Name of the Student:_____
Max. Marks : 15 Marks **Time : 15 Minutes**

Mark Schemes

Q1.

(a) **M1**: $[H^+] = [OH^-]$

***M1**: accept equal number/amounts of H^+ and OH^-*

1

M2: $[H^+]$ $(= 10^{-pH}) = 2.138 \times 10^{-7}$

***M2**: allow 2.14×10^{-7}*

1

M3: $K_w = [H^+]^2$ or $(2.138 \times 10^{-7})^2$

***M3**: allow **(M2)**^{2}*

1

M4: $K_w = 4.57 \times 10^{-14}$

***M4**: allow 4.58×10^{-14}*

M4** is dependent on (an answer)^2 in **M3

1

(b) View with Figure X (ie graph) as they may show working there.

Ignore calculations of mols of salt or acid

M1: Determines volume at half equivalence $(= \frac{19.5}{2}$ $cm^3)$ = 9.75 (cm^3)

***M1**: Allow reading on graph to be from 19.4 to 19.7 giving **M1** = 9.7 to 9.85*

1

M2: pH = 4.80 to 4.95

***M2**: Reads off pH at half equivalence*

1

M3: K_a $(= 10^{-pH}) = 10^{-4.9} = 1.26 \times 10^{-5}$

***M3**: Allow 1.12×10^{-5} to 1.58×10^{-5}*

***M3**: Allow 2sf or more*

1

Alternative method

M1: pH of pure acid = 3

M2: $K_a = (10^{-3})^2 / 0.080$

M3: $= 1.25 \times 10^{-5}$

*Alternative **M1** if calculation incorrect:*

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Allow pH = pK_a or $[H^+] = K_a$ at half equivalence

(c) cresolphthalein

1

(d)

M1: $K_a = \frac{[H^+][X^-]}{[HX]}$ or $[H^+] = \frac{K_a \times [HX]}{[X^-]}$

allow $[H^+] = \frac{K_a \times [acid]}{[salt]}$

M1:

1

M2: amount of HX = 0.0500 mol

1

M3: amount of HX after add^n of KOH = $0.05 - 3 \times 10^{-4} = 0.0497$ mol

M3: = ***M2*** – 3×10^{-4}

1

M4: amount of KX after add^n of KOH = $0.0136 + 3 \times 10^{-4} = 0.0139$ mol

1

M5: $[H^+] = \left(\frac{1.41 \times 10^{-5} \times 0.0497}{0.0139}\right) = 5.04(15) \times 10^{-5}$

1

M6: pH = $-\log_{10} 5.04(15) \times 10^{-5} = 4.30$

Answer to 2 decimal places

1

*If no attempt at **M3** and **M4** max 2 marks*

*If **M3** or **M4** attempted using 3×10^{-4} max 4 (**M1**, **M2**, **M3** or **M4** and **M6**)*

(e)

ratio $\frac{[HX]}{[X^-]}$

Allow inverse expression

1

[15]

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