

**M1.(a)** (i) Volume of crater-lake solution on  $x$ -axis  
*Do not penalise missing axes labels.*  
*If axes unlabelled use data to decide.*  
*Lose this mark if axes mis-labelled.* 1

Sensible scales  
*Lose this mark if **plotted points** do not cover at least half the paper or plot goes off the squared paper.* 1

All points plotted correctly +/- one square 1

(ii) Draws appropriate line of best fit, omitting point at  $20 \text{ cm}^3 / 15 \text{ cm}^3$   
*Lose this mark if the line deviated towards the anomalous result.*  
*Lose this mark if the candidate's line is doubled or kinked.*  
*Candidate does not have to extrapolate to the origin.* 1

(iii)  $16.5 \text{ cm}^3 \pm 0.5 \text{ cm}^3$   
*Accept this answer only.*  
*Do not mark consequentially on candidate's graph.* 1

(iv) Value corresponding to  $10 \text{ cm}^3$  crater-lake solution /  $6.00 \text{ cm}^3$   
*Must have correct identity for explanation mark.*  
*Accept results aren't concordant.* 1

Greatest % error from use of burette  
*Accept difficult to be accurate with small volumes (owtte).* 1

(b) (i)  $pV = nRT$   
*Accept any correct rearrangement.*  
*Ignore case.* 1

(ii)  $V = 81.0 \times 10^{-6}$  or  $8.1 \times 10^{-5}$  1

$n = (1 \times 10^5 \times 81.0 \times 10^{-6}) / (8.31 \times 298)$   
*Mark consequentially on candidate's volume.* 1

$n = 3.27 \times 10^{-3}$  (mol)  
*Correct answer without working scores one mark only.*  
*Allow consequential mark using incorrect conversion.*  
*Incorrect units lose this mark.* 1

(iii)  $M_r \text{ CaCO}_3 = 100.1$  (M1)  
*Accept 100 (can score this mark in calculation for M2 and M3).* 1

Moles  $\text{CaCO}_3 = (3.27 \times 10^{-3} \times 10) = 3.27 \times 10^{-2}$  (M2)  
*Do not penalise lack of units.*  
*Allow  $b(ii) \times 10$*   
*Allow  $1.25 \times 10^{-3} \times 10$*  1

Mass  $\text{CaCO}_3 = M1 \times M2 (= 3.27 \text{ g})$   
*Correct mass without working scores one mark only.*  
*Allow  $1.25 \times 10^{-2} \times 10 \times 100.1 = 12.5 \text{ g}$*  1

(iv)  $(3.27 / 95) \times 100$

Accept  $(b(iii) / 95) \times 100$ .  
Do not penalise precision.

1

3.44 g

Do not penalise lack of units.

Using 12.5 g gives 13.2 g

Correct answer without working scores 2 marks.

1

(v) Abundant / readily available  
Accept not caustic or alkaline.

Non-corrosive

Accept insoluble so safe to add in excess (owtte).

1

[17]

**M2.(a)** (ligand) substitution

Allow 'ligand exchange'.

1

(b) To displace the equilibrium to the right  
To ensure reaction goes to completion.

1

To improve the yield

Allow 'to replace all chlorines'.

1

(c) (i)  $K_2PtCl_4 + 4KI \rightarrow K_2PtI_4 + 4KCl$

Allow correct ionic equations  $PtCl_4^{2-} + 4I^- \rightarrow PtI_4^{2-} + 4Cl^-$

Allow multiples and fractions.

1

(ii)  $= (780.9) \times 100 / (415.3 + 664)$

*Working must be clearly shown.*

*Allow one mark for correct relationship even if  $M_r$  values are incorrect eg using values from ionic equation.*

1

$= 72.4$

*Allow 72%*

1



*Ignore state symbols even if incorrect.*

*This equation only.*

1

(ii) Stops the reverse reaction / equilibrium displaced to the right

1

(e) Number of steps in the process

*Allow 'equilibrium may lie on the reactant side' / side reactions / isomer formation.*

1

Losses at each stage of the synthesis

*Equilibrium losses or practical losses or yield not 100% for each step.*

1

(f) Minimum amount of hot solvent

*Accept 'small' for minimum.*

*Accept water.*

1

Cool / crystallise

1

Filter

1

(g) (i) Small amounts are more likely to kill cancer cells rather than the patient

1

(ii) Wear gloves / wash hands after use

*Ignore masks.*

*Apply the list principle if more than one answer.*

1

[15]

**M3.** (a) (i)  $M_r \text{ MgO} = 40.3$

*If used 40 then penalise this mark but allow consequential  
M2 (0.0185)*

1

$$0.741/40.3 = 0.0184$$

*0.018 with no  $M_r$  shown = 0*

*Penalise if not 3 sig figs in this clip only*

1

(ii)  $0.0184 \times \frac{5}{2} = 0.0460$

*Allow 0.0459 to 0.0463*

*Allow their (a)(i)  $\times 5/2$  ie allow process mark of  $\times 5/2$  but  
insist on a correct answer being written down*

*Ignore sig figs*

1

(b)  $pV = nRT$

1

$$(V = \frac{0.402 \times 8.31 \times 333}{100\,000})$$

*If rearranged incorrectly then lose M1*

*If this expression correct then candidate has scored first  
mark*

0.0111

1

*Ignore units*

11.1 (dm<sup>3</sup>)

*3 marks for 11.1 (dm<sup>3</sup>)*

*However if 11.1 m<sup>3</sup> or cm<sup>3</sup> allow 2 (ie penalise wrong units in final answer)*

*Ignore sig figs- but must be 2 sig figs or greater*

1

(c) (i)  $0.0152 \times 2 = 0.0304$

*Allow 0.03*

1

(ii)  $0.938 \text{ mol dm}^{-3}$

*Allow range 0.92 – 0.94*

*Minimum 2 sig figs*

*Allow consequential marking from (c)(i)*

*Ignore units even if wrong*

1

**[8]**