



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

# General Certificate of Education

## Chemistry 5421

*CHM3/P Practical Examination*

# Mark Scheme

*2006 examination - June series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

## CHM3/P

### Exercise 1 Skill assessed **Implementing** (8)

#### 1. Points assessed by supervisor during the practical examination

- |         |                                   |   |   |                        |
|---------|-----------------------------------|---|---|------------------------|
| (a) (i) | use of the <b>pipette/burette</b> | 1 | correct use of burette                  | 7 scoring points       |
|         |                                   | 2 | pipette empties under gravity           | any <b>6 = 2 marks</b> |
|         |                                   | 3 | transfers from pipette without spillage | any <b>4 = 1 mark</b>  |
|         |                                   | 4 | touches surface with pipette            |                        |
| (ii)    | use of the <b>thermometer</b>     | 5 | bulb immersed                           |                        |
|         |                                   | 6 | stirs mixture                           |                        |
| (iii)   | general                           | 7 | does not require additional sample      |                        |

#### Notes

- *if there is a blank box in the teacher grid assume candidate did **not** score this point*

#### 2. Points assessed from candidate's written report.

- |                                 |   |               |
|---------------------------------|---|---------------|
| (b) <b>recording</b> of results | results recorded clearly and in full in the table | <b>1 mark</b> |
|---------------------------------|---|---------------|

#### Notes

- *if you can read it, it is clear*
- ***full** means completes the temperature row **and** box for acid temp correctly*
- ***and** there is no entry in the shaded box at the fourth minute*
- *allow clear answer outside of the box*

- |                                   |  |               |
|-----------------------------------|--|---------------|
| (c) awareness of <b>precision</b> | temperatures recorded appropriately and consistently | <b>1 mark</b> |
|-----------------------------------|--|---------------|

#### Notes **precision** \* allow **one** error

- |   |  |                |
|---|--|----------------|
| (d) The <b>accuracy</b> of the temperature rise, measured against a teacher value |  |                |
| temperature rise is within 5% of target value                                     |  | <b>4 marks</b> |
| temperature rise is within 8 % of target value                                    |  | 3 marks        |
| temperature rise is within 10 % of target value                                   |  | 2 marks        |
| temperature rise is within 15% of target value                                    |  | 1 mark         |

#### Notes

- **teacher grid** *check best fit lines and temperature rise  
average starting temperatures for acid and alkali  
determine true temperature rise  
if true temp rise different from value quoted on teacher form, underline  
the quoted value and write the correct temperature rise beside it  
base all accuracy marks on this correct temperature rise*
- **student grid** *repeat steps as for teacher value  
use the **corrected** value to assess accuracy*
- *if staff value is wrong or missing use a group average; complete a discrepancy form*
- *when calculating a group average ignore wild data*

**Total 8 marks**

**Exercise 1**Skill assessed **Analysing (2)****(a) the plotting of the graph**

plots points for 0-3 minutes correctly

plots points for 5-10 minutes correctly

straight line through the points before addition

line through the points after addition is smooth

line through the points is best fit

extrapolation back is a natural extension of the drawn line

reads the temperature rise correctly from the graph

7 scoring point

any **6 = 2 marks\***any **3 = 1 mark**\* **must** include  
correct

extrapolation

- *If graph does not cover **half** of the paper :-  
**maximum score is 1 mark**  
write **scale** on the candidate's graph  
mark up to first 3 correct points **only**  
do not penalise again under nomenclature*
- *If the graph plot goes off the squared paper **maximum score is 1 mark**;  
do not penalise again under nomenclature*
- *If axes unlabelled use data to decide that temperature is on y axis*
- *Allow **one** incorrectly plotted point in each part*
- *“smooth” means straight for a straight line*
- *give best fit point if the student's extrapolation is close to your extrapolation*
- *“Correct extrapolation” means correct line to 4 minute ordinate*

**Total 2 marks**

**Exercise 2** Skill assessed **Analysing (6)**

Q2 volume for 0.10g is 47.0 - 48.0 cm<sup>3</sup> **1 mark**

**Notes**

- Do **not** allow other answers

Q3 PV = nRT **1 mark**

Q4  $100 \times 10^3 \times 47.5 \times 10^{-6} = \frac{0.1}{M_r} \times 8.31 \times 373$

$M_r = 66.0 - 64.5$

**1 mark**

**Notes**

- Consequential marking from answer to Q2
- Do **not** award this mark if candidate gets the correct answer by an incorrect method; don't penalise again in awarding the nomenclature mark

Q5 **errors**

	balance	0.01/0.1 × 100 = 10%	3 scoring points
	syringe	1/ 47-48 × 100 = 2.1%	any 2 = <b>1 mark</b>
	total error	12.1%	

**Notes**

- Ignore precision of answers
- Consequential marking for volume from Q2 and for overall error
- Penalise doubled errors **once**
- **Lose mark** if answers wrong because (x 100) missing from calculations; don't penalise again in awarding the nomenclature mark
  - Which error being calculated is **not** stated; allow **if** the calculations are in the same order as in the question (balance, syringe). And do **not** penalise in nomenclature

(a) The appreciation of **precision**  
 quotes volume as integer **or** to 1 dp  
 quotes  $M_r$  to 1 dp

2 scoring points  
**both = 1 mark**

**Notes**

- If no answer to part 4 can't score this mark

(b) the correct use of **nomenclature** and **terminology**

3 scoring points

second graph has sharp trace

**all 3 = 1 mark**

explains the calculation of the  $M_r$  clearly and logically  
 explains the calculation of the errors clearly  
 explains the calculation of the  $M_r$  clearly and logically  
 explains the calculation of the errors clearly

**Notes**

- Incorrect units mean the nomenclature mark is lost
- Don't penalise missing units
- **Two** blank sections mean the nomenclature mark is lost
- Answer given in part 4 or 5 without working means the nomenclature mark is **lost**
- Do not penalise for wrong calculation in Part 4 if explained clearly

**Total 6 marks**

**Exercise 2** Skill assessed **Evaluating(6)**

Q1. ignores result at 0.09g when plotting graph 2 scoring points  
line goes through the origin ( ± half a square ) **both = 1 mark**

lines good/ can extrapolate with confidence/ technique good/ results consistent or reliable **1 mark**

**Notes**

- *Allow first point in written answer to Q1 or clearly from the graph; any contradictions loses mark*
- *Must make a clear written comment for final point*

Q2. difference is 6.0 - 7.4  
against 72.0 is a 8.3 to 10.3% error **2 scoring points**  
**both = 1 mark**

**Notes**

- *Lose mark if no evidence of working in second part*
- *Ignore precision of answers*
- *Allow consequential answer from part 4 of Analysis*
- *Difference must be clearly stated*
- *Lose mark if the candidate answers a different question*
- *Using 78.5 gives difference is 6.5, and a 9.0% error*

Q3. need more accurate mass  
use a 3 fig balance etc **or** a balance with more precision **one error and appropriate improvement = 1 mark**

maintain constant temperature better  
prevent heat loss from oven by better insulation/use a steam jacket

incomplete vaporisation  
use a higher temperature **or** allow longer time (to equilibrate) **or** use longer needle

compound associates/ dissociates  
use a higher/ lower temperature

syringe sticks  
rotate syringe

**Notes**

- *Do not allow* *more accurate balance*  
*more accurate thermometer*  
*collect more gas*  
*repeat experiment*

Q4 volume lower than expected (as some liquid lost) **1 mark**  
calculated  $M_r$  would be larger **1 mark**

**Notes**

- *Mark points independently*
- *Accept less gas produced*

**Total 6 marks**

**Exercise 3** Skill assessed **Planning (8)**

1.2 The scale of working used (s) **5 scoring points**  
(s)

appreciates 2:1 reaction acid to carbonate  
realises Group I metal carbonate should be approx  $0.05 \text{ mol dm}^{-3}$   
appreciates  $M_r$  between 100 and 150  
specifies volume of solution –  $100\text{-}500 \text{ cm}^3$   
calculates appropriate mass ( $5 - 7.5 \text{ g/ dm}^3$ )

**Notes**

- *If candidate writes 2:1 reaction acid to carbonate, scores first point regardless*
- *If candidate writes 2:1 reaction without qualification and chosen concentration is correct scores both first and second points*
- *If candidate writes 2:1 reaction without qualification and chosen concentration is incorrect scores neither first nor second point*
- *Allow  $0.03\text{-}0.07 \text{ mol dm}^{-3}$*
- *In last point allow consequential answer from second point*
- *If calculates mass needed for  $25 \text{ cm}^3$  loses fourth scoring point*

3 The method used (m) **max 7 scoring points**  
(m)

appropriate washing and cleaning  
weighs appropriate mass  
suitable balance **must** quote number of places ( $\geq 2$ ) or precision is implicit in mass used  
dissolves in water  
uses graduated flask of appropriate volume *volume can be mentioned in scale section*  
includes washings  
makes up to mark  
shakes well

**Notes**

- *If no mass calculated in part 2 then allow weigh any amount;*
- *If mass mentioned in part 2 must weigh this mass*
- *Can prepare solution in volumetric flask; see end*

4 Use of indicator (i) **2 scoring points (i)**  
few drops ( 2-5 )  
yellow to orange/ red/ pink

5 The use of results (r) **4 scoring points (r)**  
calculates moles of acid  
deduces moles of carbonate  
calculates concentration of carbonate  
calculates  $M_r$  of carbonate

**Notes**

- *Candidate can use invented figures or algebra but **must** show each step unambiguously using relevant data. Statements such as “use the titration result to calculate the moles of acid used” do **not** score the point*
- *Candidates making  $25 \text{ cm}^3$  of solution can score last 2 points by correct calculation of from mass/moles*

- 6 **The appreciation of likely hazards and safety precautions (h)** **2 scoring points (h)**  
 reagents harmful / corrosive / irritant wash spillages with cold water/ wear gloves  
 eye protection/ pipette filler

**Notes**

- *Need hazard **and** sensible precaution for point 1*
- *Second sensible precaution for point 2*
- *Mark points independently*

**GRADING**

20 scoring points	18 - 20	scores	8 marks	9 - 11	scores	4 marks
	16 - 17	scores	7 marks	6 - 8	scores	3 marks
	14 - 15	scores	6 marks	3 - 5	scores	2 marks
	12 - 13	scores	5 marks	1 - 2	scores	1 mark

**Exercise 3** Skill assessed **Planning** cont

Alternative marking scheme if candidate prepares standard solution in the volumetric flask

- 3 appropriate washing and cleaning **max 7 scoring points**  
**(m)**  
 weighs appropriate mass  
 accurate balance  
 adds sample to 250 cm<sup>3</sup> graduated flask  
 includes washings **or** weigh by difference  
 dissolves sample  
 makes up to mark  
 shakes well