

Name of the Student: _____

Max. Marks : 23 Marks

Time : 23 Minutes

Mark Schemes

Q1.

$$(a) \quad \text{moles HA} = \frac{25}{10^3} \times 0.150 = 3.75 \times 10^{-3} \quad (1)$$

$$\therefore \text{vol NaOH} = \frac{3.75 \times 10^{-3}}{0.20} = 1.875 \times 10^{-2} \text{ dm}^3 \quad (1)$$

or 18.75 cm³

2

$$(b) \quad (i) \quad \text{pH} = -\log_{10} [\text{H}^+] \quad (1)$$

(ii) Value above 7 but below 11 (1)

(iii) phenol red / thymol blue / phenolphthalein / thymolphthalein
i.e. indicator with $7 < pK_{in} < 11$

3

(c) (i) Only slightly dissociated/ionised (1)
 NOT "not fully dissociated / ionised"

$$(ii) \quad K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} \quad (1)$$

$$\text{NOT } \frac{[\text{H}^+]^2}{[\text{HA}]}$$

(iii) For weak acid alone:

$$K_a = \frac{[\text{H}^+]^2}{[\text{HA}]} \quad (1)$$

$$\therefore [\text{H}^+] = \sqrt{(2.75 \times 10^{-5}) \times 0.15}$$

$$= 2.03 \times 10^{-3} \quad (1)$$

$$\therefore \text{pH} = 2.69 \quad (1)$$

*pH should be given to 2 decimal places
 penalise answer to 1 d.p. once in question*

5

$$(d) \quad \text{moles OH}^- \text{ added} = 1.875 \times 10^{-3} = \text{moles A}^- = \text{moles HA left} \quad (1)$$

or $[A^-] = [HA]$

$\therefore K_a = [H^+] \text{ or } pH = pK_a \text{ (1)}$

$\therefore pH = 4.5\textbf{6} \text{ (1)}$

3

[13]

Q2.

- (a) Order with respect to iodine: 0 **(1)**
Overall order: 2 **(1)**

2

(b) Rate constant: $k = \frac{2 \times 10^{-5}}{(1.5) \times (3 \times 10^{-2})} = 4.4(4) \times 10^{-4}$ **(1)**

Units: $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$ **(1)**

3

- (c) Appears in rate equation **(1)**

OR implied by mention of concentration or order

does not appear in (stoichiometric / overall) equation (1)

2

(d) $\text{pH} = -\log_{10} [\text{H}^+]$ **(1)**
 $= 1.25$
 $[\text{H}^+] = 0.056(2)$ **(1)**

$\therefore \text{rate} = (4.44 \times 10^{-4}) \times (1.50) \times (0.0562)$

$= 3.75 \times 10^{-5}$ **(1)** ($\text{mol dm}^3 \text{s}^{-1}$)

(3.7 — 3.8)

Can score all 3 conseq on k from part (b)

3

[10]