



**General Certificate of Education**

**Chemistry 6421**

**CHM6/P Practical Examination**

**Mark Scheme**

*2008 examination - June series*

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**CHM6/P**Exercise 1 Skill assessed **Implementing (2)****1. Points assessed by supervisor***Manipulative skills* **M**

- |                               |    |   |  |
|-------------------------------|----|---|--|
| (a) (i) use of <b>pipette</b> | 1  | empties under gravity                   | 10 scoring points<br>any <b>8</b> including<br>safety = <b>2 marks</b> |
|                               | 2  | transfers from pipette without spillage |  |
|                               | 3  | touches surface with pipette            |  |
| (ii) use of <b>burette</b>    | 4  | uses manganate(VII) in burette          | any 5 = 1 mark   |
|                               | 5  | removes the funnel before titrating     |  |
|                               | 6  | dropwise addition near the endpoint     |  |
|                               | 7  | swirls mixture                          |  |
| (iii) <b>general</b>          | 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

- (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 50cm<sup>3</sup> **lose this mark**\* if vol of KMnO<sub>4</sub> is recorded as 25cm<sup>3</sup> **lose this mark**; ignore when awarding precision\* 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 cm<sup>3</sup>

*Precision* **P**  
3 scoring point  
**all 3 = 1mark****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  
results are concordant if they are within  $\pm 0.1$  cm<sup>3</sup> of each other

*Concordancy* **C**  
**1 mark****Notes** \* award the mark for concordancy if the table contains at least **two**  
concordant results, irrespective of the results used to calculate the average

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(e)	The <b>accuracy</b> of the mean value, measured against a teacher value	<i>Accuracy A</i>
	mean titre is within 1% of target value	<b>3 marks</b>
	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 cm<sup>3</sup> 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. the **plotting of the graph**plots  $\log(1/\text{time})$  on the y axis,  $\log(\text{volume of KI})$  on the x axis

sensible scale for y axis

sensible scale for x axis

labels the axes

plots the points correctly

line through the points is

straight

best fit (must **ignore** result for expt 5)

7 scoring points

any **6 = 3 marks**any **4 = 2 marks**any **2 = 1 mark****Notes**\* if graph does not cover **half** of the paper **maximum score is 2 marks;**

do not penalise again under nomenclature

\* if the graph plot goes off the squared paper **maximum score is 2 marks;**

do not penalise again under nomenclature

\* if plots a non-linear/broken scale **maximum score is 2 marks;**mark part 2 consequentially but **loses the nomenclature mark**\* if candidate makes all of the three mistakes above **no marks** for graph\* if uses an ascending y axis of negative numbers **maximum score is 2 marks;**

do not penalise again under nomenclature

\* three points scored across the sections gives at least 1 mark

\* if axes unlabelled use data to decide that  $\log(1/\text{time})$  is on y axis\* allow mark for axes labelled " $(1/\text{time})$ " and "volume of KI"2. correct **use of the graph** to determine gradient

appropriate x and y readings written on graph or clearly in part 2

correctly calculates **gradient**0.90  $\pm$  0.02

shows working

eg 0.45/0.5

**1 mark****1 mark****1 mark****Notes**\* consequential marking from candidate's data, **to a maximum of 2;**\* if gradient calculation upside down **maximum of 2;**

\* for first mark must show triangle on graph or such as

$$\frac{1.65-1.2}{1.4-0.9}$$

\* for first mark cannot use data from table unless it matches the graph

\* for second mark must quote gradient to 1 dp or 2 dp

\* ignore if candidate proceeds to state order or includes a negative sign

3. correct estimation of **errors**

estimates error in using measuring cylinder	(0.5 in 10 = 5% )	3 scoring points
estimates error in using clock	( 1 in 36 = 2.8% )	all <b>3 = 1 mark</b>
calculates the overall apparatus error	( 7.8% on above values )	

**Notes**

- \* must calculate individual errors separately to score this mark
- \* ignore precision of answers
- \* must calculate errors for Expt 3
- \* 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 (measuring cylinder, clock )**  
     don't penalise in awarding the nomenclature mark  
     **if the calculations are *not* in the same order as in the question then n=0**

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

clear graph with sharp trace no doubling or thick line ( $\geq \frac{1}{2}$ square)	4 scoring points
graph has correct profile- appreciates need to plot negative numbers	<b>all 4 = 1 mark</b>
explains the calculation of the gradient clearly and logically	
explains the calculation of the errors clearly	

**Notes**

- \* ignore units
- \* if part 2 or part 3 is blank then **loses nomenclature mark**

**Total 8 marks**

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

1. profile is good straight line/ results good quality/order close to 1/  
can deduce order with confidence **1 mark**

**Notes** \* *must make a clear written comment*  
\* *mark consequentially to candidate's graph*

anomalous result in Expt 5 or  $20\text{ cm}^3$  **1 mark**

**Notes** \* *mark consequentially to candidate's graph*  
\* *clear written comment or **clearly** indicated on the graph; allow ring drawn around Expt 5 point if it is the only point on the graph which is ringed*  
\* *if candidate includes Expt 5 point in best fit line, **loses** this mark if claims Expt 5 is an anomaly*  
\* *if candidate includes Expt 5 point in best fit line, and states no anomalies **allow** this mark*  
\* *if candidate includes Expt 5 point in best fit line, and correctly identifies another point as anomalous **allow** this mark*

2. thermostat the mixture **or** constant temperature **or** use a water bath **1 mark**  
reaction/rate affected by temperature change **1 mark**

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use burette/ pipette/ **OR** use a larger volume **1 mark**  
reduces errors in volume measurement reduces errors in (volume) measurement **1 mark**  
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colorimeter/ uv-visible spectrometer/ light sensor to monitor colour change **1 mark**  
eliminates human error in timing/ more precise time of colour change **1 mark**

**Maximum 4 marks**

**Notes** \* *do not allow improvement to clock*  
\* *if candidate gives **more than two answers** apply the list principle – each wrong answer cancels out a correct answer*

**Total 6 marks**

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

- (a) the appreciation of **scale** **s max 2** scoring points  
 uses 1:1 ratio to calculate moles of acid **or** appreciates acid solution should be  $0.1 \text{ mol dm}^{-3}$  or other sensible value  
 calculates correct mass for chosen volume ( $250 \text{ cm}^3$  needs  $3.75 \text{ g}$  for  $0.1 \text{ M}$ )

**Notes** \* to score last point need a definite **correct** link between mass and conc. with working shown

- (b) the **method used** **m max 9** scoring points  
 uses pH meter/ probe  
 calibrates pH meter *details not needed but if given must be correct to score this point*  
 measures specified volume ( $20\text{--}50 \text{ cm}^3$ ) acid into a conical flask/beaker  
 using a pipette *do not award this point if candidate prepared  $25 \text{ cm}^3$  of solution only*  
 adds alkali from a burette  
 in sensible small portions ( $0.5\text{--}2 \text{ cm}^3$  – **not** dropwise)  
 to excess/up to at least  $30 \text{ cm}^3$ / steady high pH  
 stirs or swirls mixture  
 measures or records pH after each addition  
 smaller volumes added near endpoint (**not** dropwise)  
 repeats experiment

**Notes** \* can score points from a diagram  
 \* do **not** allow apparatus from a list except for **pH meter**  
 \* ignore additional apparatus unless contradictory - lose apparatus point(s)  
 \* ignore addition of water during titration  
 \* allow if acid in burette but check pH curve profile is appropriate  
 \* if basic expt is described, but there is a major flaw, mark method in usual way; write “-1” next to flaw and deduct **1 mark** from final score  
 \* if an unsuitable experiment is described, mark to point of departure; write **CE** at this point; consult DGW  
 \* if anything unsafe award **no hazard points**

- (c) the use of **results** **r max 6** scoring points  
 sensible sketch of pH against volume with correct profile  
 uses rough scales for pH **and** volume  
 explains clearly how to determine the endpoint (*on sketch or **clearly** in written account*)  
 divides endpoint titre by 2 to determine half-equivalence point  
 reads pH at this volume (*indicated on sketch or **clearly** in written account*)  
 converts  $\text{pK}_a$  value to  $\text{K}_a$  value

**Notes** \* mark this section independently of the method  
 \* can score points from sketch  
 \* on x axis accept actual volumes (endpoint  $20\text{--}30 \text{ cm}^3$ ) or in terms of  $v$  and  $v/2$

- (d) **safety** factors **h max 2** scoring points  
 eye protection  
 acid may be toxic/corrosive/irritant gloves / flood skin with water /use a pipette filler  
 alkali is corrosive/irritant gloves / flood skin with water

**Notes** \* need hazard and precaution for at least one of the points  
 \* do not allow “harmful”/ “wipe up spillages”/ “use a fume cupboard”/ “wear a lab coat”/ “tie back hair” or “do not ingest or inhale reagents”



**GRADING**

19 scoring points

18 - 19	scores	8 marks	9 - 11	scores	4 marks
16 - 17	scores	7 marks	6 - 8	scores	3 marks
14 - 15	scores	6 marks	4 - 5	scores	2 marks
12 - 13	scores	5 marks	1 - 3	scores	1 mark

**Approach if candidates do not plot a pH curve**1. *If candidate does a routine titration:*

- \* mark by the standard scheme for method ( **max 5** scoring points) and results
- \* do **not** award extra method points for *washing of apparatus, addition of indicator, colour change, concordant results or standard precautions*

2. *If candidate does a routine titration **then takes the pH of a half neutralised solution:***

- \* mark by the following scheme for **method** maximum **9** scoring points
  - measures specified volume (20-50 cm<sup>3</sup>) acid into a conical flask/beaker using a pipette
  - adds alkali from a burette
  - adds appropriate named indicator - e.g. phenolphthalein
  - correct colour change
  - stirs or swirls mixture
  - dropwise near endpoint
  - concordant results
  - prepares half neutralised solution
  - uses pH meter
  - calibrates pH meter
  - repeats experiment

**Notes** \* *allow if acid in burette but check preparation of half-neutralised solution*

- \* mark by the following scheme for **results** maximum **4** scoring points
  - calculates an average titre
  - divide average titre by two or adds volume of acid equal to original volume used in titration
  - take pH of half neutralised solution
  - converts pK<sub>a</sub> to K<sub>a</sub>

**Notes** \* *first three scoring points may well be in the method section*