1 Memorandum: Acids and bases

1.1	$KOH(s) \rightleftarrows K^+(aq) + OH^-(aq)$ Dissociation
1.2	$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$ Redox
1.3	$2LiOH(aq) + H_2SO_4(aq) \longrightarrow Li_2SO_4(aq) + 2H_2O(l)$ Neutralisation
1.4	$H_2SO_4(l) + 2H_2O(l) \longrightarrow 2H_3O^+(aq) + SO_4^{-2}(aq)$ Ionisation
1.5	$NH_3(aq) + HNO_3(aq) \longrightarrow NH_4Cl(aq)$ Neutralisation
1.6	$NaOH(aq) + CH_3COOH(aq) \longrightarrow CH_3COONa(aq) + H_2O(l)$ Neutralisation
2.1	conjugated pairs 2 base conj acid $HNO_3(g)$ + $H_2O(\ell)$ $\rightleftharpoons$ $NO_3^-(aq)$ + $H_3O^+(aq)$ acid conj base conjugated pair 1
2.2	a. NH_3 b. SO_4^{2-} c. OH^-
2.3	a. H_3PO_4 b. H_2SO_4 c. H_3O^+
2.4	$n_1 = n_2$ (No moles of acid added. Only H_2O added.) $c_1V_1 = c_2V_2$ $(1{,}30)(75) = C_2(100)$ $C_2 = 0{,}975\ mol \cdot dm^{-3}$
2.5	$c = \frac{m}{M \times V}$ $0{,}04 = \frac{m}{40 \times 0{,}24}$ $\tilde{m} = 0{,}384\ g$ NaOH
2.6	$n_1 = n_2$ $c_1V_1 = c_2V_2$ $(0{,}0015)(10) = 0{,}0005V_2$ $V_2 = 30\ cm^3$ New volume $V_{added} = 30 - 10$ $= 20\ dm^3$
2.7	a. $HA + H_2O(l) \rightleftharpoons A^-(aq) + H_3O^+(aq)$ b. H_3O^+ ions **less than** HA molecules (ionises incompletely) c. H_3O^+ ions **equal to** A^- ions
2.8	a. Carbonic acid Bigger K_a indicates it ionises more completely b. Carbonic acid It ionises more completely and produce more ions c. Boric acid Less hydronium ions and $K_w = [OH^-][H_4O^+]$ c. Carbonic acid Bigger K_a indicates it ionises more completely. Produce more H_3O^+.
2.8	a. Every HR molecules produces ONE hydronium (H_3O^+) ion when it ionises. b. No. The H_3O^+ ions produced is less than the HR molecules. Ionises incompletely

3.1	H_2SO_4 is a strong acid and ionises completely $H_2SO_4 + 2H_2O \rightleftharpoons SO_4^{-2}(aq) + 2H_3O^+(aq)$ $H_2SO_4 : H_3O^+$ $1 : 2$✓ $[H_3O^+] = 2(0{,}0015) = 0{,}003\ mol.dm^{-3}$ $pH = -log[H_3O^+]$✓ $= -log(0{,}003)$✓ $= 2{,}52$✓
3.2	LiOH is a strong base and dissociates completely $LiOH(s) \longrightarrow Li^+(aq) + OH^-(aq)$ $LiOH : OH^-$ $1 : 1$✓ $[OH^-] = 0{,}004\ mol.dm^{-3}$ $K_w = [OH^-][H_3O^+]$✓ $1 \times 10^{-14} = (0{,}004)[H_3O^+]$ $[H_3O^+] = 2{,}50 \times 10^{-12}\ mol.dm^{-3}$ $pH = -log[H_3O^+]$✓ $= -log(2{,}50 \times 10^{-12})$✓ $= 11{,}60$✓
3.3	$c = \frac{m}{M \times V}$✓ $= \frac{1{,}89}{63 \times 2}$✓ $= 0{,}015\ mol \cdot cm^{-3}$ HNO_3 is a strong acid and ionises completely $HNO_3 + H_2O \rightleftharpoons NO_3^-(aq) + H_3O^+(aq)$ $HNO_3 : H_3O^+$ $1 : 1$✓ $[H_3O^+] = 0{,}015 mol.dm^{-3}$ $pH = -log[H_3O^+]$✓ $= -log(0{,}015)$✓ $= 1{,}82$✓
3.4	$pH = -log[H_3O^+]$✓ $4{,}3 = -log[H_3O^+]$ $[H_3O^+] = 5{,}01 \times 10^{-4}\ mol.dm^{-3}$ $K_w = [OH^-][H_3O^+]$✓ $1 \times 10^{-14} = [OH^-](5{,}01 \times 10^{-5})$✓ $[OH^-] = 1{,}99 \times 10^{-10}\ mol.dm^{-3}$✓ $(2{,}00 \times 10^{-10})$

3.5

$$c = \frac{m}{M \times V}$$
$$= \frac{0{,}28}{40 \times 0{,}5}$$
$$= 0{,}014 \ mol \cdot dm^{-3}$$

NaOH is a strong base and dissociates completely
NaOH(s) $\longrightarrow$ Li^+ (aq) + OH^-(aq)

$$NaOH \ : \ OH^-$$
$$1 \ : \ 1$$
$$[OH^-] = 0{,}014 \ mol.dm^{-3}$$

$$K_w = [OH^-][H_3O^+]$$
$$1 \times 10^{-14} = (0{,}014)[H_3O^+]$$
$$[H_3O^+] = 7{,}14 \times 10^{-13} \ mol.dm^{-3}$$

$$pH = -log[H_3O^+]$$
$$= -log(7{,}14 \times 10^{-13})$$
$$= 12{,}15$$

3.6

a.
$$pH = -log[H_3O^+]$$
$$12{,}2 = -log[H_3O^+]$$
$$[H_3O^+] = 6{,}31 \times 10^{-13} \ mol.dm^{-3}$$

b.
$$K_w = [OH^-][H_3O^+]$$
$$1 \times 10^{-14} = [OH^-](6{,}31 \times 10^{-13})$$
$$[OH^-] = 1{,}58 \times 10^{-2} \ mol.dm^{-3}$$

NaOH is a strong base and dissociates completely
NaOH(s) $\longrightarrow$ Li^+ (aq) + OH^-(aq)

$$NaOH \ : \ OH^-$$
$$1 \ : \ 1$$
$$[NaOH] = 1{,}58 \times 10^{-2} mol.dm^{-3}$$

$$c = \frac{m}{M \times V}$$
$$1{,}58 \times 10^{-2} = \frac{m}{40 \times 0{,}25}$$
$$= 0{,}158 \ mol \cdot dm^{-3}$$

4.1

a. hydrolysis
b. basic
c. CH_3COO^- + H_2O $\rightleftharpoons$ CH_3COOH + OH^-

4.2

a. Pipette
b. 2NaOH + H_2CO_3 $\longrightarrow$ Na_2CO_3 + H_2O
c. Phenolphthalein. Strong base with weak acid gives basic end point.
d. Pink
e. Distilled water AND THEN some of the acid solution
f. Decreases
g.
$$\frac{n_a}{n_b} = \frac{C_a V_a}{c_b V_b}$$
$$\frac{1}{2} = \frac{0{,}1(25)}{C_b(20)}$$
$$c_b = 1{,}25 \ mol.dm^{-3}$$