1.a) $HCl \rightarrow H^{+} + Cl^{1-}$ ✓ 100% dissociation ✓

$\therefore [H^{1+}] = 1.0M$ ✓

$pH = -\log[H^{+}]$ ✓

$pH = -\log 1.0$

$pH = 0$ ✓

$K_w = [H^{+}][OH^{-}]$ ✓

$[OH^{-}] = \frac{K_w}{[H^{+}]}$

$[OH^{-}] = \frac{1\times10^{-14}}{1.0}$

$[OH^{-}] = 1\times10^{-14}$ ✓

$pH + pOH = 14$ ✓

$pOH = 14 - pH$

$pOH = 14 - 0$

$pOH = 14$ ✓

---

b) $HNO_3 \rightarrow H^{1+} + NO_3^{-}$ ✓ 100% dissociation ✓

$\therefore [H^{+}] = 0.5M$ ✓

this is sufficient

$pH = -\log[H^{+}]$ ✓

$pH = 0.30103$ ✓

$[OH^{-}] = \frac{K_w}{[H^{+}]}$ ✓

$[OH^{-}] = 2\times10^{-14}$ ✓

$pOH = -\log[OH^{-}]$ ✓

$pOH = 13.699$ ✓

---

c) $HClO_4 \rightarrow H^{1+} + ClO_4^{1-}$ 100% dissociation

$\therefore [H^{1+}] = 0.002M$

etc. etc. etc.

---

d) $KOH \rightarrow K^{1+} + OH^{1-}$ 100% dissociation

$[OH^{1-}] = 1.5\times10^{-4}\ M$

$pOH = -\log[OH^{1-}]$

$pOH = 3.82$

$[H^{+}] = \frac{K_w}{[OH^{1-}]}$

$[H^{+}] = 6.67\times10^{-11}$

$pH = 14 - pOH$

$pH = 10.18$

---

e) $0.040g \times \frac{1mol}{40.00g} = 0.001mol$

$NaOH \rightarrow Na^{1+} + OH^{1-}$ 100% dissociation

$C = \frac{n}{V}$ $C = \frac{0.001mol}{2.0L}$ $C = 0.0005M$

$\therefore [OH^{1-}] = 0.0005M$

etc. etc. etc.

f) $C_1V_1 = C_2V_2$

$1.0\,mL \times 0.20\,M = C_2 \times 5000\,mL$

$C_2 = 0.00004\,M$

$HCl \rightarrow H^{1+} + Cl^{1-}$ 100% dissociation

$\therefore [H^{+}] = 0.00004\,M$

etc. etc

---

g) $Na_2O + H_2O \rightarrow 2NaOH$

$NaOH \rightarrow Na^{1+} + OH^{1-}$

$$\frac{0.10\,mol\,Na_2O}{1.0\,L} \times \frac{2\,mol\,NaOH}{1\,mol\,Na_2O} \times \frac{1\,mol\,OH^{1-}}{1\,mol\,NaOH} = \frac{0.20\,mol\,OH^{1-}}{1\,L}$$

$\therefore [OH^{1-}] = 0.20\,M$ etc. etc

---

2. a) $HCN \rightleftharpoons H^{1+} + CN^{1-}$

$[CN^{1-}] = [H^{1+}]$

$[HCN] = 1.0 - [H^{+}]$

$$K_A = \frac{[H^{1+}][CN^{1-}]}{[HCN]}$$

$$3.0\times10^{-8} = \frac{[H^{1+}]^2}{1.0 - [H^{+}]}$$

$$[H^{1+}] = \sqrt{4\times10^{-10}(1.0 - [H^{+}])}$$

$[H^{1+}] = 2.00\times10^{-5}\,M$

$pH = -\log[H^{+}]$

$pH = 4.699$

$$\%\ dissociation = \frac{[H^{+}]}{C_A^{\circ}} \times 100\%$$

$$\%\ dis = \frac{2.00\times10^{-5}\,M}{1.0\,M} \times 100\%$$

$= 0.00200\ M$

Note C_A° is the symbol for initial acid [ ]

b) $[H^+] = 6.32 \times 10^{-7}$ M

pH = 6.20

% dis = 0.0632%

c) $[H^+] = 0.0261$ M

pH = 1.584

% dis = 2.61%

d) $[H^+] = 0.0160$ M

pH = 1.797

% dis = 3.19%

e) $[H^+] = 0.01$M

pH = 2

% dis = 2.00%

g) $[H^+] = 1.70 \times 10^{-5}$ M

pH = 4.77

% dis. = 0.00341%

3. $HF \rightleftharpoons H^{1+} + F^{1-}$

$$\frac{2.0\,g\ HF}{1.0\,L} \times \frac{1\,mol}{20.01\,g\ HF} = \frac{0.1\,mol}{1L}$$

$\therefore C_A^{\circ} = 0.1$M

$[H^+] = 10^{-pH}$

$= 10^{-2.2}$

$= 0.00631$M

$[F^-] = [H^+]$

$= 0.00631$M

$[HF] = 0.1 - 0.00631$

$= 0.0936$M

$$K_A = \frac{[H^+][F^-]}{[HF]}$$

$$K_A = \frac{(0.00631)(0.00631)}{0.0936}$$

$K_A = 4.251 \times 10^{-4}$

From the list the acid is likely nitrous acid (not a good match)

4. $HX \rightleftharpoons H^{1+} + X^{1-}$

$[H^+] = 0.06 \times C_A^0$

$= 0.06 \times 0.1\ M$

$= 0.006\ M$

$[X^-] = [H^+]$

$= 0.006 M$

$[HX] = C_A^0 - [H^+]$

$= 0.1 - 0.006$

$= 0.094$

$$K_A = \frac{[H^{1+}][X^-]}{[HX]}$$

$$K_A = \frac{(0.006)^2}{0.094}$$

$K_A = 3.83 \times 10^{-4}$

5. $HX \rightleftharpoons H^+ + X^-$

$[H^+] = 0.20 \times C_A^0$

$= 0.20 \times 1 \times 10^{-3}$

$= 2 \times 10^{-4}$

~~$[X^-] = [H^{1+}]$~~

~~$= 2 \times 10^{-4}$~~

$pH = -\log[H^+]$

$= 3.699$

$[X^-] = [H^+]$

$= 2 \times 10^{-4}$

$[HX] = C_A^0 - [H^+]$

$= 1 \times 10^{-3} - 2 \times 10^{-4}$

$= 8 \times 10^{-4}$

$$K_A = \frac{[H^+][X^-]}{[HX]}$$

$$K_A = \frac{(2 \times 10^{-4})^2}{8 \times 10^{-4}}$$

$K_A = 5 \times 10^{-5}$

6. $HBrO \rightleftharpoons H^+ + BrO^-$

$[H^+] = 10^{-pH}$

$= 10^{-4.8}$

$= 1.585\times10^{-5}$

$[BrO^-] = [H^+]$

$= 1.585\times10^{-5}$

$[HBrO] = C_A^\circ - [H^+]$

$= C_A^\circ - 1.585\times10^{-5}$

$\rightarrow K_A = \dfrac{[H^+][BrO^-]}{[HBrO]}$

$$2.0\times10^{-9} = \frac{(1.585\times10^{-5})^2}{C_A^\circ - 1.585\times10^{-5}}$$

$C_A^\circ = 0.12561\,M$