103) $H_2SO_3 \rightleftharpoons H^+ + HSO_3^-$

$$K_{a_1} = \frac{[H^+][HSO_3^-]}{[H_2SO_3]}$$

$HSO_3^- \rightleftharpoons H^+ + SO_3^{-2}$

$$K_{a_2} = \frac{[H^+][SO_3^{-2}]}{[HSO_3^-]}$$

105)

	H_3PO_4	$\rightleftharpoons$	H^+	+	$H_2PO_4^-$
I	0.007		0		0
C	$-x$		$+x$		$+x$
E	$0.007 - x$		x		x

$$K_{a_1} = \frac{[H^+][H_2PO_4^-]}{[H_3PO_4]} = 7.5\times10^{-3} = \frac{x^2}{0.007 - x}$$

$x = 7.5\times10^{-3}$ M

$$\%_0 = \frac{7.5\times10^{-3}}{7.5\times10^{-3}} \times 100 = 100\%$$

$$x^2 = 5\times10^{-5} - (7.5\times10^{-3})x$$

$$x^2 + (7.5\times10^{-3})x - (5\times10^{-5}) = 0$$

$x = [H^+] = 4\times10^{-3}$ M $\quad pH = -\log(4\times10^{-3}) = 2.4$

* K_{a_1} is much larger than K_{a_2} & K_{a_3} so H^+ contributed from $H_2PO_4^-$ and HPO_4^{-2} can be ignored

10) because K_{a2} for H_2S is so small, we can ignore the H^+ contributed from the K_{a2} reaction

	H_2S	$\rightleftharpoons$	H^+	+	HS^-
I	0.10		0		0
C	$-x$		$+x$		$+x$
E	$0.10-x$		x		x

$$K_{a1} = \frac{[H^+][HS^-]}{[H_2S]} = 1.0\times10^{-7} = \frac{x^2}{0.10-x}$$

$$x = 1.0\times10^{-4}$$

$$\%_0 = \frac{1.0\times10^{-4}}{0.10}\times100 = 0.10\%$$ ✓

$$pH = -\log(1.0\times10^{-4}) = 4.00$$

	HS^-	$\rightleftharpoons$	H^+	+	S^{-2}
I	1.0×10^{-4}		1.0×10^{-4}		0
C	$-x$		$+x$		$+x$
E	$1.0\times10^{-4}-x$		$1.0\times10^{-4}+x$		x

$$K_{a2} = \frac{[H^+][S^{-2}]}{[HS^-]} = 1.0\times10^{-19} = \frac{(1.0\times10^{-4}+x)(x)}{(1.0\times10^{-4}-x)}$$

$$x = [S^{-2}] = 1.0\times10^{-19}$$

$$\%_0 = \frac{1.0\times10^{-19}}{1.0\times10^{-4}}\times100$$

$1.0\times10^{-13}\%$ ✓

10a) $H_2SO_4 \longrightarrow H^+ + HSO_4^-$

$[H_2SO_4]_0 = [H^+] = [HSO_4^-] = 2.0\ M$

	HSO_4^-	$\rightleftharpoons$	H^+	+	SO_4^{-2}
I	2.0		2.0		0
C	$-x$		$+x$		$+x$
E	$2.0-x$		$2.0+x$		x

$K_{a2} = \dfrac{[H^+][SO_4^{-2}]}{[H_2SO_4]} = 1.2\times10^{-2} = \dfrac{(2.0+x)(x)}{(2.0-x)}$

$x = [SO_4^{-2}] = 1.2\times10^{-2}\ M$ $\quad \%_0 = \dfrac{1.2\times10^{-2}}{2.0}\times100 = 0.6\%$ ✓

$pH = -\log(2.0) = -0.30$

H^+ from second reaction is insignificant.

For more diluted H_2SO_4 solution... not the case