Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) completely dissociates/ionises (to form H^+ ions)

1

(b) **M1** moles HCl = 1.035×10^{-3} and moles $Ba(OH)_2$ = 3.75×10^{-3}
If M1 incorrect, lose M1 and M6

1

M2 moles OH^- = 2 × (3.75×10^{-3} = 7.50×10^{-3})
If M2 not x2, lose M2 and M6

1

M3 XS n OH^- = 7.50×10^{-3} - 1.035×10^{-3} = 6.465×10^{-3} mol in 35.35 cm^3
If no subtraction for M3, lose M3 and M6

1

M4 [OH] = 6.465×10^{-3} / 35.35×10^{-3} = 0.182885 mol dm^{-3}
= M3/35.35 × 10^{-3}
If M4 not /35.35 × 10^{-3}, lose M4 and M6
However, if divided by 35.35 only lose M4 and allow M6 (ecf = 10.09)

1

M5 $[H^+] = K_w/[OH^-]$ = 1.47×10^{-14} /0.182885 = 8.0378 × 10–14 mol dm^{-3}
= 1.47 × 10^{-14} / M4
If incorrect rearrangement or wrong equation, lose M5 and M6
If K_w = 1.00 × 10^{-14} used only lose M5 and allow M6 (ecf = 13.26)

1

M6 pH = 13.09 to 13.10
Must be 2dp

1

Alternative MS to get M2:

Starting amounts are 1.035×10^{-3} mol HCl and 3.75×10^{-3} mol $Ba(OH)_2$ M1

So the HCl will react with 5.175×10^{-4} mol of the $Ba(OH)_2$ leaving an excess of 3.2325×10^{-3} mol of $Ba(OH)_2$ (as alternative M2)

So n OH^- = 2 × 3.2325×10^{-3}= 6.465×10^{-3} mol M3
Credit other methods eg limiting reagent method since HCl limiting reagent

(c) $[H^+] = [OH^-]$

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1

(d) SO_2

1

(e) $K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$

1

(f) **M1** moles HCl added = 0.01 mol and moles CH_3COOH = 0.035 mol

1

M2 moles CH_3COO^- = 0.025 – 0.01 (= 0.015)

M2 mol CH_3COO^- = 0.025 - M1(HCl)

1

M3 moles CH_3COOH = 0.035 + 0.01 (= 0.045)

M3 mol CH_3COOH = M1(CH_3COOH) + M1(HCl)

1

M4 $[H^+] = 1.76 \times 10^{-5} \times \frac{M3\ (/\ V)}{M2\ (/\ V)}$ $(= 5.28 \times 10^{-5})$

M4 is conditional on an attempt at an addition/subtraction in M2 OR M3

1

M5 pH = 4.28

M5 must be 2dp

If used 0.07 mol for CH_3COOH can score M2, M3 and M4 (pH = 4.03)

1

[15]

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Q2.

(a) $AlCl_3 + 6H_2O \rightarrow [Al(H_2O)_6]^{3+} + 3Cl^-$

Allow

$AlCl_3 + 6H_2O \rightarrow Al(H_2O)_5(OH)_2^+ + H^+ + 3Cl^-$

Or equation to form $Al(H_2O)_4(OH)_2^+$

1

(b) $[Al(H_2O)_6]^{3+} + H_2O \rightarrow [Al(H_2O)_5(OH)]^{2+} + H_3O^+$

allow equations to form $[Al(H_2O)_4(OH)_2]^+$

1

(c) <u>white</u> ppt/solid

M1 and M2 in either order

1

effervescence/bubbles/fizzing

1

$2[Al(H_2O)_6]^{3+} + 3CO_3^{2-} \rightarrow 2[Al(H_2O)_3(OH)_3] + 3CO_2 + 3H_2O$

accept multiples

only allow spectator ions in a balanced equation

1

(d) <u>White</u> ppt/solid

1

$[Al(H_2O)_6]^{3+} + 3OH^- \rightarrow$ <u>$[Al(H_2O)_3(OH)_3]$</u> $+ 3H_2O$

only allow spectator ions in a balanced equation

1

Colourless solution forms / ppt or solid dissolves

1

$[Al(H_2O)_3(OH)_3] + OH^- \rightarrow [Al(H_2O)2(OH)4]– + H_2O$

OR

$[Al(H_2O)_3(OH)_3] + OH^- \rightarrow [Al(OH)_4]^- + 3H_2O$

only allow 6 or 4 co-ordination

Allow $[Al(OH)_6]^{3-}$ in a balanced equation

1

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