53) a) H^+ , ClO_4^- , H_2O

	$HClO_4$	$\longrightarrow$	H^+	+	ClO_4^-
I	0.250		0		0
C	-0.250		+0.250		+0.250
E	0		0.250		0.250

$pH = -\log(0.250) = 0.602$

b) H^+ NO_3^- H_2O

	HNO_3	$\longrightarrow$	H^+	+	NO_3^-
I	0.250		0		0
C	-0.250		+0.250		+0.250
E	0		0.250		0.250

$pH = -\log(0.250) = 0.602$

55) a) $[HCl] = [H^+] = 0.10\ M$

$pH = -\log(0.10) = 1.00$

b) $[HClO_4] = [H^+] = 5.0\ M$

$pH = -\log(5.0) = -0.70$

c) $[HI] = [H^+] = 1.0 \times 10^{-11}$

$pH = -\log(1.0 \times 10^{-11}) = 11.00$ not possible

\# $[H^+]$ in H_2O is $1.00 \times 10^{-7}\ M$

$pH = -\log(1.0 \times 10^{-7}) = 7$

57) $[H^+] = 10^{-pH} = 10^{-2.50} = 3.2 \times 10^{-3}\,M$

$[H^+] = [HI] = 3.2 \times 10^{-3}\,M$

59) $[H^+] = 10^{-1.50} = 3.16 \times 10^{-2}\,M$

$M_1V_1 = M_2V_2$

$(12\,M)(x) = (3.16 \times 10^{-2}\,M)(1.6\,L)$

$x = 4.2 \times 10^{-3}\,L$

to 4.2 mL of 12 M HCl, add enough water to make 1.6 L of solution

61) HNO_2 4.0×10^{-4} *

H_2O 1.0×10^{-14}

	HNO_2	$\rightleftharpoons$ H^+	+ NO_2^-
I	0.250	0	0
C	$-x$	$+x$	$+x$
E	$0.250-x$	x	x

$K_a = \frac{[H^+][NO_2^-]}{[HNO_2]} = 4.0 \times 10^{-4} = \frac{x^2}{(0.250-x)}$

$4.0 \times 10^{-4} = \frac{x^2}{0.250}$

$x = 0.010\,M$

$pH = -\log(0.010)$

$pH = 2.00$

$\% = \frac{0.010}{0.250} \times 100 = 4.0\,\%$

b) CH_3CO_2H 1.8×10^{-5} ✱

H_2O 1.0×10^{-14}

$$CH_3CO_2H \rightleftharpoons H^+ + CH_3CO_2^-$$

	CH_3CO_2H	H^+	$CH_3CO_2^-$
I	0.250	0	0
C	$-x$	$+x$	$+x$
E	$0.250-x$	x	x

$$K_a = \frac{[H^+][CH_3CO_2^-]}{[CH_3CO_2H]} = 1.8 \times 10^{-5} = \frac{x^2}{0.250-x}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.250} \qquad x = 2.1 \times 10^{-3}\ M$$

$$\% = \frac{2.1 \times 10^{-3}}{0.250} \times 100 = 0.84\%$$

$[H^+] = 2.1 \times 10^{-3}\ M$ $\qquad pH = -\log(2.1 \times 10^{-3}) = 2.68$

63) HF 7.2×10^{-4} *

H_2O 1.0×10^{-14}

$$HF \rightleftharpoons H^+ + F^-$$

	HF	H^+	F^-
I	0.020	0	0
C	$-x$	$+x$	$+x$
E	$0.020-x$	x	x

$K_a = \frac{[H^+][F^-]}{[HF]} = 7.2 \times 10^{-4} = \frac{x^2}{0.020 - x}$ $x = 3.79 \times 10^{-3}$

$5\% = \frac{3.79 \times 10^{-3}}{0.020} \times 100 = 19\%$:(

Quadratic:

$7.2 \times 10^{-4} = \frac{x^2}{0.020 - x}$

$1.4 \times 10^{-5} - 7.2 \times 10^{-4} x = x^2$

$x^2 + 7.2 \times 10^{-4} x - 1.4 \times 10^{-5} = 0$

$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $\frac{-7.2 \times 10^{-4} \pm \sqrt{(7.2 \times 10^{-4})^2 - 4(1)(1.4 \times 10^{-5})}}{2(1)}$

$\frac{-7.2 \times 10^{-4} + \sqrt{5.65 \times 10^{-5}}}{2}$ $\frac{-7.2 \times 10^{-4} - \sqrt{5.65 \times 10^{-5}}}{2}$

3.4×10^{-3} $\cancel{-4.1 \times 10^{-3}}$

$[H^+] = [F^-] = 3.4 \times 10^{-3}\,M$

$[OH^-] = \frac{1.0 \times 10^{-14}}{3.4 \times 10^{-3}} = 2.9 \times 10^{-12}\,M$

$[HF] = 0.020 - 0.0034 = 0.017\,M$

$pH = -\log(3.4 \times 10^{-3})$
$= 2.46$

1b) $HC_3H_5O_2$ $\qquad$ $K_a = 1.3 \times 10^{-5}$ *

H_2O $\qquad$ $K_w = 1.0 \times 10^{-14}$

	$HC_3H_5O_2$	$\rightleftharpoons$	H^+	+	$C_3H_5O_2^-$
I	0.100		0		0
C	$-x$		$+x$		$+x$
E	$0.100 - x$		x		x

$$K_a = 1.3 \times 10^{-5} = \frac{[H^+][C_3H_5O_2^-]}{[HC_3H_5O_2]} = \frac{x^2}{0.100 - x}$$

$x = [H^+] = 1.1 \times 10^{-3}\,M$

$$\% = \frac{1.1 \times 10^{-3}}{0.100} \times 100 = 1.1\% \checkmark$$ % dissociation

$[H^+] = [C_3H_5O_2^-] = 1.1 \times 10^{-3}\,M$

$pH = -\log(1.1 \times 10^{-3}) = 2.96$

$$[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0 \times 10^{-14}}{1.1 \times 10^{-3}} = 9.1 \times 10^{-12}\,M$$

$[HC_3H_5O_2] = 0.100\,M$