

A2 Practical 2816/03 January 2004: Mark Scheme

Skill P

16 marks

P 7 marks (max) for pH measurement

- P1 Known mass of sulphamic acid dissolved in water using a volumetric flask [1]
- P2 Dips probe of pH meter into the solution to measure the pH. [1]
- P3 One accuracy precaution:
 Outlines calibration of the pH meter before/during use
 or waits for instrument to stabilise before taking pH reading
 or stirs/shakes to ensure that solution is homogeneous [1]
- P4 Ionic equations for dissociations of sulphamic acid quoted, to illustrate basicity. [1]
 At least two equations must be given: state symbols are required.
- P5 Clear deduction of basicity from pH data obtained
 or calculates the pH of aq sulphamic acid solution used (if monobasic) [1]
- P6 Repeats the pH measurement using at least two other solutions of sulphamic acid, with different known concentrations. [1]
- P7 Calculation to show that the pH would be 0.3 units lower if the acid was dibasic. [1]
- P8 Compares the titration-pH curves of typical monobasic and dibasic acids
 or measures pH of sulphamic acid and compares with equimolar HCl [1]
- P9 Uses the displayed structure of sulphamic acid to explain that it is monobasic. [1]

T 7 marks for titration procedure

- T1 Uses a "known" solution of sulphamic acid
 and titrates with a named alkali of known concentration [1]
- T2 Brief description of use of burette and pipette [1]
- T3 Trial done **and** at least two consistent titres obtained [1]
 Titration within 0.1 cm³ = consistent
- T4 Suitable indicator **and** the correct end point colour quoted [1]
- T5 Gives a balanced equation for titration reaction (if monobasic)
 $\text{NH}_2\text{SO}_3\text{H} + \text{NaOH} \rightarrow \text{NH}_2\text{SO}_3\text{Na} + \text{H}_2\text{O}$ [1]
- T6 Calculation of suitable quantities of both materials for the titration [1]
 eg - 2.4 g sulphamic \rightarrow 250 cm³ then titrated with 0.10 mol dm⁻³ NaOH
- T7 Simple explanation of how the titre value relates to basicity. [1]
 eg - If the number of moles of OH⁻ equals H⁺, then the acid is monobasic

S 3 marks for Safety, Sources and QWC

- S1** Risk assessment for use of sulphamic acid **or** alkali given. [1]
*Hazard **and** specific safety measure are required for the mark*
No hazard stated = no mark S1
Photocopied/downloaded hazard information does not score S1
- S2** References to **two** secondary sources quoted as footnotes **or** at end of Plan. [1]
Book references must be specific and have chapter or page numbers
Internet reference must go beyond the first slash of web address
Accept one specific reference to "Hazcards" without any qualification
- S3** Good QWC: between 300 and 800 words **and** with word count given. [1]
Accept a word count given in multiples of 200
*QWC: allow up to **five** different errors in spelling **or** grammar **or** language*

A2 Practical Test (B)

Part 1 Mainly Skill I

13 marks

Two mass readings clearly listed, **with** units (once) **and** both quoted to 2 or 3 d.p. **and** subtraction to give mass of HA is correct. [1]

Presentation of titration data in a labelled table. [2]
Six bullet points correct = 2 marks: five correct = 1 mark: four correct = 0

- Correctly labelled table (initial, final and difference) used to record titration data
- Units, cm^3 , are given
- Trial titre is shown and clearly labelled (e.g. by "T" or "R" but not "1")
- All "accurate" burette data (including 0.0) are quoted to at least 0.1 cm^3
- All subtractions are correct
- Data for at least **three** titrations are quoted.
*Recording the start volume as "50 cm^3 " forfeits **both** marks.*
*"Reversed data" (i.e. Final = 0.0; Initial = 27.3) forfeits **both** marks*
*A table giving only the titre differences forfeits **both** marks.*

Candidate's accurate titres (as used for the mean) agree within 0.10 cm^3 . [2]
One mark is awarded if titres are consistent within 0.20 cm^3
If there are no ticks to show readings used, subtract one mark (from these two)

Mean titre correctly calculated [1]
*Candidate must **not** include the trial **or** any deviant readings (outside 0.2 cm^3).*

Accuracy – 7 marks are available, by comparison with the supervisor's titration

Adjusted titre, T = candidate's correct mean titre $\times \frac{\text{candidate's mass}}{\text{supervisor's mass}}$

T is within 1.30 cm^3 of mean supervisor's value	[1]
T is within 1.10 cm^3 of mean supervisor's value	[2]
T is within 0.90 cm^3 of mean supervisor's value	[3]
T is within 0.70 cm^3 of mean supervisor's value	[4]
T is within 0.50 cm^3 of mean supervisor's value	[5]
T is within 0.30 cm^3 of mean supervisor's value	[6]
T is within 0.20 cm^3 of mean supervisor's value	[7 marks]

Spread penalty

If candidate's spread of titres is $> 0.40 \text{ cm}^3$, subtract 1 mark from mark out of 7.

If candidate's spread of titres is $> 0.70 \text{ cm}^3$, subtract 2 marks

If candidate's spread of titres is $> 1.00 \text{ cm}^3$, subtract 3 marks (etc)

The mark awarded for accuracy is shown in the margin, written as "+6" etc.

Part 2 Skill A**12 marks**

Answers should be quoted to 2, 3 or 4 sig fig: penalise **once** only on pages 4 and 5

Apply ecf from one part to the next

- (a) M_r of sulphamic acid = 97.1 (97) [1]
- Correct concentration = mass used $\times 4 / 97.1$ (= approx 0.04 mol dm^{-3}) [1]
 Correct answer scores the "working" mark.
- (b) $n(\text{sulphamic acid})$, correctly calculated using $n = \frac{MV}{1000}$ [1]
- (c) Formulae correct – $\text{Ca}(\text{OH})_2$ and H_2O [1]
and state symbols correct – aq, aq, aq, l
 Balancing correct – 1, 2, 1, 2 [1]
 Wrong formula of calcium hydroxide **or** wrong co-product forfeit both marks
- (d) $n(\text{calcium hydroxide})$ in mean titre = $0.5 \times \text{"b"}$ [1]
 $[\text{Ca}(\text{OH})_2] = 0.5 \times 0.0012 \times \frac{1000}{25}$: correct answer obtained = 20 "b" [1]
No marks awarded on (d) if candidate halves his/her answer from (a)
- (e) (i) $[\text{Ca}^{2+}] = \text{"d"}$ (approx 0.024) [1]
 (ii) $[\text{OH}^-] = 2 \times \text{"d"}$ (approx 0.048) [1]
- (f) $K_s = 4d^2$ (correctly worked out: should be approx 4.8×10^{-5}) [1]
 This mark is for correct working from candidate's own answers to (e)
 If candidate used 0.028, then $K_s = 8.78 \times 10^{-5}$
 If the answer for K_s (correctly worked) is $___ \times 10^{-5}$ (with 3 s.f. quoted) [1]
 This mark is not be awarded if the candidate has used 0.028
 Units are $\text{mol}^3 \text{ dm}^{-9}$ [1]

Part 3 Skills I and A**5 marks**

- (a) Gives a cloudy/milky/white precipitate/suspension [1]
- (b) Precipitate is calcium hydroxide [1]
 Excess/more [aqueous] OH^- ions were added [1]
or a formal statement of Le Chatelier's Principle
 Equilibrium position moves to the left to reduce $[\text{OH}^-(\text{aq})]$ [1]
- (c) NaOH is corrosive so must not be spilt on hands or clothes (etc) [1]
or a simple explanation of what "corrosive" means

Part 4 Skill E: Evaluation**14 marks (max)****(a) 8 marks**

- A1 X-axis labelled "Volume of [sulphamic] acid /cm³" and with suitable figures [1]
Numerical labelling must correspond to the candidate's mean titre
- A2 Good sketch of pH curve for the titration of a strong acid and a strong alkali [1]
Sketch graph must start at pH 12 – 14 and end at pH 0 – 2
- A3 Vertical pH drop of several units across the end point [1]
Graph must show at least 4 units of sudden pH change (pH 9 to pH 5).
- A4 Typical indicators change colour completely within *about* 2 pH units [1]
A4 can be scored by inference from marking/labelling of the graph
- A5 A suitable indicator changes colour completely within the sudden pH drop [1]
- A6 Both indicators may be used to determine the end point. [1]
A definite supported statement is required to award this mark
- A7 Phenolphthalein, if it had been used, would change from red/pink to colourless [1]
*Both colours are required **and** must be the correct way round. Not "clear".*
- A8 A relevant comment about the clarity of either of the indicator colour changes [1]

(b) 9 marks maximum

- B1 $\text{Cu}^{2+} + 2\text{OH}^- \rightarrow \text{Cu}(\text{OH})_2$ [1]
- B2 $M_r = 97.5$ [1]
- B3 $n(\text{Cu}(\text{OH})_2) = 0.05/97.5 = 0.000513 \text{ mol}$ [1]
- B4 $[\text{Ca}(\text{OH})_2] = 0.00051 \times 1000/25 = 0.0205 \text{ mol dm}^{-3}$ [1]
Answer must be to 2 or 3 sig fig
- C1 Quantitative example of accuracy tolerance for the burette **or** pipette [1]
- C2 Titration readings were repeated [but gravimetric experiment was done once] [1]
- C3 Consistent readings in the titration are evidence of reliability (ora) [1]
- C4 In a titration it is easy to tell when the reaction has finished, due to the indicator. [1]
- D1 Masses involved in gravimetric experiment are too small [1]
- D2 Quantitative discussion of % inaccuracy of the 0.05 g mass reading [1]
- D3 A specific reference to a likely problem with filtration [1]
eg - drying the precipitate on the filter paper might be incomplete
- D4 Gravimetric method has two/fewer readings so less *cumulative* inaccuracy. [1]

APPENDIX A

Cover sheet for Standardisation scripts

A copy must be sent to your Team Leader with each your ten standardisation scripts.

Centre/Candidate number/.....

Examiner's Name

Mark	Tick	Comment from TL on marking (if needed)
P1		
P2		
P3		
P4		
P5		
P6		
P7		
G/T1		
2		
3		
4		
5		
6		

G/T7		
S1		
S2		
S3		
Total		(maximum = 16)

Skill	Comment from TL on marking (if needed)
I + A	
E	

Appendix B: Marking schedule

1. Standardisation

As soon as possible after this Standardisation meeting send 10 scripts to your team leader.

- The 10 scripts must include the three photocopies labelled **X**, **Y** and **Z**.
- The other 7 scripts should come from at least two different Centres.
- Do not send scripts scoring fewer than 20 **or** more than 50 marks (out of 60).
- Send the special standardisation cover sheet (Appendix A) with each script.
- Fill in and send form STAND/1 to your TL, but keep the pink copy yourself.
- Send a stamped addressed envelope with your scripts for their return.
- DO NOT do any “hard” marking until you have heard back from your TL.
- When you receive the standardisation scripts back, change the marks if necessary on scripts you have provisionally marked, then get on with your marking in earnest!

2. Batch One

The Batch One deadline date on this paper is **XX**.

Before this deadline you should do all of the following.

- Mark about 80 scripts and fill in the Mark Sheet forms. If you have been allocated any very large Centres, don't mark them until Batch 2.
- **Get your checker to check** the adding up and accuracy of entries on the MS forms.
- Stick MARKED stickers on all packages you have marked so far.
- All Mark Sheets must be sent direct to Cambridge in an envelope with the special green label. (Do not send mark sheets to your TL).
- Send about 25 scripts from a minimum of two **complete** Centres to your Team Leader. *(Do not split up the contents of any package of scripts and do not send scripts from the same Centres as you did for the Standardisation scripts).*
- Sent the other 50+ scripts to Cambridge, using the appropriate DHL envelopes.
- You will not receive any feedback from your TL on Batch 1 scripts.

3. Batch Two

The Batch Two deadline on this paper is **XX**
Before this deadline you should do all of the following.

- Complete **all** the marking, **get it checked** and fill in **all** the Mark Sheets. (*Relief!*)
- Send all Mark Sheets back to Cambridge.
- Phone your Team Leader. **Do not** send any more scripts back to Cambridge until you have contacted your TL. He will ask you send about 20 – 30 more scripts and he will tell you which Centres he wishes to check.
- Now send all the other scripts you have marked to Cambridge by DHL.

4. And, finally . .

- Fill in a copy of your report on the paper (using form AERF) and send it to your TL.
- Send to OCR Finance the Checker's and Expenses claim forms and also (if you haven't done this already) both of the claim forms for the Standardisation meeting.
- Put your feet up – you deserve it!
- Wait for your well-deserved payment to arrive by BACS.