15) HCO_3^- : CO_3^{-2} solution

strong acid: H^+ reacts with CO_3^{-2}

$H^+ + CO_3^{-2} \rightarrow HCO_3^-$

strong base: OH^- reacts with HCO_3^-

$OH^- + HCO_3^- \rightarrow H_2O + CO_3^{-2}$

17)

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

$$K_a = \frac{[H^+][C_3H_5O_2^-]}{[HC_3H_5O_2]}$$

$$1.3\times10^{-5} = \frac{x^2}{0.100-x}$$

$x = [H^+] = 1.1\times10^{-3}\,M$

pH: 2.96

5% rule $\frac{1.1\times10^{-3}}{0.10}\times100 = 1\%$ ✓

b) $C_3H_5O_2^- + H_2O \rightleftharpoons HC_3H_5O_2 + OH^-$

	$C_3H_5O_2^-$		$HC_3H_5O_2$	OH^-
I	0.100		0	0
C	$-x$		$+x$	$+x$
E	$0.100 - x$		x	x

$$K_b = \frac{1.0\times10^{-14}}{1.3\times10^{-5}} = 7.7\times10^{-10} = \frac{[HC_3H_5O_2][OH^-]}{[C_3H_5O_2^-]}$$

$$7.7\times10^{-10} = \frac{x^2}{0.100} \rightarrow$$

$x = [OH^-] = 8.8\times10^{-6}\ M$

$pOH = -\log(8.8\times10^{-6}) = 5.06$

$pH = 14 - 5.06 = 8.94$

$\frac{8.8\times10^{-6}}{0.100}\times100 = 0.0088\%$ ✓

c) Pure water $[H^+] : [OH^-] = 1.0 \times 10^{-7}\ M$

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

d) $H_2O \rightleftharpoons H^+ + OH^-$

* $HC_3H_5O_2 \rightleftharpoons H^+ + C_3H_5O_2^-$

Na^+

$C_3H_5O_2^-$

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

$$K_c = \frac{[H^+][C_3H_5O_2^-]}{[HC_3H_5O_2]}$$

$$1.3 \times 10^{-5} = \frac{(0.100 + x)(x)}{0.100 - x}$$

5%

$$\frac{1.3 \times 10^{-5}}{0.10} \times 100$$

$X = [H^+] = 1.3 \times 10^{-5}\ M$

$pH = -\log(1.3 \times 10^{-5}) = 4.89$

1a) $0.100\,M\ HC_3H_5O_2$

% dissociation: $\frac{1.1\times10^{-3}}{0.100}\times100 = 1.1\%$

$0.100\,M\ HC_3H_5O_2 + 0.100\,M\ NaC_3H_5O_2$

% dissociation $\frac{1.3\times10^{-5}}{0.100}\times100 = 1.3\times10^{-2}\%$

% dissociation decreased ... common ion effect

$$HA \rightleftharpoons H^+ + A^-$$

(3) ↑ HA; (2) ← H^+; (1) ↑ A^-