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Cambridge International Advanced Level

MARK SCHEME for the October/November 2014 series

9701 CHEMISTRY

9701/51 Paper 5 (Planning, Analysis and Evaluation), maximum raw mark 30

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<table>
<tr><th>Question</th><th>Expected Answer</th><th>Mark</th><th></th></tr>
<tr><td>1 (a)</td><td>
<table>
<tr><td>reagent added</td><td>reagent added</td><td>reagent added</td></tr>
<tr><td>sulfuric acid</td><td>(excess, aqueous) ammonia</td><td>sulfuric acid</td></tr>
<tr><td>substances present at the end of the reaction</td><td>substances present at the end of the reaction</td><td>substances present at the end of the reaction</td></tr>
<tr><td>zinc sulfate AND aluminium sulfate(copper)</td><td>zinc (tetra) ammine (ions) (aluminium hydroxide)</td><td>ammonium sulfate (zinc hydroxide)</td></tr>
<tr><td>substances removed by filtration</td><td>substances removed by filtration</td><td>substances removed by filtration</td></tr>
<tr><td>copper</td><td>aluminium hydroxide</td><td>zinc hydroxide</td></tr>
</table>
Allow: Correct formulae or ions instead of names.
</td><td></td><td>[5]</td></tr>
<tr><td>(b)</td><td>Step 1: Sufficient / enough / excess sulfuric acid (to dissolve the zinc and aluminium)

Step 2: Sufficient / enough / excess aqueous ammonia (to precipitate aluminium hydroxide and to completely dissolve the zinc hydroxide)

Step 3: Sufficient / enough / sulfuric acid to:
neutralise / react with ammonia
(re-) precipitate the zinc hydroxide
but not so much that the zinc hydroxide reacts / dissolves</td><td>1

1

1
1</td><td>[4]</td></tr>
<tr><td>(c)</td><td>Heat (the hydroxides)

To constant mass</td><td>1

1</td><td>[2]</td></tr>
</table>

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Question	Expected Answer	Mark	
(d)	Measure mass of any three of solder, copper, zinc oxide / hydroxide and aluminium oxide / hydroxide or residues / precipitates	1	
	The copper should be washed (with water / propanone or any other suitable organic solvent) and dried	1	[2]
(e)	0.794 g	1	[1]
(f)	The mass / amount / percentage of copper is small	1	[1]
		Total	15

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Question	Expected Answer	Mark	
2 (a)	All plotted points correctly drawn	1	
	The best fit line should pass through or lie close to the first 10 points. (If all points do not lie on the line then the net deviation of the non-anomalous points on each side of the best fit line must be approximately the same.)	1	[2]
(b)	The point at 12.00 cm^3 is an anomaly. (ECF from incorrect anomalous point.)	1	
	The sodium hydroxide has not been properly mixed with the acid **OR** insufficient sodium hydroxide was added.	1	[2]
(c)	Indicator range between 6.5 and 11 for a minimum of 1 pH unit change.	1	[1]
(d) (i)	Any **two** of the following: Na^+, A^-, HA	1	[1]
(ii)	They will all have (nearly) the same concentration **OR** $A^- > Na^+ > HA$	1	
	Half of the HA has reacted with/been neutralised by / used up by the NaOH	1	[2]
(e)	Reads correct value of pH from the graph drawn	1	
	Gives correct expression for K_a	1	
	Calculates K_a.	1	[3]
(f) (i)	$[H^+] = 0.00389\ mol\ dm^{-3}$ **OR** $[H^+] = [A^-]$ ECF as (ans to $[H^+]$)^2/(ans to **(e)**)	1	
	Calculates [HA] correctly based on the pH read from the graph	1	[2]

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Question	Expected Answer	Mark	
(ii)	Conc of HA = $4 \times 2.7 = 10.8$ g dm^{-3} Relative molecular mass of HA = 10.8/ **2(f)(i)**	1	[1]
(g)	Any appropriate error discussion e.g.: • many readings / measurements are taken each of which will have an error., • the H^+ from the water has been ignored, • no pH reading was taken at 15.00 cm^3, • H^+ is not exactly equal to A^- temperature varies during titration, • graph drawn by hand is not very accurate, • experiment not repeated.	1	[1]
		Total	15

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