



General Certificate of Education

Chemistry 5421

CHM3/P Practical Examination

Mark Scheme

2008 examination - June series

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CHM3/P**Exercise 1** Skill assessed **Implementing (2)****1. Points assessed by supervisor***Manipulative skills m*

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

Notes * if does not work safely, maximum 1 mark

* if there is a blank space on the teacher's grid, assume candidate did not score that point

* if the Works Safely column is blank ask AQA to contact centre for an explanation

2. Points assessed from candidate's written report.

- (b) the **recording** of results
results recorded clearly and in full in the table

Recording t
1 mark

- Notes**
- * if you can read it, it is clear
 - * **full** means completes at least **two** columns
 - * one error in calculation of titre **loses this mark**
 - * allow clear answer outside of the box
 - * if initial burette reading is recorded as 50cm³ **lose this mark**
 - * if initial and final readings are transposed **lose this mark**

- (c) the awareness of **precision**
results of at least **2** titrations which are counted
indicates results which are counted - *can appear in calculation of average*
volumes to 0.05 cm³

Precision p
3 scoring point
all 3 = 1 mark

- Notes**
- * ignore precision of zero entries
 - * allow **one** other error
 - * if indicates first titre is rough one, ignore this column, **unless** candidate uses rough titre in calculating the average, when $p=0$
 - * quotes titres to other than nearest 0.05 **loses the precision mark**
 - * ignore precision of average titre

- (d) the **concordancy** of the results used in calculating the mean
results are concordant if both are within $\pm 0.1 \text{ cm}^3$ of each other

Concordancy c
1 mark**Notes** * award this mark if the table contains at least **two** concordant results

| | | |
|-----|---|-------------------|
| (e) | The accuracy of the mean value, measured against a teacher value | <i>Accuracy a</i> |
| | 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*
 - * *if initial burette reading recorded as 50.00 cm³ mark titres as recorded by candidate; check with Team Leader if an alternative interpretation would help*

Total 8 marks

Exercise 2 Skill assessed **Analysing (3)**

1. Calculates a mean titre 22.70 **1 mark**

Notes * if no working allow this mark but **loses** nomenclature mark
 * if candidate averages all of the titres (22.83) loses this mark; do **not** penalise again in nomenclature

2. Calculates the moles of HCl 2.27×10^{-3} **1 mark**
 Calculates the moles of Na_2CO_3 1.14×10^{-3} **1 mark**

Notes * allow consequential answer from part 1
 * averaging all titres gives 2.28×10^{-3} and 1.14×10^{-3}
 * a correct answer for moles of Na_2CO_3 by any correct method scores 2 marks

3. Calculates the M_r of Na_2CO_3 131.6 - 132.2 **1 mark**

Notes * must divide 0.15 by answer part 2 to score this mark
 * allow consequential answer from part 2
 * using 22.83 gives 131.4
 * ignore g unit

4. **Uses data** to calculate mols water of crystallisation 1 (1.42 - 1.46) **1 mark**

Notes * allow consequential answer from part 3
 * using 130.0 gives 1.33; using 131.4 gives 1.41
 * must show working clearly to score this mark, but **don't** penalise again in awarding the nomenclature mark

5. **Errors** calculates the % error for the balance $\pm 6.7\%$ 3 scoring points
 calculates the % error for the burette $\pm 0.7\%$ **all 3 = 1 mark**
 calculates the overall apparatus error $\pm 7.4\%$

Notes * must calculate individual errors separately to score this mark
 * ignore precision of answers
 * consequential marking for answer to part 1
 * if error(s) doubled **lose this mark**
 * if (x 100) missing from calculations **lose this mark** } don't penalise again in awarding the nomenclature mark
 * allow this mark if which error is being calculated is not stated:
 if the calculations are in the same order as in the question (balance, burette) don't penalise in awarding the nomenclature mark
 if the calculations are **not** in the same order as in the question then n=0

- (6) **Precision** quotes average titre as 22.70 cm^3 2 scoring points
 quotes M_r to 1 decimal place **both = 1 mark**

Notes * If no answer to part 3 can't score this mark

(7) 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***
- * *if there is no number work in part 3 treat as a blank section*
- * *don't penalise missing units*
- * *answer given in parts 1, 2, 3 or 5 without working means the nomenclature mark is **lost***

Total 8 marks

Exercise 2 Skill assessed **Evaluating** (4)

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

Notes

- * *must make a clear written statement of **both** points*
- * *do not accept "three accurate/precise results"*
- * *consequential marking for no. of concordant titres from Analysis part 1*

first titration probably a rough titration
overshot end-point
too much indicator
air in the jet space
errors in weighing sample

any one = **1 mark**

Notes

- * *do not accept "operator error" without qualification*
- * *do not accept "misread burette"*
- * *reason for anomalous result must not affect all results*

2. calculation of difference 8.2
132.2 against 124.0 is a 6.6% error

2 scoring points
both = 1 mark

Notes

- * *difference must be clearly stated*
- * ***lose mark** if no evidence of working in **second** part*
- * *allow consequential answer from part 3 of Analysis*
- * *using 130.0 gives a difference of 6.0 and a percentage of 4.8*
- * *ignore precision of answers*
- * ***lose mark** if the candidate answers a different question*

appreciates discrepancy < maximum apparatus error

1 mark

Notes * *allow if apparatus error given as a figure*

3. dry weighing bottle all sample transferred to flask owtte
or weigh by difference
or add washings from bottle
or weigh directly into conical flask

2 scoring points
any improvement
+ explanation
= **1 mark**

use a 3 dp (or more) balance reduces error in weighing
or use greater mass

2 scoring points
any improvement
+explanation
= **1 mark**

Notes

- * *allow "a balance measuring to more decimal place" or wtte*
- * *do not allow "a more accurate balance" without further qualification*
- * *do not allow "gives a more accurate weight/mass" as explanation*

General

- * *do not allow "a more accurate burette" etc.*
- * ***two correct improvements on their own scores 1 mark***

Total 6 marks

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

- (a) the **scale** of working used **maximum 5 points (s)**
 sensible volume of CuSO_4 soln. in cup (20 cm^3 to 250 cm^3)
 calculates moles CuSO_4 (5 $\times 10^{-3}$ for 25 cm^3)
 deduces moles of zinc needed (as above or allows for a deliberate excess)
 calculates mass of zinc (0.325g for 25 cm^3)
 uses excess zinc (allow any excess)

Notes * to score 3rd and 4th points need a definite **correct** link between moles and mass
 * only award last point if candidate has calculated a mass of zinc; a correct volume and a guess at a mass of Zn only is s=1

- (b) **apparatus** **maximum 5 points (a)**
 polystyrene cup or other suitable eg insulated glass vessel **don't allow bomb calorimeter**
 support e.g. beaker or suitable clamp
 measuring cylinder, burette or pipette *allow without precision specified*
 0.1°C to 0.5°C thermometer **not just accurate thermometer**
 lid or lagging for the calorimeter
 balance

Notes * can score these marks from a diagram, even if not labelled
 * **only allow 0.1°C to 0.5°C thermometer and balance from an apparatus list**
 * ignore additional apparatus unless contradictory, then apply list principle
 * **don't allow "digital thermometer"** without stated accuracy
 * allow temperature probe with data logger

- (c) the **method** used **maximum 6 points (m)**
 measures initial temperature CuSO_4 soln. *(can score from table or graph)*
 transfers CuSO_4 soln. to cup
 adds zinc
 thermometer bulb immersed in liquid *(can score from diagram)*
 stirs mixture
 records temperature at suitable intervals *(can score from table or graph)*
 repeats experiment

Notes * allow adding CuSO_4 to Zn, but must measure initial temp of CuSO_4 to score pt 1
 * if makes a solution of zinc penalise **1 mark** } *write -1 at this point*
 * if method seriously unsafe penalise **1 mark** } *in the script*
 * if method unworkable mark up to point where method fails; write CE at this point

(d) the **use of results****maximum 6 points (r)**

plots a labelled graph of temperature against time
 graph has correct profile
 extrapolates correctly for **both** sections to allow for heat loss
 temperature rise read correctly
 correct $mc\Delta T$ calculation
 scales up to molar quantities
 by appropriate factor ($\times 200$ for 25 cm^3 of 0.2M)

(allow straight lines or curves)
 (can score from diagram)
 (must have appropriate numbers)

Notes

- * mark as separate section; candidate can score some points even if method unworkable
- * **lose first three points** if no graph or candidate plots wrong graph for experiment described
- * units, and scale on temp axis not needed to score 1st pt but **must** indicate point of mixing on time axis
- * allow (mass of water + mass of zinc) used in $mc\Delta T$ calculation
- * ignore missing conversion to kJ and sign of enthalpy change in final answer

(e) the **appreciation of likely hazards and safety precautions****maximum 2 points (h)**

reagents harmful/toxic/irritant/corrosive etc wash spillages (with water)/ wear gloves/
 pipette filler if using a pipette
 eye protection

Notes

- * need hazard and precaution for first point
- * do not allow "wipe up spillages"/ "use a fume cupboard" or "do not ingest or inhale reagents"

24 scoring points

22 - 24 scores 8 marks
 19 - 21 scores 7 marks
 16 - 18 scores 6 marks
 13 - 15 scores 5 marks

10 - 12 scores 4 marks
 7 - 9 scores 3 marks
 4 - 6 scores 2 marks
 1 - 3 scores 1 mark

Total 8 marks