Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Mark Schemes

Q1.

(a) **M1** $K_w = [H^+]\,[OH^-]$

M2 $[H^+] = \sqrt{2.92 \times 10^{-14}}$

M3 pH = 6.77

M3 = -log$_{10}$ M2
Answer to 2 decimal places

3

(b) **M1** n OH^- = 5.25×10^{-3} **and** n H^+ = 2.00×10^{-3} mol

M2 excess OH^- = 3.25 × 10-3 mol

M2 = n(OH^-) - n(H^+) in M1

M3 $[OH^-] = \frac{3.25\times10^{-3}}{55.0\times10^{-3}} = 0.0591$ mol dm^{-3}

$M3 = \frac{M2}{55 \times 10^{-3}}$

M4 $[H^+] = \frac{2.92\times10^{-14}}{0.0591} = 4.94 \times 10^{-13}$ mol dm^{-3}

$M4 = \frac{2.92 \times 10^{-14}}{M3}$

M5 12.31

M5 = -log$_{10}$(M4)

5

[8]

Q2.

(a) Only a (small) fraction of the molecules dissociate (into ions)/ionise (when added to water/in aqueous solution)
OR
partially dissociates/does not fully dissociate (into ions)/ionise (when added to water/in aqueous solution).

Not 'reaction is reversible'
Not if incorrect ions suggested
Not ";Hydrogen ions do not fully dissociate"

1

(b) As there is a large pH change (for a small addition of alkali)

Need idea of rapid/large change in pH
Allow pH change is rapid/gradient is steep (at equivalence point)
Ignore equivalence/end point is very steep
Ignore so they do not miss the equivalence point

1

(c) **M1** $K_a = \frac{[H^+]\,[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$

Allow $[H_3O^+]$ for $[H^+]$
NOT () for concentration
NOT $K_a = \frac{[H^+]^2}{[CH_3CH_2COOH]}$

M2 $[CH_3CH_2COOH] = [CH_3CH_2COO^-]$

Allow [HA] = $[A^-]$ / mol/amount of HA = mol/amount of A^-
Allow $[HA]/[A^-]$ OR $[A^-]/[HA] = 1$

M3 $K_a = [H^+]$ (therefore pH = pK_a)

Allow Log 1 = 0

3

(d) **M1** Allow pH between 4.4 - 4.7

M2 Answer from $K_a = 10^{-M1}$ to min 2sf

M2 ECF from M1 only if M1 is in range 4.0 to <4.4 or >4.7 to 5.0
If M1 in range shown, M2 = 1.99526×10^{-5} to 3.9811×10^{-5} to at least 2 sf
Using pH at start (= 2.80) scores 0/2

2

(e) **M1** OH^- reacts with propanoic acid OR reacts with H^+

M2 EITHER

ratio of $[CH_3CH_2COOH]$ to $[CH_3CH_2COO^-]$ remains almost constant

OR

Equilibrium **for dissociation of CH_3CH_2COOH** moves right to maintain $[H^+]$ /replace H^+

Allow CH_3CH_2COOH dissociates to maintain $[H^+]$ /replace H^+

2

(f) **M1** Methyl orange - would not change colour at the equivalence point (allow end-point)/pH range does not match rapid pH change/pH range does not include/match equivalence point

Allow methyl orange changes colour before/below equivalence point
Allow pH range does not fall in the range of pH from 6-11
Ignore reference to this being a weak acid - strong base titration

M2 Universal indicator - idea of range of colours during titration/no distinct colour change (at equivalence/end-point)

2

[11]