

Chapter 7 Review

PG. 444 - 445 # 31 - 33

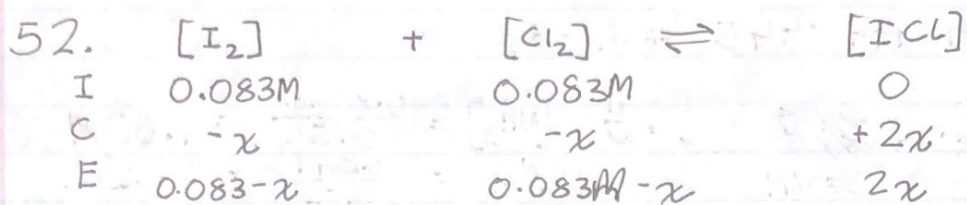
31. a) ~~not a~~ $c = \frac{n}{V}$ $[NH_3] = \frac{0.80 \text{ mol}}{0.5 \text{ L}} = 1.60 \text{ M}$
 $[N_2] = \frac{0.10 \text{ mol}}{0.5 \text{ L}} = 0.20 \text{ M}$
 $[H_2] = \frac{0.3}{0.5} = 0.60 \text{ M}$

a) $K_{eq} = \frac{[N_2][H_2]^3}{[NH_3]}$ b) $K_{eq} = \frac{(0.20)(0.60)^3}{1.60} = 0.01687$
 $= 0.017$

32. $K_{eq} = \frac{[PCl_5]}{[PCl_3][Cl_2]}$ $49 = \frac{[PCl_5]}{(0.035 \text{ M})^2}$ $[PCl_5] = 49 \cdot (0.035 \text{ M})^2$
 $= 0.060025 \text{ M}$
 $= 0.060 \text{ M}$

33. $[I_2] = \frac{0.024 \text{ mol}}{2.0 \text{ L}} = 0.012 \text{ M}$ $K_{eq} = \frac{[IBr]^2}{[I_2][Br_2]}$
 $[Br_2] = \frac{0.050 \text{ mol}}{2.0 \text{ L}} = 0.025 \text{ M}$
 $[IBr] = \frac{0.38 \text{ mol}}{2.0 \text{ L}} = 0.19 \text{ M}$
 $= \frac{(0.19)^2}{(0.012)(0.025)} = 120.3$
 $= 1.2 \times 10^2$

PG 451-452 #52-60



$$K_{eq} = \frac{[ICl]^2}{[I_2][Cl_2]} \Rightarrow \sqrt{82} = \sqrt{\frac{(2x)^2}{(0.083-x)^2}}$$

$$9.05538 = \frac{2x}{0.083-x} \times 0.083x$$

$$9.05538(0.083-x) = 2x$$

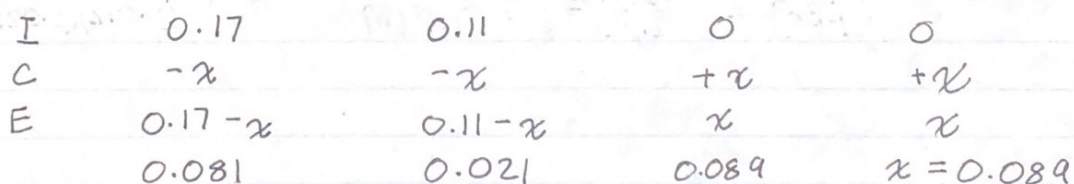
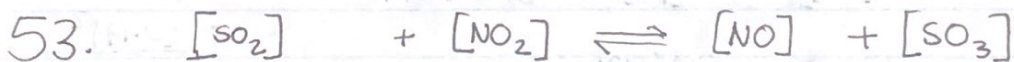
$$0.75159 - 9.05538x = 2x$$

$$x = 0.06798$$

$$[I_2] = 0.083 - 0.067 = 0.016M$$

$$[H_2] = [I_2]$$

$$[ICl] = 2(0.06798) = 0.134M$$



$$K_{eq} = \frac{[NO][SO_3]}{[NO_2][SO_2]} = \frac{[0.089]^2}{(0.081)(0.021)} = 4.6566 = 4.7$$



I	0.045M	0	0
C	-2x	+x	+x
E	0.045-2x	x	x

$$K_{eq} = \frac{[\text{H}_2][\text{Br}_2]}{[\text{HBr}]} \quad ; \quad \sqrt{4.2 \times 10^{-9}} = \sqrt{\frac{x^2}{0.045-2x}}$$

$$[\text{HBr}] = -2(2.916 \times 10^{-6})$$

$$= 0.045M$$

$$6.4807 \times 10^{-5} = \frac{x}{0.045-2x}$$

$$[\text{H}_2] = [\text{I}_2]$$

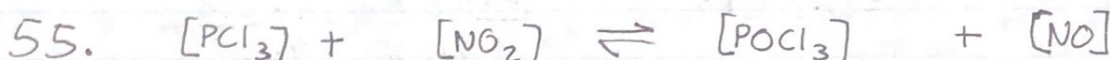
$$= 2.9 \times 10^{-6}$$

$$(6.4807 \times 10^{-5})(0.045-2x) = x$$

$$2.916 \times 10^{-6} - 5.832 \times 10^{-6}x = x$$

$$2.916 \times 10^{-6} = x + 5.832 \times 10^{-6}x$$

$$2.916 \times 10^{-6} = 1.00x$$



I	1.24	1.24	0	0
C	-x	-x	+x	+x
E	1.24-x	1.24-x	x	x

$$K_{eq} = \frac{[\text{POCl}_3][\text{NO}]}{[\text{PCl}_3][\text{NO}_2]} \quad ; \quad \sqrt{3.77} = \sqrt{\frac{x^2}{(1.24-x)^2}}$$

$$[\text{PCl}_3] = [\text{NO}_2]$$

$$= 1.24 - 0.8187$$

$$= 0.4219$$

$$= 0.4M$$

$$[\text{POCl}_3] = [\text{NO}]$$

$$= 0.8187$$

$$= 0.8M$$

$$1.94 = \frac{x^2}{1.24-x}$$

$$1.94(1.24-x) = x^2$$

$$2.407 - 1.94x = x^2$$

$$2.407 = x + 1.94x$$

$$\frac{2.407}{2.94} = \frac{2.94x}{2.94}$$

$$0.8187 = x$$



I	0.15	0.45	0
C	$-x$	$-x$	$+2x$
E	$0.15 - x$	$0.15 - x$	$2x$

$$K_{eq} = \frac{[NO]^2}{[N_2][O_2]} = \frac{(2x)^2}{(0.15-x)^2} = 52.1$$

$$[N_2] = [O_2] = \frac{2x}{0.15-x}$$

$$= 0.15 - 0.1174$$

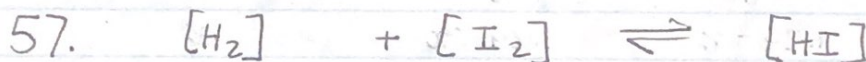
$$= 0.03254 \quad 7.218(0.15-x) = 2x$$

$$[NO] = 2(0.1174) \quad 1.0827 - 7.218x = 2x$$

$$= 0.2348 \quad 1.0827 = 2x + 7.218x$$

$$\frac{1.0827}{9.218x} = \frac{9.218x}{9.218x}$$

$$0.1174 = x$$



I	1.17	1.17	0
C	$-x$	$-x$	$+2x$
E	$1.17 - x$	$1.17 - x$	$2x$

$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]} = \frac{(2x)^2}{(1.17-x)^2} = 49.6$$

$$[H_2] = [I_2] = \frac{2x}{1.17-x}$$

$$= 1.17 - 0.9113$$

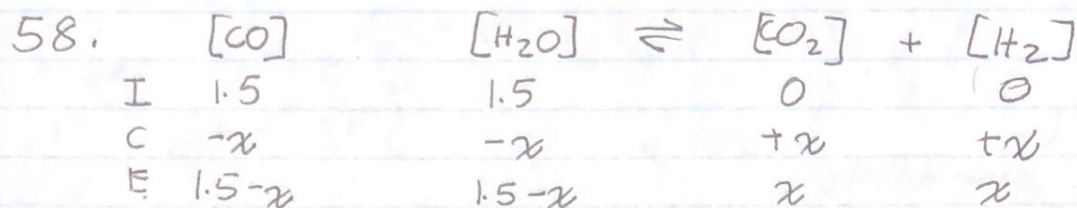
$$= 0.2586 \quad 7.042(1.17-x) = 2x$$

$$[HI] = 2(0.9113) \quad 8.2399 - 7.042x = 2x$$

$$= 1.8226 \quad 8.2399 = 2x + 7.042x$$

$$\frac{8.2399}{9.042} = \frac{9.042x}{9.042}$$

$$0.9113 = x$$



$$K_{eq} = \frac{[CO_2][H_2]}{[CO][H_2O]}$$

$$\sqrt{4.2} = \sqrt{\frac{x^2}{(1.5-x)^2}}$$

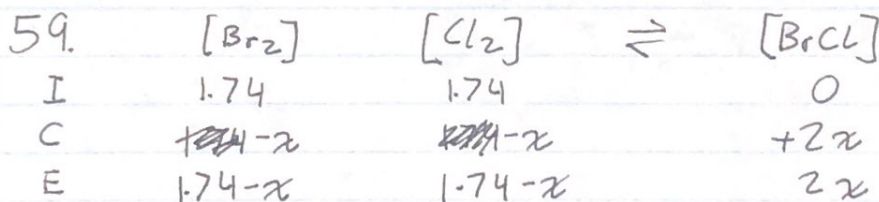
$$2.049 = \frac{x}{1.5-x}$$

$$\begin{aligned} [CO] &= [H_2O] \\ &= 1.5 - 1.008 \\ &= 0.49M \times 1.5 \\ &= 0.735M \end{aligned}$$

$$\begin{aligned} 2.049(1.5-x) &= x \\ 3.0740 - 2.049x &= x \\ 3.0740 &= x + 2.049x \\ 3.0740 &= \frac{3.049x}{3.049} \end{aligned}$$

$$\begin{aligned} [CO_2] &= [H_2] \\ &= 1.008 \times 1.5 \\ &= 1.512M \end{aligned}$$

$$1.008 = x$$



$$K_{eq} = \frac{[BrCl]^2}{[Br_2][Cl_2]}$$

$$\sqrt{28.8} = \sqrt{\frac{(2x)^2}{(1.74-x)^2}}$$

$$5.3665 = \frac{2x}{1.74-x}$$

$$\begin{aligned} [Br_2] &= [Cl_2] \\ &= 1.74 - 1.2626 \\ &= 0.4723 \times 5 \\ &= 2.3615 \text{ mol} \end{aligned}$$

$$\begin{aligned} 5.3665(1.74-x) &= 2x \\ 9.3378 - 5.3665x &= 2x \\ 9.3378 &= 5.3665 + 2x \end{aligned}$$

$$\begin{aligned} [BrCl] &= 2(1.2626) \\ &= 2.5252 \times 5 \\ &= 12.626 \text{ mol} \end{aligned}$$

$$\begin{aligned} 9.3378 &= \frac{7.3665x}{7.3665} \\ 1.2626 &= x \end{aligned}$$

Acid and Base HW

TB PG 496 #1-10

1. fluoride ion ; F^-

2. carbonate ; CO_3^{2-}

3. hydrogen sulfate ; HSO_4^-

4. ammonium ; NH_4^+

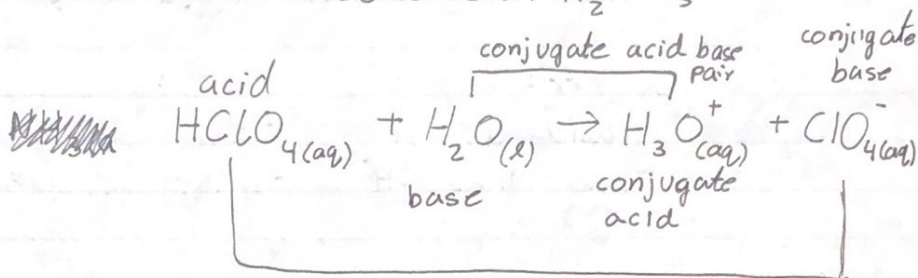
5. nitric acid ; HNO_3

6. water ; H_2O

7. hydronium ; H_3O^+

8. carbonic acid ; H_2CO_3

9. ~~H_2O~~
base



10. a) HS^-/H_2S ; H_2O/OH^-

b) H_2O/OH^- ; O^{2-}/OH^-

c) H_2S/HS^- ; NH_4^+/NH_3

d) H_2SO_4/HSO_4^- ; H_3O^+/H_2O

TB PG 497 # 1-6

1. Arrhenius Acid - substance that contains H in its formula, and it ionizes in water to form a hydronium ion

Arrhenius Base - substance that contains OH in its formula, and it ionizes in water to form the hydroxide ion

2. B-L Acid - any substance that donates a H^+ ion

B-L Base - any substance that accepts a H^+ ion

3. Two substances that are related by the gain or loss of a proton; the acid of an acid-base pair has one more proton than its conjugate base

4. A conjugate base is the particle produced when an acid donates a hydrogen to the base. A conjugate acid is the particle produced when a base accepts a hydrogen ion from an acid.

5. A H^+ ion is released from the acid. This ion is attracted to the surrounding water molecules. As a result, a hydronium ion is formed (H_3O^+).

6. Arr:

- acid have H

- base has OH^-

B-L:

- acid donate H^+

- base accepts H^+

TB PG 500 #11, 12, 17-20

$$11. K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.0 \times 10^{-14}$$

$$[\text{H}_3\text{O}^+] = \frac{K_w}{[\text{OH}^-]} = \frac{1.0 \times 10^{-14}}{0.150 \text{ M}} = 6.67 \times 10^{-14}$$

$$\begin{aligned} 12. [\text{LiOH}] &= [\text{OH}^-] & [\text{H}_3\text{O}^+] &= \frac{K_w}{[\text{OH}^-]} = \frac{1.0 \times 10^{-14}}{1.33 \text{ M}} \\ &= \frac{n}{V} & &= 7.52 \times 10^{-15} \text{ M} \\ &= \frac{2.00 \text{ mol}}{1.50 \text{ L}} \\ &= 1.33 \text{ M} \end{aligned}$$

$$\begin{aligned} 17. K_w &= [\text{OH}^-][\text{H}_3\text{O}^+] \\ &= (0.455 \text{ M})(2.20 \times 10^{-14} \text{ M}) \\ &= 1.00 \times 10^{-14} \end{aligned}$$

$$\begin{aligned} 18. [\text{OH}^-] &= \frac{K_w}{[\text{H}_3\text{O}^+]} = \frac{1.00 \times 10^{-14}}{0.152 \text{ M}} \\ &= 6.58 \times 10^{-14} \text{ M} \end{aligned}$$

$$\begin{aligned} 19. [\text{H}_3\text{O}^+] &= \frac{K_w}{[\text{OH}^-]} = \frac{1.00 \times 10^{-14}}{0.0025 \text{ M}} \\ &= 4 \times 10^{-12} \text{ M} \end{aligned}$$

$$\begin{aligned} 20. [\text{OH}^-] &= \frac{K_w}{[\text{H}_3\text{O}^+]} = \frac{1.00 \times 10^{-14}}{1.55 \text{ M}} \\ &= 6.45 \times 10^{-15} \end{aligned}$$

TB PG 502 21-30

$$\begin{aligned} 21. \text{pOH} &= 14 - \text{pH} \\ &= 14 - 5.84 \\ &= 8.16 \end{aligned}$$

$$\begin{aligned} 22. \text{pH} &= 14 - \text{pOH} \\ &= 14 - 2.77 \\ &= 11.23 \end{aligned}$$

$$\begin{aligned} 23. [\text{H}_3\text{O}^+] &= [\text{H}^+] ; \text{pH} = -\log(3.20 \times 10^{-10}) ; \text{pOH} = 14 - 9.49 \\ &= 9.49 &= 4.51 \end{aligned}$$

$$\begin{aligned} 24. [\text{NaOH}] &= 0.12 \text{ M} ; \text{pOH} = -\log(0.12) ; \text{pH} = 14 - 0.92 \\ [\text{NaOH}] &= [\text{OH}^-] &= 0.92 &= 13.08 \end{aligned}$$

$$\begin{aligned} 25. [\text{OH}^-] &= 0.21 \text{ M} ; \text{pOH} = -\log(0.21) ; \text{pH} = 14 - 0.68 \\ &= 0.68 &= 13.32 \end{aligned}$$

$$\begin{aligned} 26. \text{pOH} &= -\log(1.74 \times 10^{-9}) ; \text{pH} = 14 - 8.76 \\ &= 8.76 &= 5.24 \end{aligned}$$

$$\begin{aligned} 27. [\text{H}_3\text{O}^+] &= [\text{HNO}_3] ; \text{pH} = -\log(0.097) ; \text{pOH} = 14 - 1.01 \\ &= 1.01 &= 12.99 \end{aligned}$$

28.	$\text{Ca}(\text{OH})_2$	\rightarrow	Ca^{2+}	$+$	2OH^-	$\left \begin{array}{l} \text{pOH} = -\log(0.01792172) \\ = 1.74 \\ \text{pH} = 14 - 1.74 \\ = 12.25 \end{array} \right.$
I	0.00896 M		—		—	
C	$-x$		$+x$		$+2x$	
E	$0.00896 - x$		x		$2x$	

$$\begin{aligned} 29. \text{pH}_2\text{O} &= 14 - 7.95 & [\text{H}_3\text{O}^+] &= 10^{-6.05} \\ &= 6.05 & &= 8.91 \times 10^{-7} \end{aligned}$$

~~28.~~

Weak Acids H.W.

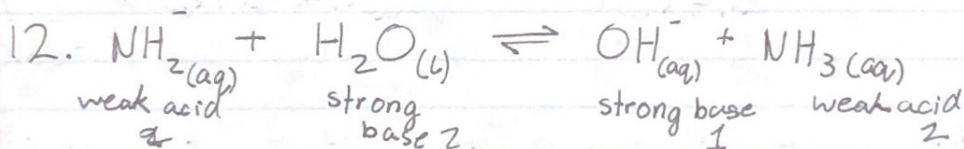
TB PG 509 # 7-10, 12

7. A strong acid is an acid that dissociates completely in water. Contrarily, a weak acid is an acid that doesn't dissociates completely in water.

8. A strong base is a base that ionizes completely in water. Contrarily, a weak base is a base that doesn't ionize completely in water.

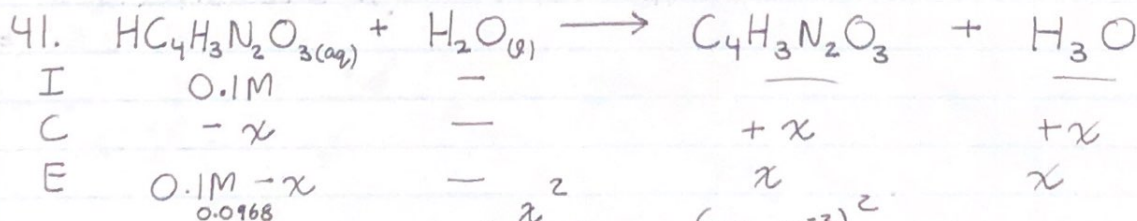
9. A strong acid is a proton donor, while a strong base is a proton acceptor.

10. Hydroiodic acid is a stronger acid than water.



Products are favored because NH_2^- is a stronger base than OH^- .

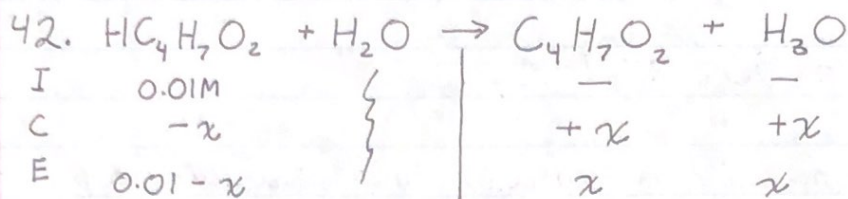
TB PG 512 # 41-44, 48-50



$$[\text{H}_3\text{O}^+] = 10^{-2.5}$$

$$x = 3.16 \times 10^{-3}$$

$$K_a = \frac{x^2}{0.1\text{M} - x} = \frac{(3.16 \times 10^{-3})^2}{0.0968} = 1.338 \times 10^{-4}$$

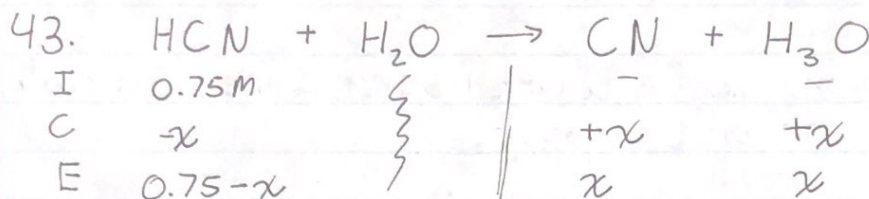


$$[\text{H}_3\text{O}^+] = 10^{-3.41}$$

$$x = 3.89 \times 10^{-4}$$

$$K_a = \frac{(3.89 \times 10^{-4})^2}{(0.01 - 3.89 \times 10^{-4})} = \frac{1.51 \times 10^{-7}}{9.61 \times 10^{-3}} = 1.57 \times 10^{-5}$$

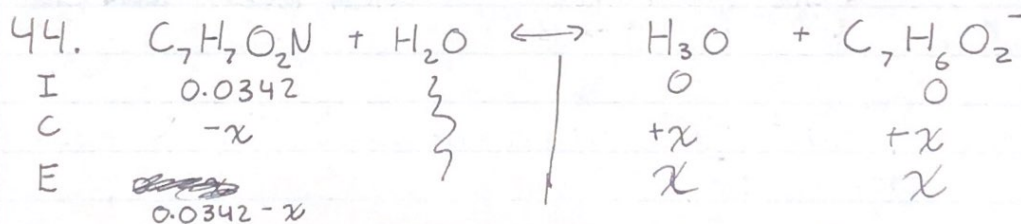
$$\text{P.D.} = \frac{3.89 \times 10^{-4}}{0.010} \times 100 = 3.9\%$$



$$x = [\text{H}_3\text{O}^+] = 10^{-4.67}$$

$$= 2.14 \times 10^{-5}$$

$$K_a = \frac{(2.14 \times 10^{-5})^2}{(0.75 - 2.14 \times 10^{-5})} = \frac{4.57 \times 10^{-10}}{0.74999} = 6.09 \times 10^{-10}$$



$$x = [\text{H}_3\text{O}^+] = 10^{-3.19}$$

$$= 6.46 \times 10^{-4}$$

$$K_a = \frac{(6.46 \times 10^{-4})^2}{(0.0342 - 6.46 \times 10^{-4})} = \frac{4.16 \times 10^{-7}}{0.033554} = 1.24 \times 10^{-5}$$

$$48. [\text{H}_3\text{O}^+] = 10^{-1.72} \\ = 0.019054$$

$$K_a = \frac{(0.019054)^2}{(0.52 - 0.019054)} = \frac{3.63 \times 10^{-4}}{0.500946} \\ = 7.25 \times 10^{-4}$$

$$\text{P.D.} = \frac{0.019054}{0.52} \times 100 = 3.66\%$$

$$49. M = \frac{2.62 \text{ g}}{131 \text{ g/mol}} \\ = 2.05 \times 10^{-2}$$

$$\text{P.D.} = \frac{5.89 \times 10^{-3}}{2.05 \times 10^{-2}} \times 100 \\ = 28.72\%$$

$$[\text{H}_3\text{O}^+] = 10^{-2.23} \\ = 5.89 \times 10^{-3}$$

$$50. [\text{C}_4\text{H}_4\text{N}_2\text{O}_2] = 1.11 \times 10^{-2} \text{ M}$$

$$\text{P.D.} = \frac{1.95 \times 10^{-3}}{1.11 \times 10^{-2}} \times 100$$

$$[\text{H}_3\text{O}^+] = 10^{-5.71} \\ = 1.95 \times 10^{-6}$$

$$K_a = \frac{(1.95 \times 10^{-6})^2}{(1.11 \times 10^{-2} - 1.95 \times 10^{-6})} = \frac{3.8025 \times 10^{-12}}{0.01109805} = 3.43 \times 10^{-10}$$

TB PG 514 #51-59

$$51. K_a = \frac{x^2}{0.075 - x}$$

$$0.0115 = \frac{x^2}{0.075 - x} \rightarrow 0.0115(0.075 - x) = x^2 \\ \rightarrow 8.625 \times 10^{-4} - 0.0115x = x^2$$

$$\therefore x^2 + 0.0115x - 8.625 \times 10^{-4} = 0$$

$$x = \frac{-(0.0115) \pm \sqrt{(0.0115)^2 - 4(1)(-8.625 \times 10^{-4})}}{2(1)}$$

$$x = \frac{-0.0115 \pm 0.05985}{2}$$

$$\text{pH} = -\log(0.024176) \\ = 1.62$$

$$x = 0.024176$$

$$52. 3.47 \times 10^{-4} = \frac{x^2}{0.015 - x}$$

$$3.47 \times 10^{-4} (0.015 - x) = x^2$$

$$5.205 \times 10^{-6} - 3.47 \times 10^{-4} x = x^2$$

$$x^2 + 3.47 \times 10^{-4} x - 5.205 \times 10^{-6} = 0$$

$$x = \frac{-(3.47 \times 10^{-4}) \pm \sqrt{(3.47 \times 10^{-4})^2 - 4(1)(-5.205 \times 10^{-6})}}{2}$$

$$x = \frac{-3.47 \times 10^{-4} \pm 4.58 \times 10^{-3}}{2}$$

$$x = 2.11 \times 10^{-3}$$

$$\text{pH} = -\log(2.11 \times 10^{-3})$$

$$= 2.67$$

$$53. x = \frac{-3.47 \times 10^{-4} \pm \sqrt{(3.47 \times 10^{-4})^2 - 4(1)(1.5615 \times 10^{-5})}}{2}$$

$$x = \frac{-3.47 \times 10^{-4} \pm 7.91 \times 10^{-3}}{2}$$

$$x = 3.78 \times 10^{-3}$$

$$\text{pH} = -\log(3.78 \times 10^{-3})$$

$$= 2.42 \quad \therefore 0.24$$

$$54. 2.29 \times 10^{-2} = \frac{x^2}{0.084 - x}$$

$$2.29 \times 10^{-2} (0.084 - x) = x^2$$

$$1.9236 \times 10^{-3} - 2.29 \times 10^{-2} x = x^2$$

$$x^2 + 2.29 \times 10^{-2} x - 1.9236 \times 10^{-3} = 0$$

$$x = \frac{-(2.29 \times 10^{-2}) \pm \sqrt{(2.29 \times 10^{-2})^2 - 4(1)(-1.9236 \times 10^{-3})}}{2}$$

$$= \frac{-2.29 \times 10^{-2} \pm 3.907 \times 10^{-2}}{2}$$

$$x = 3.39$$

$$\text{pH} = -\log(3.39)$$

$$= 1.47$$

$$55. 2.51 \times 10^{-11} = \frac{x^2}{0.064 - x}$$

$$2.51 \times 10^{-11} (0.064 - x) = x^2$$

$$1.6064 \times 10^{-12} - 2.51 \times 10^{-11} x = x^2$$

$$x^2 + 2.51 \times 10^{-11} x - 1.6064 \times 10^{-12} = 0$$

$$x = \frac{-(2.51 \times 10^{-11}) \pm \sqrt{(2.51 \times 10^{-11})^2 - 4(1)(-1.6064 \times 10^{-12})}}{2}$$

$$x = \frac{-2.51 \times 10^{-11} \pm 2.53 \times 10^{-6}}{2}$$

$$x = 1.28 \times 10^{-6}$$

$$\text{pH} = -\log(1.28 \times 10^{-6})$$

$$= 5.90$$