



General Certificate of Education

Chemistry 6421

CHM6/P Practical Examination

Mark Scheme

2008 examination - June series

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

- | | | | |
|-------------------------------|----|---|---|
| (a) (i) use of pipette | 1 | empties under gravity | 10 scoring points
any 8 including
safety = 2 marks |
| | 2 | transfers from pipette without spillage | |
| | 3 | touches surface with pipette | |
| (ii) use of burette | 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) 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*

- | | |
|---|--------------------|
| (b) the recording of results | <i>Recording T</i> |
| 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* *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 vol of KMnO₄ is recorded as 25cm³ lose this mark; ignore when awarding precision** *if initial and final readings are transposed lose this mark*

- | | |
|---|----------------------|
| (c) the awareness of precision | <i>Precision P</i> |
| results of at least 2 titrations which are counted | 3 scoring point |
| indicates results which are counted - <i>can appear in calculation of average</i> | all 3 = 1mark |
| volumes to 0.05 cm ³ | |

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 | <i>Concordancy C</i> |
| results are concordant if they are within $\pm 0.1 \text{ cm}^3$ of each other | 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*

(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. 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 all 3 = 1 mark
estimates error in using clock	(1 in 36 = 2.8%)	
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 all 4 = 1 mark
graph has correct profile- appreciates need to plot negative numbers	
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 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
reaction/rate affected by temperature change **1 mark**
1 mark

use burette/ pipette/ **OR** use a larger volume **1 mark**
reduces errors in volume measurement reduces errors in (volume) measurement **1 mark**

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 mol dm^{-3} or other sensible value
 calculates correct mass for chosen volume (250 cm^3 needs 3.75 g for 0.1 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 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 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 pK_a value to 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 cm³) 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_a to K_a

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