1000} = 9.89 \times 10^{-4}$ (allow 9.9x10-4 for M3 but check not via 4 titres in which case only 1 mark)	1 1 1	If 3 or more titres used them MAX 1 for conseq M3 Calculates mean Calculates mol (working or result gains credit) 9.92×10^{-4} scores 1 if all 4 titres used 9.83×10^{-4} scores 1 if titres 1,2,and 3 used
03.2	mol $MHCO_3$ = ANS 3.1 x 10 (= 9.89×10^{-3}) $Mr = \frac{1464/1000}{M1}$ Mr = 148 (3sf)	1 1 1	Use ecf if wrong mean calculated above Allow ecf following wrong mass conversion
03.3	Suggestion: Use a larger mass of solid OR use a more concentrated solution of $MHCO_3$ OR less concentrated / more dilute solution of HCl OR more $MHCO_3$ Justification: So a larger titre/reading will be needed OR larger volume of HCl	1 1	Cannot score justification mark unless suggestion correct, but suggestion could be after justification Assume reference to the solution means the $MHCO_3$

Question	Marking Guidance	Mark	Comments
03.4	This question is marked using levels of response. Level 3 - Must use volumetric flask to access level 3 Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 then stage 3. 6 marks - All stages are covered and the description of each stage is complete 5 marks – all stages are covered but up to 2 omissions/errors from different stages. If 2 omissions/errors from same stage only level 2 possible Level 2 Answer is mainly coherent and shows progression from stage 1 to stage 3 4 marks - All stages are covered but 3 omissions/errors 3 marks – all stages are attempted Level 1 Answer includes isolated statements but these are not presented in a logical order or show confused reasoning. 2 marks – 2 stages attempted 1 mark – 1 stage attempted Level 0 0 marks Insufficient correct chemistry to gain a mark.	6	**Indicative Chemistry content** **Stage 1:** transfers known mass of solid a) Weigh the sample bottle containing the solid on a (2 dp) balance b) Transfer to beaker* and reweigh sample bottle c) Record the difference in mass Or d) Place beaker* on balance and tare e) Transfer solid into beaker f) Record mass Or g) Known mass provided h) Transfers (known) mass into beaker* i) Wash all remaining solid from sample bottle into beaker Allow use of weighing boat *Allow other suitable glassware including volumetric flask **Stage 2:** Dissolves in water (100 cm^3) a) Add distilled / deionised water b) Stir (with a glass rod) or swirl c) Until all solid has dissolved **Stage 3:** Transfer, washing and agitation a) Transfer to volumetric / graduated flask. Allow if a clear description/diagram given eg long necked flask with 250cm^3 mark b) With washings c) Make up to 250cm^3 / mark with water d) Shakes/inverts/mixes

Example : Back (Indirect) Titration to Determine the Amount of an Insoluble Salt

A student was asked to determine the mass, in grams, of calcium carbonate present in a 0.125 g sample of chalk. The student placed the chalk sample in a 250 cm^3 conical flask and added 50.00 cm^3 of 0.200 $moldm^{-3}$ HCl using a pipette. The excess HCl was then titrated with 0.250 $moldm^{-3}$ NaOH. The average NaOH titre was 32.12 cm^3.

Calculate the mass of calcium carbonate, in grams, present in the chalk sample and the percentage purity.