Neutralization Reactions

① a) $HCl \, (aq) + LiOH \, (aq) \rightarrow LiCl \, (aq) + H_2O \, (l)$

b) $HNO_3 \, (aq) + CsOH \, (aq) \rightarrow CsNO_3 \, (aq) + H_2O \, (l)$

c) $HBr \, (aq) + KOH \, (aq) \rightarrow KBr \, (aq) + H_2O \, (l)$

② $HClO_4 \rightarrow H^+ + ClO_4^-$
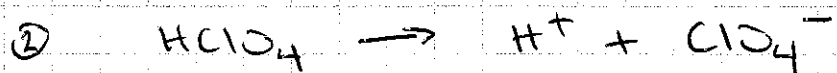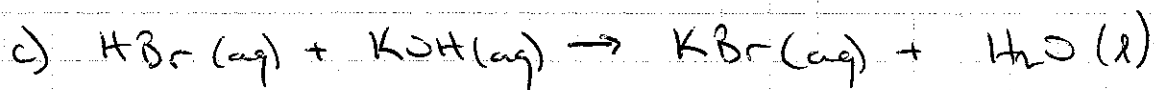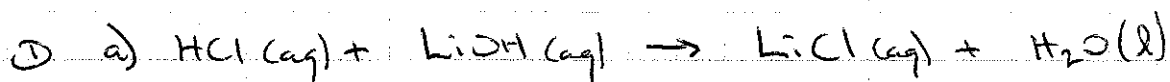
$[H^+] = [HClO_4] = 5 \text{ mol/L}$
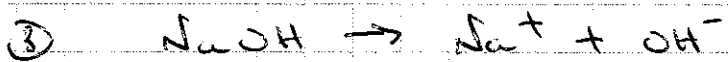
$5 \text{ mol/L} \times 0.020 \, L = 0.1 \text{ mol } H^+$

$\text{mol } OH^- = \text{mol } H^+ = 0.1 \text{ mol}$

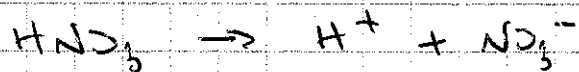$[OH^-] = \dfrac{\text{mol } OH^-}{vol} = \dfrac{0.1 \text{ mol}}{0.1 \, L} = 1 \text{ mol/L}$

$NaOH \rightarrow Na^+ + OH^-$

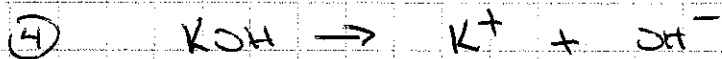$[NaOH] = [OH^-] = \boxed{1 \text{ mol/L}}$

③ $NaOH \rightarrow Na^+ + OH^-$

$$[OH^-] = [NaOH] = 0.02 \text{ mol/L}$$

$$0.02 \text{ mol/L} \times 0.06 \text{ L} = 0.0012 \text{ mol } OH^-$$

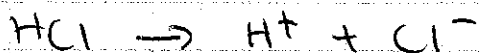$$\text{mol } H^+ = \text{mol } OH^- = 0.0012 \text{ mol}$$

$$HNO_3 \rightarrow H^+ + NO_3^-$$

$$[HNO_3] = [H^+] = \frac{0.0012 \text{ mol}}{0.015 \text{ L}} = \boxed{0.08 \text{ mol/L}}$$

④ $KOH \rightarrow K^+ + OH^-$

$$[OH^-] = [KOH] = 0.3 \text{ mol/L}$$

$$0.3 \text{ mol/L} \times 0.01 \text{ L} = 0.003 \text{ mol } OH^-$$

$$\text{mol } H^+ = \text{mol } OH^- = 0.003 \text{ mol}$$

$$HCl \rightarrow H^+ + Cl^-$$

$$[HCl] = [H^+] = \frac{0.003 \text{ mol}}{0.03 \text{ L}} = \boxed{0.1 \text{ mol/L}}$$

⑤ $HBr \rightarrow H^+ + Br^-$

$[H^+] = [HBr] = 0.25 \; mol/L$

$0.25 \; mol/L \times 0.0264 \; L = 0.0066 \; mol \; H^+$

$mol \; OH^- = mol \; H^+ = 0.0066 \; mol$

$CsOH \rightarrow Cs^+ + OH^-$

$[CsOH] = 0.22 \; M = \dfrac{0.0066 \; mol}{V}$

$V = \dfrac{0.0066}{0.22} = 0.03 \; L = \boxed{30 \; mL}$

⑥ $LiOH \rightarrow Li^+ + OH^-$

$[OH^-] = [LiOH] = 0.215 \; mol/L$

$0.215 \; mol/L \times 0.035 \; L = 0.007525 \; mol \; OH^-$

$mol \; H^+ = mol \; OH^- = 0.007525 \; mol$

$HClO_4 \rightarrow H^+ + ClO_4^-$
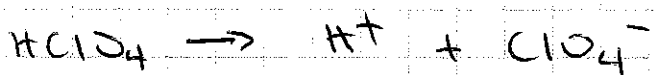
$[HClO_4] = 0.16 \; mol/L = \dfrac{0.007525 \; mol}{V}$

$V = \dfrac{0.007525}{0.16}$

$V = 0.047 \; L = \boxed{47 \; mL}$

⑦ $HCl \longrightarrow H^+ + Cl^-$
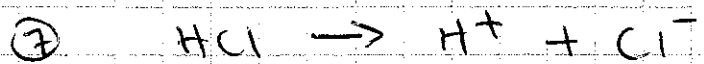
$[H^+] = [HCl] = 1 \, mol/L$

$1 \, mol/L \times 0.025 \, L = 0.025 \, mol \, H^+$

$mol \, OH^- = mol \, H^+ = 0.025 \, mol$

$NaOH \longrightarrow Na^+ + OH^-$

$mol \, NaOH = mol \, OH^- = \boxed{0.025 \, mol}$