

1. What is the pH of a solution whose:

a. $[H^+] = 2.1 \times 10^{-3} M$

2.7

$$pH = -\log [H^+]$$

b. $[OH^-] = 3.8 \times 10^{-5} M$

9.6

$$pOH = -\log [OH^-]$$

c. pOH is 6.8

7.2

$$pH + pOH = 14$$

Show work

2. Determine the pH of a solution made by mixing 0.25 g of NaOH in 500 mL of water? (4)

NaOH is a very strong base that dissociates at nearly 100%

$$\frac{1 \text{ mol NaOH}}{x} = \frac{40.00 \text{ g}}{0.25 \text{ g}}$$

$$\frac{6.25 \times 10^{-3} \text{ mol}}{0.500 \text{ L}} = 0.0125 M$$

$$x = 6.25 \times 10^{-3} \text{ mol}$$

$$pOH = -\log [OH^-] \\ = -\log [0.0125]$$

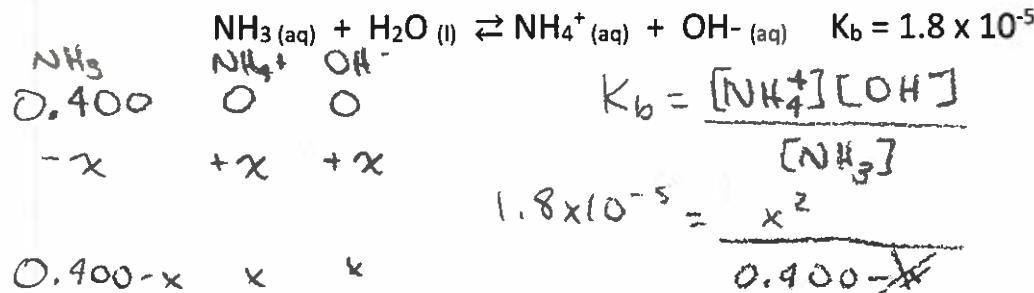
$$pH + pOH = 14$$

$$14 - pOH = pH$$

$$14 - 1.90 = pH$$

$$12.1 = pH$$

3. What is the pH of a 0.400 M ammonia solution? (4)



$$7.2 \times 10^{-6} = x^2$$

$$2.68 \times 10^{-3} = x = [OH^-]$$

$$pH = -\log [H^+]$$

$$= -\log 3.73 \times 10^{-12}$$

$$= 11.4$$

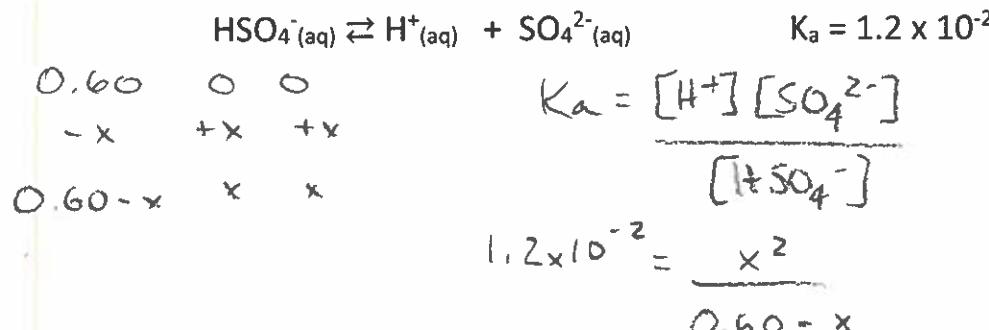
$$K_w = [H^+][OH^-]$$

$$10^{-14} = [H^+](2.68 \times 10^{-3})$$

$$[H^+] = 3.73 \times 10^{-12}$$

$$pH = 11$$

4. Calculate the % ionization of a 0.60 M solution of HSO_4^- . (4)



$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-0.012 \pm \sqrt{0.012^2 - 4(1)(-0.007)}}{2(1)}$$

$$= \frac{-0.012 \pm \sqrt{0.028944}}{2}$$

$$x = 0.0791$$

$$x = -0.0911$$

$$\% = \frac{[H^+]}{[HSO_4^-]} \times 100$$

$$= \frac{0.0791}{0.60} \times 100$$

$$= 13\%$$

Show all your work for questions 2, 3 and 4.

1. What is the pH of a solution whose:

a. $[H^+] = 2.7 \times 10^{-3} M$ 2.6

b. $[OH^-] = 8.8 \times 10^{-5} M$ 9.9 $pOH = 4.06$

c. pOH is 3.8 10.

2. Determine the pH of a solution made by mixing 0.25 g of NaOH in 750 mL of water? (4)
NaOH is a very strong base that dissociates at nearly 100%

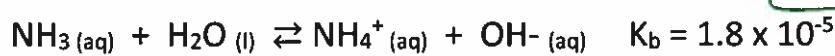
$$\frac{1 \text{ mol NaOH}}{x} = \frac{40.00 \text{ g}}{0.25 \text{ g}} \quad \frac{6.25 \times 10^{-3} \text{ mol}}{0.750 \text{ L}} = 8.3 \times 10^{-3} M = [OH^-]$$

$$x = 6.25 \times 10^{-3} \text{ mol} \quad pOH = -\log [OH^-] \quad pH + pOH = 14$$

$$= -\log (8.3 \times 10^{-3}) \quad pH = 14 - pOH$$

$$pOH = 2.08 \quad = 14 - 2.08$$

3. What is the pH of a 0.450 M ammonia solution? (4)



NH_3	NH_4^+	OH^-	$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$
0.450	0	0	
$-x$	$+x$	$+x$	
0.450	x	x	$1.8 \times 10^{-5} = \frac{x^2}{0.450 - x}$

$$\sqrt{8.1 \times 10^{-6}} = \sqrt{x^2}$$

$$2.845 \times 10^{-3} = x = [OH^-]$$

$$pH = 14 - pOH$$

$$= 14 - 2.5458$$

$$= 11.454$$

$$pH = 11$$

$$pOH = -\log (2.845 \times 10^{-3}) = 2.5458$$

4. Calculate the % ionization of a 0.50 M solution of HSO_4^- . (4)

$$HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$$

$$K_a = \frac{[H^+][SO_4^{2-}]}{[HSO_4^-]}$$

$$0.50 \quad 0 \quad 0$$

$$-x \quad +x \quad +x$$

$$0.50 - x \quad x \quad x$$

$$1.2 \times 10^{-2} = \frac{x^2}{0.50 - x}$$

$$6 \times 10^{-3} - 0.012x = x^2$$

$$0 = x^2 + 0.012x - 0.006$$

$$K_a = 1.2 \times 10^{-2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-0.012 \pm \sqrt{(0.012)^2 - 4(1)(-0.006)}}{2(1)}$$

$$= \frac{-0.012 \pm \sqrt{0.024144}}{2}$$

$$\% \text{ ionization} = \frac{[H^+]}{[HSO_4^-]} \times 100 \quad x = 0.0717 \quad \text{or} \quad x = -0.0837$$

$$= \frac{0.0717}{0.50} \times 100$$

$$= 14\%$$

Show all your work for questions 2, 3 and 4.

1. What is the pH of a solution whose:

a. $[H^+] = 7.2 \times 10^{-3} M$ 2.1

b. $[OH^-] = 1.8 \times 10^{-5} M$ 9.3

c. pOH is 13.8 0.2

2. Determine the pH of a solution made by mixing 0.25 g of NaOH in 900 mL of water? (4)
NaOH is a very strong base that dissociates at nearly 100%

$$\frac{1 \text{ mol NaOH}}{x} = \frac{40.00 \text{ g}}{0.25 \text{ g}}$$

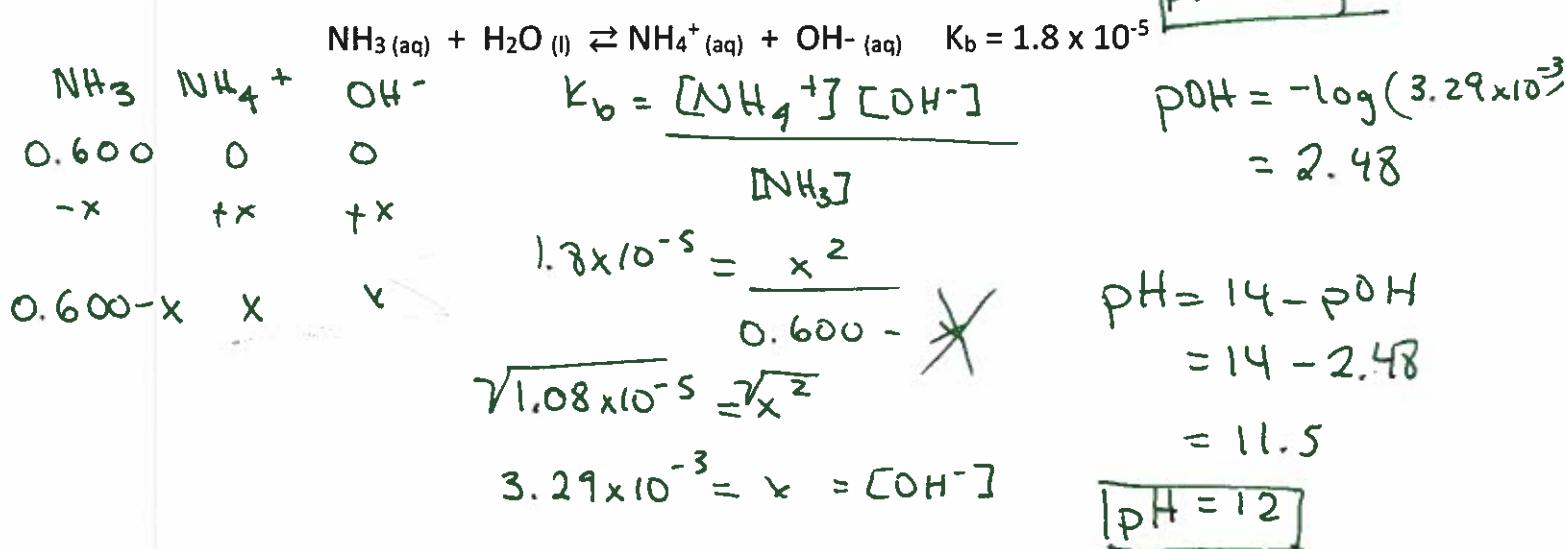
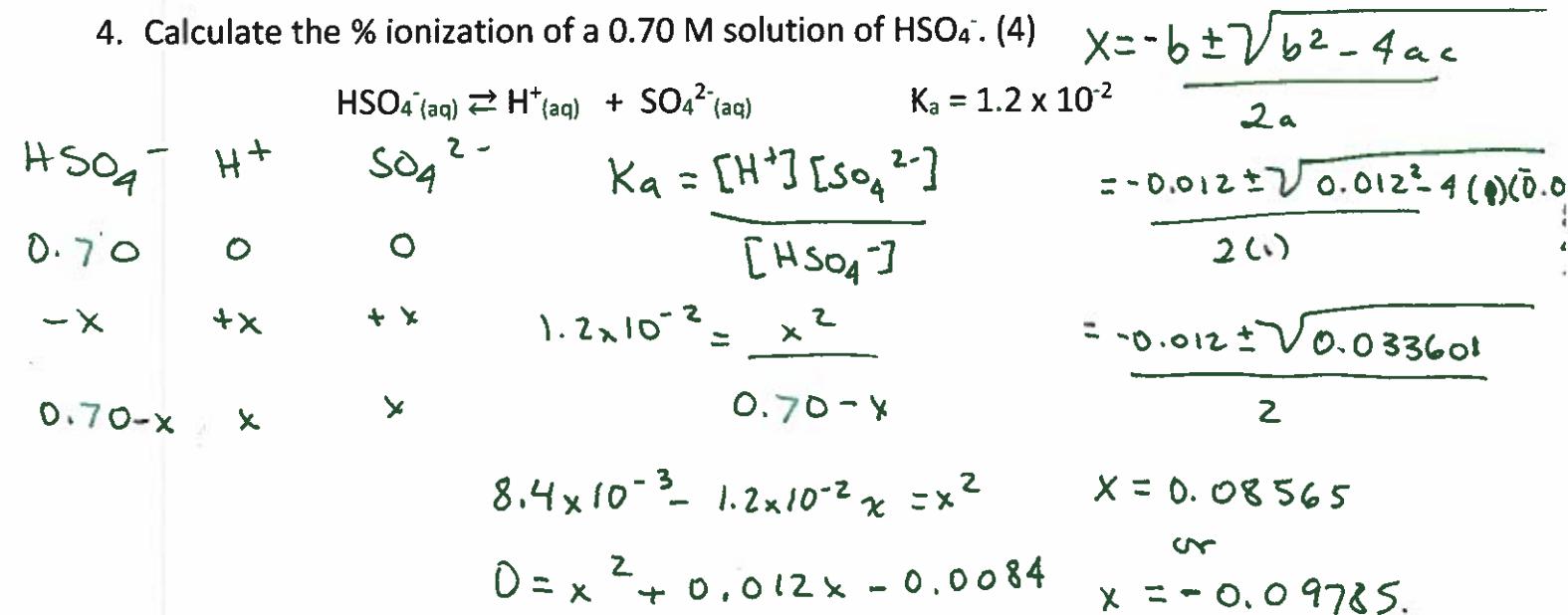
$$\frac{6.25 \times 10^{-3} \text{ mol}}{0.900 \text{ L}} = 6.94 \times 10^{-3} M = [OH^-]$$

$$x = 6.25 \times 10^{-3} \text{ mol}$$

$$pOH = -\log(6.94 \times 10^{-3}) = 2.16$$

$$pH = 14 - pOH = 14 - 2.16 = 11.8$$

3. What is the pH of a 0.600 M ammonia solution? (4)

4. Calculate the % ionization of a 0.70 M solution of HSO_4^- . (4)

$$\% \text{ ionization} = \frac{[H^+]}{[HSO_4^-]} \times 100$$

$$= \frac{0.08565}{0.7} \times 100 = 12\%$$