

1. What is the pH of a solution whose: (5)

- a) $[H^+] = 1 \times 10^{-3}$? $\frac{3}{2.5}$
 b) $[H^+] = 2.93 \times 10^{-3}$? $\frac{2.93}{2.5}$
 c) pOH is 8? $\frac{14-8}{14} = \frac{6}{14}$
 d) pOH is 10.2? $\frac{14-10.2}{14} = \frac{3.8}{14}$
 e) $[OH^-] = 2.1 \times 10^{-5}$? $\frac{2.1}{9.3}$

$$pOH = 4.7 \quad \frac{14-10.2}{14}$$

2. LiOH is a strong base. This means that it dissociates completely in water according to the reaction below.



What is the pH of a solution made by dissolving 20.0 g of LiOH in 750 ml of water? (4)

$$\text{molar mass} = 23.95 \quad [OH^-] = \frac{0.835 \text{ mol } OH^-}{0.750 \text{ L}} = 1.11 \text{ M} \quad pH + pOH = 14$$

$$\frac{1 \text{ mol}}{x} = \frac{23.95}{20 \text{ g}} \quad pH = 14 - pOH$$

$$x = 0.835 \text{ mol LiOH} \quad pOH = -\log 1.11 \\ = -0.0467$$

$$= 14 - (-0.0467) \\ pH = 14.0$$

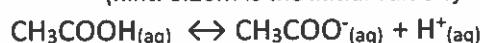
3. Baking soda has a pH of 9. Water has a pH of 7. In terms of the acidity, how much stronger is the juice?

$$pH$$

$$x \quad 100 \quad (2)$$

4. Find the $[OH^-]$, the $[H^+]$ and the pH of a 0.20M solution of acetic acid. $K_a = 1.8 \times 10^{-5}$. (4)

(hint: 0.20M is the initial value of the acid, I.C.E. table needed)



I	0.20	0	0
C	-x	+x	+x
E	0.20-x	x	x

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$\text{check: } \frac{x}{0.20} \leq 5\%$$

$$pH = -\log [H^+] \\ = -\log (1.9 \times 10^{-3}) \\ = 2.7$$

$$K_w = [H^+][OH^-] \\ 1 \times 10^{-14} = (1.9 \times 10^{-3})[OH^-] \\ [OH^-] = 5.3 \times 10^{-12} \text{ M}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.20-x}$$

$$\frac{1.9 \times 10^{-3}}{0.20} \leq 5\%$$

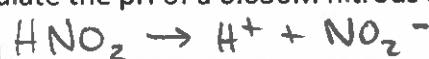
$$0.9\% \leq 5\%$$

$$1.9 \times 10^{-3} = x$$

justified.

$$[OH^-] = 5.3 \times 10^{-12} \text{ M} \\ [H^+] = 1.9 \times 10^{-3} \text{ M} \\ pH = 2.7$$

5. Calculate the pH of a 0.030M nitrous acid (HNO_2) solution. The K_a of HNO_2 is 4.0×10^{-4} . (4)



I	0.030	x	x
C	-x	x	x
E	0.030-x	x	x

$$K_a = \frac{[H^+][NO_2^-]}{[HNO_2]}$$

$$4.0 \times 10^{-4} = \frac{x^2}{0.030-x}$$

$$\rightarrow 1.2 \times 10^{-5} - 4.0 \times 10^{-4}x = x^2$$

$$0 = x^2 + 4.0 \times 10^{-4}x - 1.2 \times 10^{-5}$$

$$\sqrt{1.2 \times 10^{-5}} = x$$

$$3.5 \times 10^{-3} = x$$

$$\frac{x}{0.030} = 11.5\% \text{ No shortcut!}$$

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

$$x = \frac{-4 \times 10^{-4} \pm \sqrt{(4 \times 10^{-4})^2 - 4(-1.2 \times 10^{-5})}}{2}$$

$$= \frac{-4 \times 10^{-4} \pm \sqrt{1.6 \times 10^{-7} + 4.8 \times 10^{-5}}}{2}$$

$$= \frac{-4 \times 10^{-4} \pm \sqrt{4.816 \times 10^{-5}}}{2}$$

$$= \frac{-4 \times 10^{-4} \pm 6.94 \times 10^{-3}}{2}$$

$$x = 3.27 \times 10^{-3}$$

$$x = 3.67 \times 10^{-3}$$

$$[H^+] = 3.3 \times 10^{-3} \text{ M}$$

$$pH = -\log [H^+] = -\log(3.27 \times 10^{-3}) = 2.5$$

$$\boxed{pH = 2.5}$$