ACID/BASE PAPER 1A

1. B
2. C
3. B
4. C
5. A

6. B
7. B
8. C
9. C
10. A

11. B
12. C
13. C
14. B
15. A

16. D
17. A
18. A
19. A
20. A

ACID/BASE PAPER 1B

1. (a) Anomalous result: Trial 1 (26.30 cm^3) [1]. Average = (24.90 + 24.80) / 2 = 24.85 cm^3 [1].

(b) Amount of NaOH = 0.100 * 0.02485 = 0.002485 mol **[1]**

(c) Moles ethanoic acid = 0.002485 mol [1]. Concentration = 0.002485 / 0.0250 = 0.0994 mol dm^{-3} **[1]**

(d) An acid that only partially dissociates into ions in aqueous solution. **[1]**

(e) Phenolphthalein **[1]**

2. (a) $CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$ [1 for formulas, 1 for state symbols]

(b) Moles $CaCO_3$ = 2.50 / 100.09 = 0.0250 mol [1]. Moles HCl = 0.050 * 1.00 = 0.050 mol [1]. Neither is limiting (exactly stoichiometric). Allow calculation demonstrating equality. **[1]**

(c) Moles CO_2 = 0.0250 mol. Volume = 0.0250 * 22.7 = 0.568 dm^3. **[2]**

(d) Rate: Slower [1]. Final Volume: The same [1].

ACID/BASE PAPER 2

1. (a) Moles NaOH = 0.0185 * 0.150 = 0.00278 mol **[1]**

(b) Moles HA = 0.00278 mol [1]. Concentration = 0.00278 / 0.0250 = 0.111 mol dm^{-3} **[1]**

(c) Greater than 7 [1]. The salt formed contains a weak conjugate base which hydrolyses water, producing OH^- ions [1].

(d) The equivalence point for HA/NaOH is at a basic pH (>7), but for HCl/NaOH it is at pH 7 [1]. An indicator must be chosen whose pKa (color change range) overlaps with the sharp pH change at equivalence [1].

2. (a) NO_x: Internal combustion engines at high temperatures / car exhaust [1]. SO_x: Burning coal containing sulfur [1].

(b) $SO_3(g) + H_2O(l) \rightarrow H_2O(l) + H_2SO_4(aq)$ **[1]**

(c) Limestone contains calcium carbonate, $CaCO_3$ [1]. Reacts with acid to form soluble states, causing erosion [1]. $CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(aq) + H_2O(l) + CO_2(g)$ [1].

3. (a) A substance that can act as both a Brønsted-Lowry acid (proton donor) and base (proton acceptor) [1].

(b) $HCO_3^- + H_2O \rightarrow CO_3^{2-} + H_3O^+$ [1]
$HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$ **[1]**

(c) CO_3^{2-} **[1]**

4. (a) pH = -log(0.050) = 1.30 **[1]**

(b) $[H^+][OH^-] = 1.0 * 10^{-14}$ **[1]**

(c) Initial moles $Ba(OH)_2$ = 0.025 * 0.100 = 0.0025. Moles OH^- = 2 * 0.0025 = 0.0050 mol [1]. $[OH^-]$ in 500 cm3 = 0.0050 / 0.500 = 0.010 mol dm^{-3} [1]. pOH = 2.0, so pH = 12.0 [1].

5. (a) 1. Electrical conductivity measurement [1]: HCl will have a higher electrical conductivity than HF as it fully dissociates into ions [1].
2. Rate of reaction with Mg ribbon (or metal carbonate) [1]: HCl will produce gas faster (more vigorous bubbling) than HF [1].