

Name of the Student: _____

Max. Marks : 17 Marks

Time : 17 Minutes

Mark Schemes

Q1.

$$K_a = 10^{-3.75} = 1.78 \times 10^{-4} \text{ mol dm}^{-3}$$

$$pH = pK_a - \log \frac{[HCOOH]}{[HCOO^-]}$$

1

$$[H^+] = 10^{-4.05} = 8.91 \times 10^{-5} \text{ mol dm}^{-3}$$

$$\log \frac{[HCOOH]}{[HCOO^-]} = pK_a - pH = 3.75 - 4.05 = -0.30$$

1

$$[Salt] = \frac{1.78 \times 10^{-4} \times 0.100}{8.91 \times 10^{-5}} = 0.200$$

$$\frac{[HCOOH]}{[HCOO^-]} = 10^{-0.30} = 0.50 \text{ (and } [HCOOH] = 0.1)$$

(so $[HCOO^-] = 0.200 \text{ mol dm}^{-3}$)

1

$$\text{amount} = \text{vol} \times \text{conc} = 0.200 \times 25/1000 = 0.00500 \text{ mol}$$

OR

$$\text{amount acid} = 0.0025 \text{ mol so amount salt} = 0.005 \text{ mol}$$

$$\text{amount} = \text{vol} \times \text{conc} = 0.200 \times 25/1000 = 0.00500 \text{ mol}$$

1

$$\text{mass} = \text{amount} \times M_r = 0.00500 \times 68.0 = 0.339 / 0.34 \text{ g}$$

$$\text{mass} = \text{amount} \times M_r = 0.00500 \times 68.0 = 0.339 \text{ g}$$

1

[5]

Q2.

- (a) (Acid) partially or slightly ionises/dissociates (in water to form H^+ ions)

Allow – does not fully ionise/dissociate

1

- (b)

$$(K_a) = \frac{[H^+][C_2H_5COO^-]}{[C_2H_5COOH]}$$

Allow $[H_3O^+]$ for $[H^+]$

Do not allow ()

1

- (c) **M1** $[C_2H_5COOH] = 0.125$ (mol dm⁻³)

*Allow consequential marking from wrong **M1***

*If $[C_2H_5COOH] = 0.0125$ (mol dm⁻³) lose **M1**,*

*allow **M2**, **M3** = 4.108×10^{-4} and **M4** = 3.39*

1

M2 $[H^+] = \sqrt{K_a \times [C_2H_5COOH]}$ OR $[H^+] = \sqrt{1.35 \times 10^{-5} \times 0.125}$

1

M3 $[H^+] = 1.30 \times 10^{-3}$ (mol dm⁻³)

1

M4 $pH = -\log_{10}(1.30 \times 10^{-3}) = 2.89$

*Allow **M4** = $-\log_{10}$ **M3***

Answer must be to 2 decimal places

1

- (d) **M1** $[H^+] = 10^{-4.5} = 3.16 \times 10^{-5}$ (mol dm⁻³)

1

M2 $[C_2H_5COO^-] = \frac{[C_2H_5COOH] K_a}{[H^+]}$

OR $[C_2H_5COO^-] = \frac{0.250 \times 1.35 \times 10^{-5}}{3.16 \times 10^{-5}}$

M2: Rearrangement

*If rearrangement incorrect, could score **M1** **M4** **M5** and **M6***

1

M3 $[C_2H_5COO^-] = 0.1068$ (mol dm⁻³)

1

M4 M_r sodium propanoate = 96

1

M5 n (sodium propanoate) = $0.1068 \times 0.5 = 0.0534$

1

M6 mass (sodium propanoate, x) = $0.0534 \times 96 = 5.13$ (g)

M6 *Allow 5.09 to 5.14 (g)*

Alternative **M5** and **M6**

M5 $0.1068 \times 96 = 10.25$ (g)

$$M5 = M3 \times M4$$

$$M6 \quad \text{Mass (sodium propanoate, x)} = \frac{10.25}{2} = 5.13 \text{ (g)}$$

10.25 g scores 4 marks

If Henderson Hasselbach used

$$M1 \quad pK_a = -\log(1.35 \times 10^{-5}) = 4.87$$

$$M2 \quad \log[A^-] = pH - pK_a + \log[HA]$$

$$M3 \quad \log[A^-] = 4.50 - 4.87 + (-0.60206) = -0.9717$$

$$M4 \quad [CH_3CH_2COO^-] = 10^{-0.9717} = 0.1067$$

$$M5 \quad M_r = 96(.0)$$

$$M6 \quad x = 96.0 \times 0.1067/2 = 5.12 \text{ g}$$

1

[12]