Version 1.0

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Chemistry 5421

CHM3/P Practical

Mark Scheme

2005 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.

Exercise 1 Mark scheme Skill assessed **Implementing** (2)

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

(a) (i) use of the **pipette**	1 empties under gravity 2 transfers from pipette without spillage 3 touches surface with pipette	10 scoring points
(ii) use of the **burette**	4 uses acid in burette, and alkali in the pipette 5 removes the funnel before titrating 6 dropwise addition near the endpoint any 7 swirls mixture 8 reads burette correctly	any 8 **including** works safely = **2 marks** any 5 = **1 mark**
(iii) general	9 does not require additional sample 10 works safely	

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

(b) the **recording** of results — results recorded clearly and in full in the table — **1 mark**

Notes * *if you can read it, it is clear*
* ***full*** *means completes at least* ***two*** *columns correctly*
* *allow clear answer outside of the box*
* *check candidate's subtractions-* ***one*** *error means candidate* ***loses mark***

(c) the awareness of **precision** — at least **2** titrations which are counted; indicates results which are counted; titre volumes to 0.05 cm^3 — 3 scoring points; **all** 3 = **1 mark**

Notes * *ignore zero entries*
* *allow* ***one*** *other error*

(d) the **concordancy** — concordant if two results are within 0.10 cm^3 of each other — **1 mark**

Notes * *award the mark for concordancy if the table contains at least* ***two*** *concordant results*

(e) The **accuracy** of the mean value, measured against a teacher value for the titration. — **3 marks**

mean titre is within 1% of target value 3 marks
mean titre is within 1.5 % of target value 2 marks
mean titre is within 2% of target value 1 mark

Notes * *ensure average titre is calculated correctly*
* *if value entered by the candidate is wrong, underline the wrong value and write the correct value by the side*
* *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

Exercise 2 Mark scheme Skills assessed **Analysing** (3)
Evaluating (4)

Skill 3 **Analysing**

1. Correct equation $2HCl + MCO_3 = MCl_2 + CO_2 + H_2O$ **1 mark**
   Notes * *Allow $CaCO_3$ etc*
   * *Do **not** allow H_2CO_3*

2. Completes table and calculates a mean titre 19.10 **1 mark**
   Notes * *If no working allow this mark but **loses** nomenclature mark*
   * *If candidate averages all of the titres loses this mark; do **not** penalise again in nomenclature*

3. Calculates the moles of MCO_3 9.55×10^{-3} **1 mark**
   Notes * *Allow consequential answer from part 2*
   * *Averaging all titres gives 19.23 and 9.62×10^{-3}*

4. Calculates the M_r of MCO_3 104.7 **1 mark**
   Notes * *Allow consequential answer from part 3*
   * *9.62×10^{-3} gives 104.0*
   * *Ignore g unit*

5. **Uses data** to confirm the Group II metal is Ca **1 mark**
   Notes * *Allow consequential answer from part 4*
   * *Must show working clearly to score this mark, but **don't** penalise again in awarding the nomenclature mark*
   * *Allow use of data from Evaluation 2 as long as clearly explained*

6. **Errors**

calculates the % error for the balance	± 1.0%	3 scoring points
calculates the % error for the burette	± 0.8%	**all** 3 = **1 mark**
calculates the overall apparatus error	± 1.8%	

   Notes * *Ignore precision of answers*
   * *Consequential marking 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, burette). And do **not** penalise in nomenclature*

(7) **Precision**

quotes average titre as 19.10 cm^3 or 2dp	2 scoring points
quotes M_r to 1 decimal place	**both** = **1 mark**

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

(8) **Nomenclature** clear calculation of average titre **all 3 = 1 mark**
calculations clear & logical, with sensible layout
units where used are correct

   Notes * *Incorrect units mean the nomenclature mark is lost*
   * ***Two** blank sections mean the nomenclature mark is lost*
   * *Don't penalise missing units*

** Answer given in part 2, 3, 4, or 6 without working means the nomenclature mark is lost*

Total 8

Skill 4 Evaluating

1. three consistent /concordant results (and one close) so consistent/good **1 mark**

   first titration probably a rough titration
   overshot end-point in Titration 3
   mis-read of the end-point
   any one = **1 mark**

   Notes ** Must make a clear written comment for first point*
   **Reason for anomalous result must not affect all results*

2. calculation of difference 4.6
   104.7 against 100.1 is a 4.6% 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*
   ** Averaging all titres gives 3.9 and 3.9%*
   ** Using 106 gives 5.9 and 5.9%*

3. appreciates discrepancy > maximum apparatus error **1 mark**

4. dry weighing bottle — all sample transferred to flask
   weigh by difference
   add washings from bottle
   any scoring point + explanation = **1 mark**

   use more accurate balance — reduces error in weighing
   use larger mass
   any scoring point + explanation = **1 mark**

   Notes ** Do not allow a more accurate burette*

Total 6

Exercise 3 Mark scheme Skill assessed **Planning** (1)

(a) the **scale** of working used
sensible volume of HA solution (20 cm^3 to 100 cm^3) **maximum 4 points (s)**
sensible volume of NaOH solution (same or slight excess)
appreciates need for significant ΔT (at least 5^o)
appropriate concentration of HA solution (at least M)

Notes * *To score last two points need a definite **correct** link between conc and* ΔT

(b) the **method** used

(i) **apparatus**
polystyrene cup or other suitable ***don't*** *allow bomb calorimeter* **maximum 4 points (a)**
support e.g. beaker or suitable clamp
measuring cylinders or pipettes *allow without precision specified*
accurate thermometer (0.1^oC or 0.5^oC) ***don't*** *allow digital without stated accuracy*

lid or lagging for the calorimeter

Notes **Can score these marks from a diagram, even if not labelled, but not from a list*
**Ignore additional apparatus unless renders experiment void, when CE means no points scored in this section*

(ii) the **procedure** used
measures initial temperature acid solution **maximum 6 points (m)**
measures initial temperature alkali solution
transfers acid solution to cup
adds alkali
records temperature at suitable intervals **or** records highest temperature reached
thermometer bulb immersed in liquid *(can score from diagram)*
stirs mixture
repeats experiment

Notes * *Allow adding acid to alkali*
** Can score initial temperature of reagent in cup from graph*
** If method unworkable mark up to point where method fails*
** If method seriously unsafe penalise **1 mark***

(c) the **use of results**
plots a labelled graph of temperature against time **maximum 6 points (r)**
graph has correct profile **and** extrapolation
temperature rise read correctly (can score from diagram) **or** determines maximum ΔT

correct $mc\Delta T$ calculation
scales up to molar quantities
by appropriate factor (x 40 for 25 cm^3 of M)

(d) the **appreciation** of **likely hazards** and **safety precautions** **maximum 2 points (h)**
reagents harmful / toxic / irritant etc wash spillages with cold water/ wear gloves
eye protection
pipette filler if using a pipette

Notes * *Need hazard and precaution for first point*

22 scoring points

21 - 22	scores	8 marks	9 - 11	scores	4 marks
18 - 20	scores	7 marks	6 - 8	scores	3 marks
15 – 17	scores	6 marks	3 - 5	scores	2 marks
12 – 14	scores	5 marks	1 - 2	scores	1 mark