

## CELL PHYSIOLOGY Special Lecture - Calculations for pH (Part II)

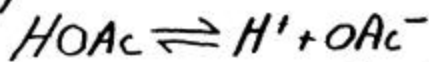
## I. More pH problems:

What is the pH of each of the following solutions?

a)  $10^{-3}$  HCl  $[H^+] = 1 \times 10^{-3}$ ;  $pH = -\log[10^{-3}]$   
 $pH = \underline{\underline{3.00}}$

b)  $10^{-2}$  NaOH  $[OH^-] = 1 \times 10^{-2}$ ;  $pOH = -\log[10^{-2}]$   
 $pOH = 2.00$ ;  $pH + pOH = 14.0$ ;  $pH = 14.0 - 2.00 = \underline{\underline{12.0}}$

c) A mixture of equal volumes of 0.10 M acetic acid and 0.03 M sodium acetate

 $pK_a$  from book/table = 4.8

$$pH = pK_a + \log \frac{[OAc^-]}{[HOAc]}$$

$$pH = 4.8 + \log \frac{0.03}{0.10}$$

$$pH = 4.8 + \log(0.30)$$

$$pH = 4.8 - 0.523$$

$$pH = \underline{\underline{4.28}}$$

The following chemicals are combined and diluted to a final volume of 1.75 L: 25 mL of 85% phosphoric acid (density = 1.65 g/mL), 85 g of  $NaH_2PO_4$ , and 5.0 mL of 6.0 N HCl. What is the pH of the resulting solution?

SOLUTION NOTES THAT  $H_3PO_4 \rightleftharpoons H^+ + H_2PO_4^-$   $pK_a = 2.14$ 

MW  $H_3PO_4 = 98$  g/mol

MW  $NaH_2PO_4 = 120$  g/mol



$$pH = pK_a + \log \frac{[NaH_2PO_4]}{[H_3PO_4]}$$
 "HA"

①  $(25 \text{ mL } H_3PO_4)(0.85)(1.65 \text{ g/mL}) = 35.06 \text{ g } H_3PO_4$

②  $(35.06 \text{ g } H_3PO_4) \left( \frac{1 \text{ mol}}{98 \text{ g}} \right) = 0.358 \text{ mol } H_3PO_4$

$(85 \text{ g } NaH_2PO_4) \left( \frac{1 \text{ mol}}{120 \text{ g}} \right) = 0.708 \text{ mol } NaH_2PO_4$

③  $(5 \text{ mL HCl}) \left( \frac{6 \text{ mol}}{L} \right) \left( \frac{1 \text{ L}}{1000 \text{ mL}} \right) = 0.030 \text{ mol HCl}$

④  $0.358 \text{ mol } H_3PO_4 + 0.030 \text{ mol } H^+ = 0.388 \text{ mol [HA]} / 1.75 \text{ L} = 0.222 \text{ M}$   
 $0.708 \text{ mol } NaH_2PO_4 - 0.030 \text{ mol } H^+ = 0.678 \text{ mol [A}^-] / 1.75 \text{ L} = 0.387 \text{ M}$

⑤  $pH = 2.14 + \log \frac{0.387}{0.222} = \underline{\underline{2.38}}$