Version 1.1 : 07/07

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Chemistry 6421

CHM6/P Practical Examination

Mark Scheme

June examination - 2007 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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX *Dr Michael Cresswell Director General*

CHM6/P

Exercise 1 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

(ii) use of the **burette**
4 uses $Na_2S_2O_3$ in burette, and KIO_3 in the pipette
5 removes the funnel before titrating
6 dropwise addition near the endpoint any
7 swirls mixture
8 reads burette correctly

(iii) general
9 does not require additional sample
10 works safely

10 scoring points any 8 **including** works safely = **2 marks** any 5 = **1 mark**

Notes ** if there is a blank space on the teacher's grid, assume candidate did not score t hat 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 **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***
** lose this mark if initial titre recorded as 50.00 cm^3*

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

Notes ** ignore zero entries*
** allow **one** other error*
** precision applies to the numbers in the table, not to the average titre*
** ignore precision of data in first column if clearly marked "rough"*

(d) the **concordancy** concordant if two results are within 0.10 cm^3 of each other **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 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*
* *if initial titre recorded as 50.00 cm^3 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)

Question 1

pH on the y axis, volume of alkali on the x axis — 7 scoring points
uses sensible scale for y axis — any **6** = **2 marks**
uses sensible scale for x axis — any 4 = 1 mark
labels the axes
plots the points correctly
line through the points is smooth
best fit - ignores pt at 20 cm^3 (ignore 0 - 5 cm^3 section)

Notes * *If graph does not cover half of the paper :-*
maximum score is 1 mark
*write **scale** on the candidate's graph*
mark up to first 4 correct points only
do not penalise again under nomenclature
do not penalise again under nomenclature
* *If the graph plot goes off the squared paper maximum score is 1 mark; do not penalise again under nomenclature*
* *If axes unlabelled use data to decide that pH is on y axis*
* *Allow mark for axes labelled "pH" and "volume"*
* *A kinked graph loses smooth **and** best fit points*
* *Loses nomenclature mark if graph drawn with dotted lines*

Question 2

(i) identifies endpoint **22.2 cm^3 ± 0.2** — 3 scoring points
(ii) identifies half-equivalence point **half of the above** — **all 3 = 1 mark**
(iii) pH at half-equivalence point **3.9 ± 0.2**

Notes * *Do **not** allow other answers*

Question 3 correctly calculates value for K_a 3.9 gives **1.26×10^{-4}** **1 mark**

Notes ** Consequential marking from candidate's endpoint/pH*
** Do **not** award this mark if candidate gets the correct answer by an incorrect method; don't penalise again in awarding the nomenclature mark*

Question 4 **methanoic acid** **1 mark**

Notes ** Consequential marking from candidate's K_a value*
** No lucky guesses - candidate must apply answer from Q3*

Question 5 estimates error in using pipette (**0.2**%) **3 scoring points**
estimates error in using burette (using 22.2, **0.68**%) **all 3 = 1 mark**
total error (**0.9**%)

Notes ** Ignore precision of errors*
** Lose burette error if not calculated on candidate's end-point*
** **Lose mark** if answers wrong because (x 100) missing from calculations or errors doubled;*
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. And do **not** penalise in nomenclature*

(a) **precision** quotes **both** volumes to 1 or 2 dp **3 scoring points**
pH reading to 1 place of decimals **any 2 = 1 mark**
K_a value to 3 sig fig; accept integer if >100

Notes ** If no answers to Q2 can't score this mark*

(f) **nomenclature** clear graph with sharp trace 3 scoring points
explains calculations clearly & logically, with sensible layout
all 3 = 1 mark
uses terminology accurately e.g. K_a not confused with pK_a

Notes ** Graph with broad line or clearly doubled line means mark is lost*
** Incorrect units mean the nomenclature mark is lost*
** Don't penalise missing units*
** **Two** blank sections mean the nomenclature mark is lost*
** Answer given in Q5 without working means the nomenclature mark is **lost***
** Do not penalise for wrong calculation in Q 3 if explained clearly*

Total 8 marks

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

Graph ignores anomalous result at 20 cm^3 in plotting graph **1 mark**

Notes ** Allow first point in written answer to Q1 or clearly from the graph; any contradiction on graph **loses** this mark*

Question 1

difference is 1.6-1.26 = 0.34 x 10^{-4} **1 mark**
a 21.3% error **1 mark**

Notes ** **Lose mark** if no evidence of working in second part*
** Ignore precision of answers*
** Allow consequential answer from part 3 of Analysis*
** Difference must be clearly stated*
** **Lose mark** if the candidate answers a different question*
* Using 1.9 x 10^{-4} gives 0.3 x 10^{-4} and 18.8%

Question 2

discrepancy < apparatus error **2 scoring points**
adequate technique/ within limits of the apparatus **both = 1 mark**

Notes ** Must make a clear written statement linking both points to score mark*
** If candidate's answers from Q5 of Analysis and Q1 of Evaluation mean discrepancy > apparatus error award mark for:*
discrepancy > apparatus error
human/ procedural error

Question 4

pH meter reading to 2dp/ 3dp/ more than 1dp any **2** = **2 marks**
thermostat the mixture **or** maintain constant temperature any 1 = 1 mark
calibrate meter

Notes ** Do not penalise additional answers unless they contradict*
** Do not allow "repeat experiment"- answer has to improve accuracy of pH measurements*

Total 6 marks

Exercise 3

Skill assessed **Planning** (1)

1. the **appreciation** of **scale** **s** max 4 scoring points
   (a) correct reaction equation (1:1)
   (b) calculates theoretical mass of BCC to make 5g PBC 3.56g
   (c) calculates minimum mass of BCC to make 5g PBC 5.09g
   (d) calculates mass of phenol needed 3.39g

   Notes ** Allow theoretical mass of phenol, 2.37g. in (d)*
   ** Consequential marking from answer to (b)*
   ** Ignore precision of answers*

2. the **purification process** **m** max 7 scoring points
   dissolves in the minimum quantity
   of hot ethanol ***not solvent, not warm***
   filters hot/ decants solution
   cools hot solution
   collects crystals
   Buchner apparatus/ suction or reduced pressure or vacuum filtration *allow mention at any stage of process*
   dries crystals
   weighs (dry) sample

   Notes ** If method completely unworkable CE means no points scored in this section*
   ** If method flawed(eg evaporates to dryness) mark up to error; write CE at point of error; ignore reflux if it does not negate the process*
   ** Can score from a diagram; does not need to be labelled as long as unambiguous*
   ** If solvent used is water then **m = 5 max***
   ** If method seriously unsafe e.g. uses a naked flame mark normally then penalise **1 mark** at end*

3. the **check** on **purity** **r** max 2 scoring points
   melts sharply/ over small temperature range
   melting point agrees with data value/ mpt of known sample

   Notes ** Allow r=2 for mix product with sample of pure substance*
   mixture melts sharply at expected mpt

4. the appreciation of **safety** **h** max 4 scoring points
   phenol corrosive/toxic skin protection or flood affected area with water
   benzenecarbonyl chloride irritant vapour fume cupboard
   hydrogen chloride corrosive/ irritant fume cupboard
   ethanol flammable avoid naked flames/ electric heating/ water bath
   eye protection

   Notes ** Need hazard **and** sensible precaution for points 1-4*
   ** Do **not** allow "Use a fume cupboard" as a precaution for toxicity*
   ** Do **not** allow "do not eat/ consume, do not breathe in" as precautions*
   **If candidate lists hazards and precautions separately, without connection, max h=2*

GRADING Total 17 scoring points

16-17	points	scores 8 marks	8-9	points	scores 4 marks
14-15	points	scores 7 marks	6-7	points	scores 3 marks
12-13	points	scores 6 marks	4-5	points	scores 2 marks
10-11	points	scores 5 marks	1-3	points	scores 1 mark

Total 8 marks