

GCE 2004

June Series



Mark Scheme

Chemistry

(Subject Code CHM6/P)

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.

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Dr Michael Cresswell Director General

CHM6/P Practical Examination**Exercise 1**Skill assessed **Implementing (2)**

(a) Points assessed by supervisor

Manipulative skills m

- | | | | |
|---------------------|----|---|--|
| (i) use of pipette | 1 | empties under gravity | 10 scoring points
any 8 = 2 marks
any 5 = 1 mark |
| | 2 | transfers from pipette without spillage | |
| | 3 | touches surface with pipette | |
| (ii) use of burette | 4 | uses manganate(VII) in burette | |
| | 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*

(b) Points assessed from candidate's written report.

- | | | | |
|---|--|---|---|
| (i) the recording of results | results recorded clearly and in full in the table | | <i>Recording r</i>
1 mark |
| | Notes | * <i>if you can read it, it is clear</i> | |
| | | * <i>full means completes at least two columns correctly</i> | |
| | | * <i>allow clear answer outside of the box</i> | |
| | | * <i>if initial reading is 50cm³ lose recording mark</i> | |
| | | * <i>if initial and final readings are transposed lose recording mark</i> | |
| (ii) the awareness of precision | results of at least 2 titrations which are counted | | <i>Precision p</i>
3 scoring point
all 3 = 1 mark |
| | indicates results which are counted - <i>can appear in calculation of average</i> | | |
| | volumes to 0.05 cm ³ | | |
| Notes | * <i>ignore precision of zero entries</i> | | |
| | * <i>allow one other error</i> | | |
| | * <i>if indicates first titre is rough one, ignore this column, unless candidate uses rough titre in calculating the average, when p=0</i> | | |
| | * <i>quotes titres to other than nearest 0.05 loses the precision mark</i> | | |
| (iii) the concordancy of the results used in calculating the mean | results are concordant if both are within 0.1 cm ³ of each other | | <i>Concordancy c</i>
1 mark |
| | Notes | * <i>award the mark for concordancy if the table contains at least two concordant results</i> | |

(iv) 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*

Total 8 marks

Exercise 2Skill 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 4 scoring points
 sensible scale for y axis any 3 = 1 mark
 sensible scale for x axis
 labels the axes
- plots the points correctly both = 1 mark
 line through the points is smooth
- line through the points plotted is best fit 1 mark
- Notes * *if graph does not cover half of the paper deduct 1 mark; do not penalise again under nomenclature*
 * *if the graph plot goes off the squared paper deduct 1 mark; do not penalise again under nomenclature*
 * *if uses an ascending y axis of negative numbers deduct 1 mark; do not penalise again under nomenclature*
 * *if plots a non-linear/broken scale deduct 1 mark; mark part 2 consequentially but loses the nomenclature mark*
 * *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/time)” and “volume of KI”*
- 2 correct use of the graph to determine gradient
 appropriate x and y readings on graph or clearly in part 2 1 mark
 correctly calculates gradient 0.90 ± 0.02 1 mark
 shows working 1 mark
- Notes * *consequential marking from candidate's data, to a maximum of 2;*
 * *if gradient calculation upside down maximum of 2;*
 * *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%) any 2 = 1 mark
 calculates the overall apparatus error (7.8% on above values)
- Notes * *ignore precision of answers*
 * *consequential marking for overall error*
 * *penalise doubled errors once*
 * *lose mark if answers wrong because ($\times 100$) missing from calculations; don't penalise again in awarding the nomenclature mark*
 * *lose mark if don't use values from Experiment 3; don't penalise again in awarding the nomenclature mark*

- 4 the correct use of nomenclature and terminology
clear graph with sharp trace
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*
- 4 scoring points
all 4 = 1 mark
- Total 8 marks

Exercise 2Skill 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 1 mark
rate affected by temperature change 1 mark
- use burette/ pipette/ larger volume OR use more accurate clock 1 mark
more accurate volume more accurate timings 1 mark
- spectroscopy to monitor colour change 1 mark
eliminates human error 1 mark
- Notes * *Do not penalise additional answers unless they contradict*

Maximum 4 marks

Total 6 marks

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

- (a) the appreciation of scale **s** max 3 scoring points
 appreciates a 1:1 reaction appreciates acid solution should be
 0.1 mol dm⁻³ or other sensible value
 calculates correct mass for chosen volume (250 cm³ needs 3.75g for 0.1M)
 Notes * *to score last point need a definite correct link between mass and conc.*
- (b) the method used **m** max 10 scoring points
 uses pH meter
 calibrates pH meter
 measures specified volume (20-50 cm³) acid into a conical flask/beaker
 using a pipette
 adds alkali from a burette
 in sensible small portions (0.5-2 cm³)
 to excess/up to at least 30 cm³/ steady high pH
 stirs or swirls mixture
 measures pH after each addition *use of a datalogger scores*
 records pH value *these two points*
 smaller volumes added near endpoint
 repeats experiment
 Notes * *can score points from a diagram*
 * *ignore additional apparatus unless contradictory - lose apparatus point(s)*
 * *allow if acid in burette but check pH curve profile is appropriate*
 * *if method is clearly unworkable, CE; allow points common to correct method; consult DGW*
 * *if anything unsafe award no hazard points*
- (c) the use of results **r** max 5 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
 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 * *can score points from sketch*
 * *on x axis accept actual volumes (endpoint 20-30 cm³) or in terms of v and v/2*

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

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	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 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 10 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
 - take pH of half neutralised solution
 - converts pK_a to K_a

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