

Biochemistry: Acids and bases  
Homework for video (4)  
Answers in video (5)

Be sure to carefully review your video notes before attempting these problems.

1. Find the following without using a calculator:

- (a)  $\log 100$
- (b)  $\log 10$
- (c)  $\log 1$
- (d)  $\log 0$
- (e)  $\log -4$

For the remaining questions you can use a calculator.

2. Solve for  $y$ :  $\log (4.3 \times 10^{-2}) = y$

3. (a) Write the **chemical** equation for water autoionization.

(b) Write the **mathematical** equation for water autoionization.

4. (a) Write the general **chemical** equation for acid ionization.

(b) Write the general **mathematical** equation for acid ionization (for weak acids).

5. (a) Solution A has  $[H^+] = 10^{-3}$  M. Solution B has  $[H^+] = 10^{-7}$  M. How many times more acidic is solution A than solution B? (b) Solution C has  $pH=3$ . Solution D has  $pH=7$ . How many times more acidic is solution C than solution D (i.e., how many times bigger is  $[H^+]$  for solution C than for solution D)? (c) Solution E has  $[H^+]=4.2 \times 10^{-10}$  M. Solution F has  $[H^+]=3.1 \times 10^{-8}$  M. *Approximately* how many times more acidic is solution F than solution E?

6. The  $K_a$  of hydrazoic acid is  $1.9 \times 10^{-5}$ . What is the  $pK_a$  of hydrazoic acid?

7. The  $K_a$  of formic acid is  $1.77 \times 10^{-4}$ . The  $K_a$  of acetic acid is  $1.76 \times 10^{-5}$ . Which acid is stronger?

8. The  $pK_a$  of benzoic acid is 4.19. The  $pK_a$  of propionic acid is 4.87. Which acid is stronger?

9. Is  $pK_a$  the same as  $pH$ ? If not, what's the difference?

10. Write down the Henderson-Hasselbach equation. When does this equation apply?

11. What is a buffer solution?

12. What is the  $pH$  of pure water?

13. A solution is  $4.6 \times 10^{-4}$  M HBr. What is the  $pH$ ?

14. A solution is  $6.4 \times 10^{-5}$  M NaOH. What is the pH?

15. A solution is  $3.8 \times 10^{-3}$  M HBrO. The  $K_a$  of HBrO is  $2 \times 10^{-9}$ . What is the pH of the solution?

1. A solution is  $5 \times 10^{-4}$  M HCN and  $3.7 \times 10^{-3}$  M  $\text{CN}^-$ . The  $\text{p}K_a$  of HCN is 9.2. What is the pH of the solution?

2. A solution is  $4.2 \times 10^{-5}$  HF and  $2.4 \times 10^{-6}$  M  $\text{F}^-$ . The  $K_a$  of HF is  $7.2 \times 10^{-4}$ . What is the pH of the solution?

3. The  $\text{p}K_a$  of  $\text{HNO}_2$  is 3.4. In a solution with  $\text{pH}=3.4$ , what is the ratio of the protonated to the deprotonated forms of  $\text{HNO}_2$ ?

1. What is the  $\text{A}^-/\text{HA}$  ratio when the weak acid is in a solution one pH unit above its  $\text{p}K_a$ ?

- (a) 1:1
- (b) 1:10
- (c) 10:1
- (d) 2:1

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