volume of pipette

1. You are provided with the following:

BA1, which is a solution made by dissolving 3.45 g of a hydrated salt $X.nH_2O$ in 250 cm³ of water.

BA2, which is a 0.1 M hydrochloric acid.

You are required to determine the value of *n* in the salt.

To award for the final reading, first look at centre average the volume of BA_2 (value) must be within that for centre by ±5

Procedure:

Pipette 25 cm³ (or 20 cm³) of **BA1** into a conical flask. Add 2-3 drops of methyl orange indicator and titrate with **BA2** from the burette.

Repeat the titration until you obtain consistent results.

Record your results in the table below.

Initial burette reading no condition apart from 2dp.

Volume of pipette used ....25.0 ✓ 00½....cm³. (½ mark)

Rounding to 1dp or odp awarded ½ mark.

Final burette reading (cm³)	29.10 ✓	28.00 ✓	29.60 ✓
Initial burette reading (cm³)	1.50 ✓	0.50 ✓	2.10 ✓
Volume of BA2 used (cm³)	27.60 ✓	27.50 ✓	27.50 ✓

07½

(7½ marks)

— Final burette reading to both decimal places = 1 mark each

Titre values of **BA2** used for average (01 mark)

Correct subtraction of volume of BA_2 used ... awarded

...agreed values ....27.50, 27.50 ✓ 01 (difference must be 0.2 max)....cm³.

(Should come from the table) range should be within 0.2 maximum

Average volume of BA2 used (2½ marks)

$\frac{27.50 + 27.50}{2} = 27.50 cm^3$

±0.1 ✓ ±0.2 ✓ ±0.3 ✓ ±0.4 ✓ ±0.5 ✓ — 02½ Teachers average

Table ...cm³.

correct subtraction awarded ½ even if it is to odp or 1dp

Case (i) volume of BA_2 used (no subtraction made), not filled: subtract for the candidate and award initial & final reading normally, only if the subtraction is within the range ±5

* If outside range, award only initial reading
* no mark for values of BA_2 used for average
* Average volume of BA_2 award accordingly

Questions

(a) Calculate the;

(i) number of moles of hydrochloric acid that reacted. (1½ marks)

1000 cm³ of HCl contains 0.1 moles ✓

- Deny mark if wrong units used, - Award if no units

27.50 cm³ of HCl acid contains $\left(\frac{0.1 \times 27.50}{1000}\right)$ moles ✓ 03

= 0.00275 moles ✓ at least 4dps

Case (ii): Final burette reading not filled.
- Award initial burette reading
- No mark for subtraction
- Deny values of BA_2 used for average
- Deny for average volume of BA_2

Case (iii): 2 columns correctly filled: mark the candidate normally; final ✓ initial ✓ volume of BA_2 ✓; the values used awarded; average ✓ award

(ii) number of moles of $X.nH_2O$ that reacted. (*1 mole of $X.nH_2O$ reacts with 2 moles of hydrochloric acid*). (02 marks)

1 mole of $X.nH_2O$ reacts with 2 moles of HCl

moles of $X.nH_2O$ reacted = $\frac{1}{2} \times 0.00275$ moles ✓

$= 0.001375$ moles ✓ 02

Alternatively
2 moles HCl reacts with 1 mole $X.nH_2O$ ✓
0.00275 moles HCl reacts with $(\frac{1}{2} \times 0.00275)$ moles
$= 0.001375$ moles ✓

(iii) number of moles of $X.nH_2O$ in 250 cm^3 of BA1. (03 marks)

25 cm^3 of BA_1 contains 0.001375 moles of $X.nH_2O$ ✓

250 cm^3 of BA_1 contains $\frac{0.001375 \times 250}{25}$ moles ✓ 03

$= 0.01375$ moles ✓

(at least 3 dps)

(b) Determine the value of n in $X.nH_2O$. (5½ marks)
($H = 1$; $O = 16$; $X = 106$)

0.01375 moles of $X.nH_2O$ weighs 3.45 g ✓

1 mole of $X.nH_2O$ weighs $\frac{3.45 \times 1}{0.01375}$ g ✓

$= 250.91$ g ✓ 05½

Mass of nH_2O = 250.91 − 106 = 144.91 ✓

Rfm of H_2O = (1×2) + 16 = 18 ✓

$18n = 144.91$

$n = \frac{144.91}{18}$ ✓

$n = 8$ ✓

OR

$X.nH_2O = 250.91$

$106 + 18n = 250.91$ ✓

$18n = 250.91 - 106$ ✓

$18n = 144.91$

$n = \frac{144.91}{18}$ ✓ ... $n = 8$ ✓

25

Case(5): Only one column filled

19.00		
0.00		
19.00		

Award for table only.
no ~~name~~ Deny range (0.2)
Deny accuracy (average)

Case(6): Initial greater than final.

eg

0.00	20.00	18.00
19.00	39.20	36.00
19.00	19.20	26.00

5
260
106
154

Deny initial for the whole table.

Case(7): Volume of Pipette not indicated:
- Award for initial volume
- Deny final burette reading
- Award for subtraction in the table.
- Deny accuracy (average volume)
- If candidate has indicated 25 cm³ (volume of pipette) in a (a); then award the table normally.

Case(8): Student using ratios in the table.
19.00 39.20 20.20
0.00 18.00 18.00
19.00 21.20 2.20 Deny ratios
If mixture of ratios and abs Deny ratio and award for those in abs

Turn Over

TESTS	OBSERVATIONS	DEDUCTIONS
(iv) To the **fourth** portion of the acidified solution, add lead(II) nitrate solution and warm.	White precipitate ✓ insoluble on warming Reject "insoluble in excess"	SO_4^{2-} ✓ 01½
(v) Use the **fifth** portion of the acidified solution to carry out a test of your own to confirm the anion in **Q**. **TEST** Add Barium nitrate solution ✓ OR Add $Ba(NO_3)_2(aq)$ accept $BaCl_2(aq)$	white ✓ precipitate	✓ SO_4^{2-} 03
(c) Dissolve the residue in minimum amount of dilute sulphuric acid and divide the resultant solution into **two** parts.	Pale brown ✓ solution or yellow solution (accept only here but not particles)	
(i) To the **first** part of the solution add sodium hydroxide solution drop-wise until in excess.	Brown precipitate ✓ insoluble in excess ✓	02 Fe^{3+} ✓
(ii) To the **second** part of the solution, add 1 small piece of zinc granules and leave the solution to stand for 5 minutes. Divide the solution into two portions and use them for part (d).	Pale yellow or brown solution turned green ✓	✓ Fe^{3+} reduced to Fe^{2+} ✓ 01½

Fe^{2+} (aq) award ✓ Turn Over 08

TESTS	OBSERVATIONS	DEDUCTIONS
(d) (i) To the **first** part of the solution, add sodium hydroxide solution drop-wise until in excess.	green precipitate insoluble in excess	Fe^{2+} (Fe^{3+} present in Q) 01½
(ii) To the **second** part of the solution, add **aqueous ammonia** drop-wise until in excess.	green precipitate insoluble in excess	Fe^{2+} formed Fe^{3+} present in Q 02½

(e) (i) The cations in **Q** are ....Al^{3+}, Fe^{3+}.... 01½

(ii) The anion in **Q** is....SO_4^{2-}....

25

END