

$$16.55 \quad \text{pH} = -\log[\text{H}^+] \quad 2.44 = -\log[\text{H}^+] \quad \text{H}^+ = 0.00363\text{M}$$



I	0.10M	0 M	0 M
C	-0.00363M	+0.00363M	+0.00363M
E	0.09637M	0.00363M	0.00363M

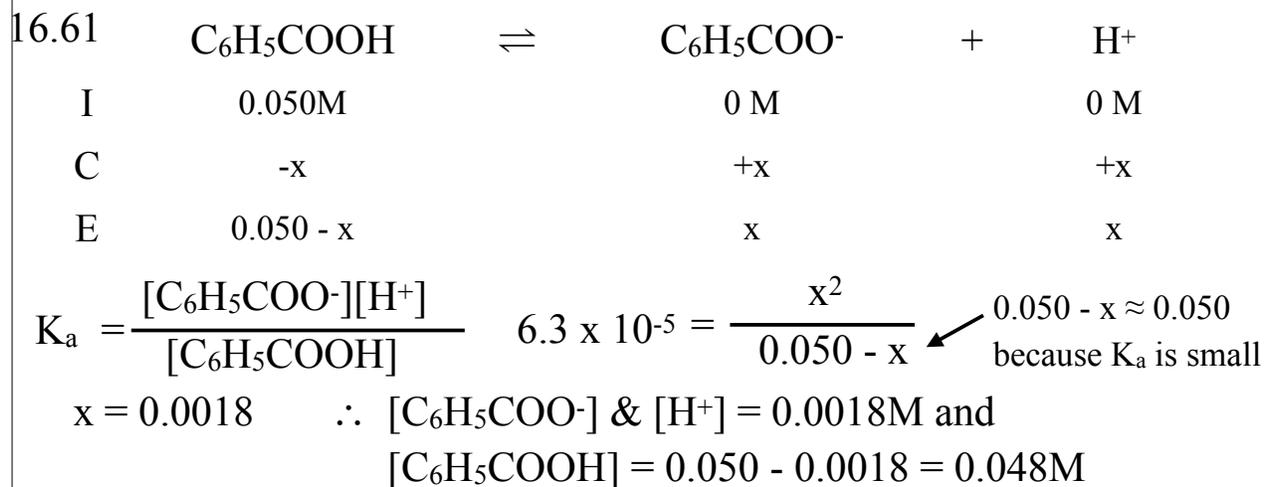
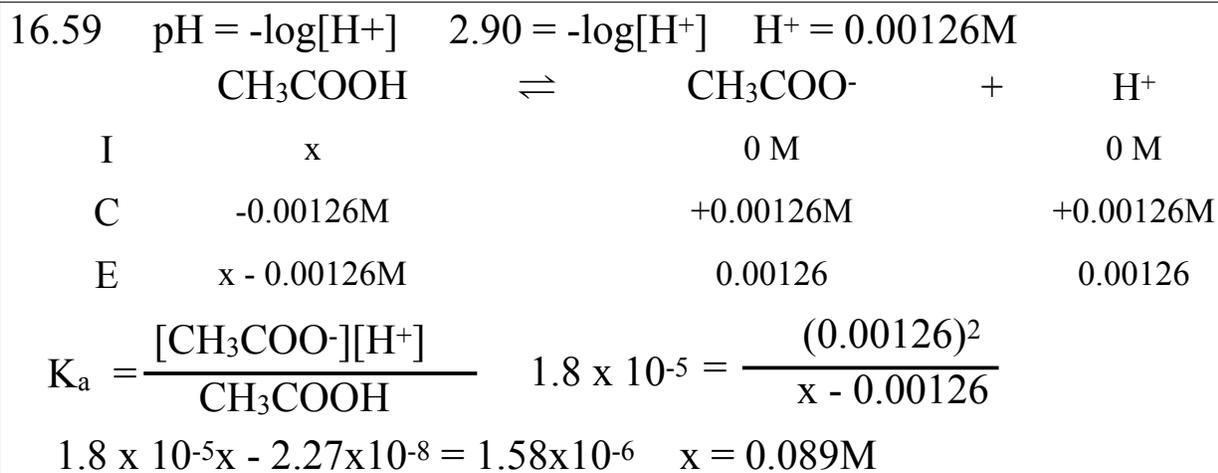
$$K_a = \frac{[\text{CH}_3\text{CH}(\text{OH})\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{CH}(\text{OH})\text{COOH}]} = \frac{(0.00363)^2}{0.09637} = 1.4 \times 10^{-4}$$

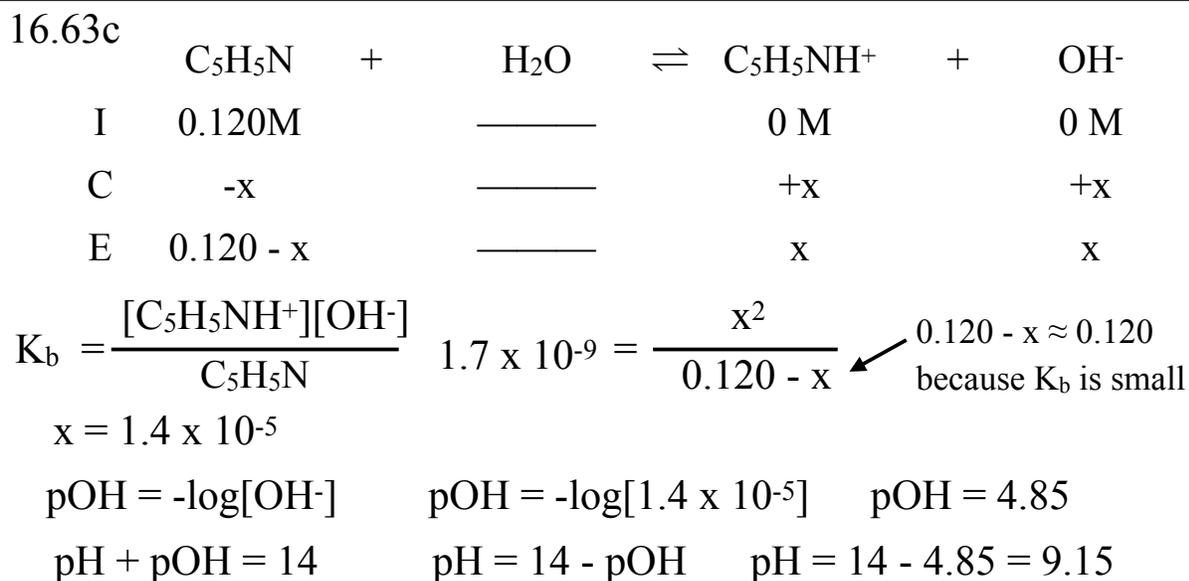
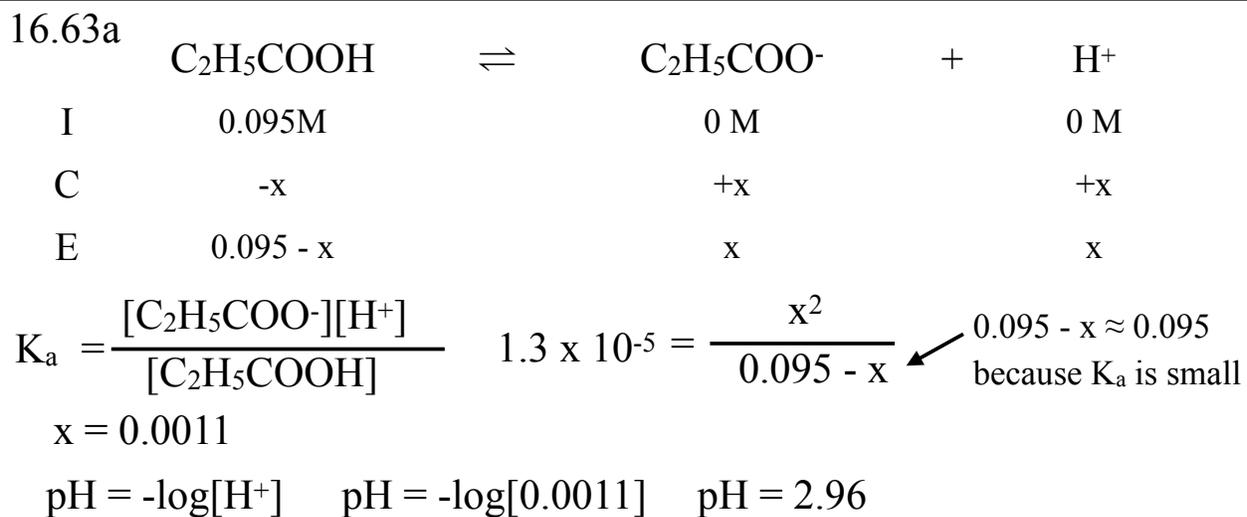
$$16.57 \quad \% \text{ Ion} = \frac{[\text{H}^+]}{[\text{HA}_{\text{initial}}]} \quad 0.11 = \frac{[\text{H}^+]}{[0.100\text{M}]} \quad [\text{H}^+] = 0.0110\text{M}$$



I	0.10M	0 M	0 M
C	-0.0110M	+0.0110M	+0.0110M
E	0.0890M	0.0110M	0.0110M

$$K_a = \frac{[\text{ClCH}_2\text{COO}^-][\text{H}^+]}{[\text{ClCH}_2\text{COOH}]} = \frac{(0.0110)^2}{0.0890} = 1.4 \times 10^{-3}$$





16.65

	$\text{HNC}_7\text{H}_4\text{SO}_3$	$\rightleftharpoons$	$\text{NC}_7\text{H}_4\text{SO}_3^-$	+	$\text{H}^+$
I	0.10		0 M		0 M
C	-x		+x		+x
E	0.10 - x		x		x

$$\text{p}K_a = -\log[K_a] \quad 2.32 = -\log[K_a] \quad K_a = 0.00479$$

$$K_a = \frac{[\text{NC}_7\text{H}_4\text{SO}_3^-][\text{H}^+]}{[\text{HNC}_7\text{H}_4\text{SO}_3]} \quad 4.79 \times 10^{-3} = \frac{x^2}{0.10 - x}$$

$$x^2 + 0.00479x - 0.000479 = 0 \quad x = 0.0196$$

$$\text{pH} = -\log[\text{H}^+] \quad \text{pH} = -\log[0.0196] \quad \text{pH} = 1.71$$

16.67a

	$\text{HN}_3$	$\rightleftharpoons$	$\text{N}_3^-$	+	$\text{H}^+$
I	0.400		0 M		0 M
C	-x		+x		+x
E	0.400 - x		x		x

$$K_a = \frac{[\text{N}_3^-][\text{H}^+]}{[\text{HN}_3]} \quad 1.9 \times 10^{-5} = \frac{x^2}{0.400 - x} \quad \leftarrow \begin{array}{l} 0.400 - x \approx 0.400 \\ \text{because } K_a \text{ is small} \end{array}$$

$$x = 2.8 \times 10^{-3} \quad \% \text{ Ion} = \frac{[2.8 \times 10^{-3}]}{[0.400]} = 0.70\%$$

16.67b

$$K_a = \frac{[\text{N}_3^-][\text{H}^+]}{[\text{HN}_3]} \quad 1.9 \times 10^{-5} = \frac{x^2}{0.100 - x} \quad \leftarrow \begin{array}{l} 0.100 - x \approx 0.100 \\ \text{because } K_a \text{ is small} \end{array}$$

$$x = 1.4 \times 10^{-3} \quad \% \text{ Ion} = \frac{[1.4 \times 10^{-3}]}{[0.100]} = 1.4\%$$

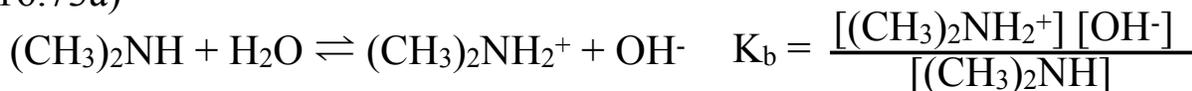
16.63 a&b reflect the idea that the higher the initial concentration, the smaller the % ionization, as seen in 16.4

16.71 a)  $\text{NH}_3\text{OH}^+$

b) When hydroxylamine acts as a base, the nitrogen accepts the protons. Nitrogen is an effective proton acceptor because of its unbonded electrons.

c) In hydroxylamine, both the oxygen and the nitrogen have unbonded electrons which could be shared with hydrogen. This said, nitrogen will more likely share electrons because its electronegativity is lower.

16.73a)



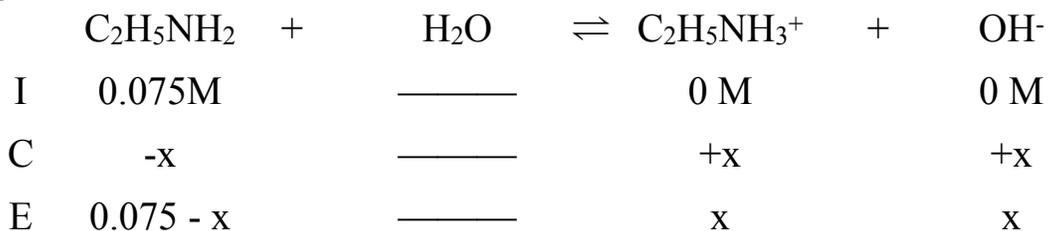
b)



c)



16.75



$$K_b = \frac{[\text{C}_2\text{H}_5\text{NH}_3^+][\text{OH}^-]}{[\text{C}_2\text{H}_5\text{NH}_2]} \quad 6.4 \times 10^{-4} = \frac{x^2}{0.075 - x} \quad \leftarrow \begin{array}{l} 0.075 - x \approx 0.120 \\ \text{because } K_a \text{ is small} \end{array}$$

$$x = 0.0069$$

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

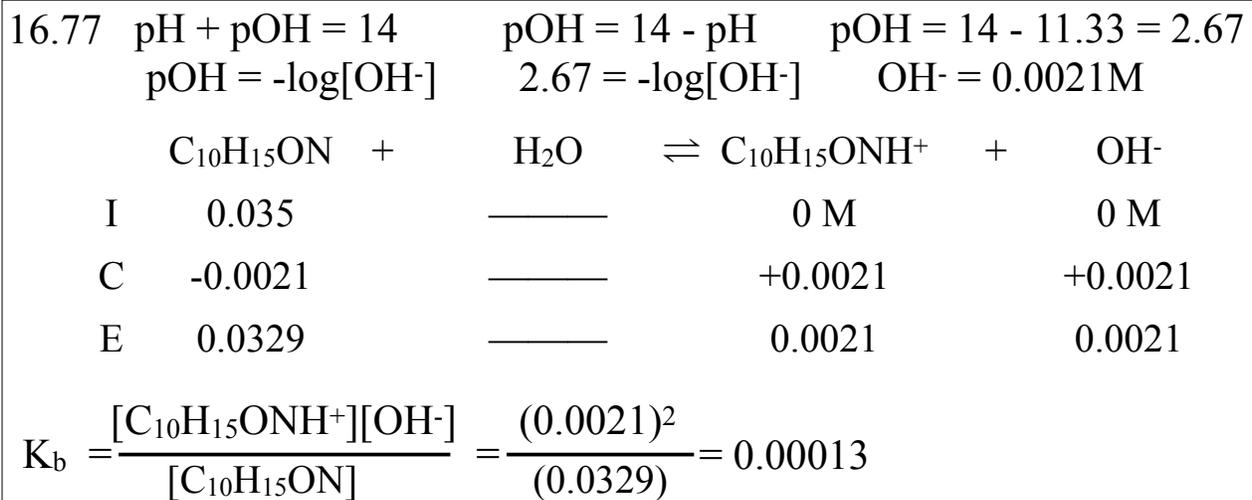
$$\text{pOH} = -\log[0.0069]$$

$$\text{pOH} = 2.16$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = 14 - 2.16 = 11.84$$



b)  $K_a \times K_b = K_w$   
 $1.3 \times 10^{-10} \times K_b = 1.0 \times 10^{-14}$   
 $K_b = 7.7 \times 10^{-5}$

c) Phenol is a weak acid than water, as indicated by its  $K_a$  value being less than  $1 \times 10^{-7}$ .

16.81a) Acetic acid ( $K_a = 1.8 \times 10^{-5}$ ) is a stronger weak acid than hypochlorous acid ( $K_a = 3.0 \times 10^{-8}$ ).

b) Weaker weak acids have stronger conjugate bases. As such, the conjugate base of the weaker hypochlorous acid (hypochlorite ion) is the stronger base.

c)

$K_a \times K_b = K_w$	$K_a \times K_b = K_w$
$1.8 \times 10^{-5} \times K_b = 1.0 \times 10^{-14}$	$3.0 \times 10^{-8} \times K_b = 1.0 \times 10^{-14}$
$K_b = 5.6 \times 10^{-10}$	$K_b = 3.3 \times 10^{-7}$