Strong Acids

① a) $HNO_3 \rightarrow H^+ + NO_3^-$

$[H^+] = [HNO_3] = \boxed{0.3 \text{ mol/L}}$

b) $K_w = [H^+][OH^-]$

$1 \times 10^{-14} = 0.3\,[OH^-]$

$[OH^-] = \boxed{3.3 \times 10^{-14} \text{ mol/L}}$

② HCl $\quad \frac{0.37 \text{ g}}{36.5 \text{ g/mol}} = 0.010 \text{ mol}$

$\frac{1.014 \text{ mol}}{0.25 \text{ L}} = 0.041 \text{ mol/L}$

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

$[H^+] = [HCl] = 0.041 \text{ mol/L}$

$K_w = [H^+][OH^-]$

$1 \times 10^{-14} = 0.041\,[OH^-]$

$[OH^-] = \boxed{2.5 \times 10^{-13} \text{ mol/L}}$

③ $K_w = [H^+][OH^-]$

$1 \times 10^{-14} = 4.4 \times 10^{-3}\,[OH^-]$

$[OH^-] = \boxed{2.3 \times 10^{-12} \text{ mol/L}}$

④ a) $HI \rightarrow H^+ + I^-$

$[H^+] = [HI] = 0.006 \text{ mol/L}$

$pH = -\log(0.006) = \boxed{2.22}$

$pOH = 14 - pH$

$= 14 - 2.22$

$pOH = \boxed{11.78}$

$[OH^-] = 10^{-pOH}$

$= 10^{-11.78}$

$[OH^-] = \boxed{1.7 \times 10^{-12} \text{ mol/L}}$

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

$[H^+] = [HNO_3] = 0.025 \text{ mol/L}$

$pH = -\log(0.025) = \boxed{1.60}$

$pOH = 14 - pH$

$= 14 - 1.60$

$pOH = \boxed{12.40}$

$[OH^-] = 10^{-12.40}$

$[OH^-] = \boxed{4.0 \times 10^{-13} \text{ mol/L}}$

④ c) $HCl \rightarrow H^+ + Cl^-$

$[H^+] = [HCl] = 0.010 \text{ mol/L}$

$pH = -\log(0.010) = \boxed{2}$

$pOH = 14 - pH$

$= 14 - 2$

$pOH = \boxed{12}$

$[OH^-] = 10^{-12}$

$= \boxed{1 \times 10^{-12} \text{ mol/L}}$

⑤ $NaOH$ $\frac{26 \text{ g}}{40 \text{ g/mol}} = 0.65 \text{ mol}$

$\frac{0.65 \text{ mol}}{0.15 \text{ L}} = 4.333 \text{ mol/L}$

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

$[OH^-] = [NaOH] = 4.333 \text{ mol/L}$

$pOH = -\log(4.333) = \boxed{-0.64}$

$pH = 14 - pOH$

$= 14 - (-0.64)$

$pH = \boxed{14.64}$

⑥ $pH = 11.5$

$pOH = 14 - 11.5 = 2.5$

$[OH^-] = 10^{-2.5}$

$[OH^-] = 0.0032 \text{ mol/L}$

$KOH \rightarrow K^+ + OH^-$

$[KOH] = [OH^-] = 0.0032 \text{ mol/L}$

$0.0032 \text{ mol/L} \times 0.5 \text{ L} = 0.00158 \text{ mol of KOH}$

$0.00158 \text{ mol} \times 56.1 \text{ g/mol} = \boxed{0.089 \text{ g}} \text{ of KOH}$

⑦ a)

Food	$[H_3O^+]$	$[OH^-]$	pH	pOH
oranges	5.5×10^{-3}	1.8×10^{-12}	2.26	11.74
asparagus	4×10^{-9}	2.5×10^{-6}	8.4	5.6
olives	5×10^{-4}	2×10^{-11}	3.3	10.70
blackberries	4×10^{-4}	2.5×10^{-11}	3.4	10.6

b) oranges

c) asparagus – it's a base, so it will neutralize stomach acid

⑧ $[H_3O^+] = 10^{-4} = 1 \times 10^{-4}$ mol/L before

$[H_3O^+] = 10^{-2} = 1 \times 10^{-2}$ mol/L after

$[H_3O^+]$ after is 100 times greater.