

### Exam Wednesday Night

#### Place

UTC 2.102A Last name A-K  
UTC 2.112A Last name L-Z

#### Time

7:30-9:00

We will start right at 7:30  
We will end right at 9:00  
get there early

### Makeup Exam Sunday night

#### Place

TBD

#### Time

6:30-8:00

Anyone who would  
like to can take the  
makeup exam

You cannot take  
both

When are you planning to take the exam

- A. Wednesday night
- B. Sunday night

### Converting pH and pOH

$$K_w = [\text{H}^+][\text{OH}^-]$$

$$\log(K_w) = \log([\text{H}^+][\text{OH}^-])$$

$$\log(K_w) = \log[\text{H}^+] + \log[\text{OH}^-]$$

$$\log(10^{-14}) = \log[\text{H}^+] + \log[\text{OH}^-]$$

$$-14 = -\text{pH} - \text{pOH}$$

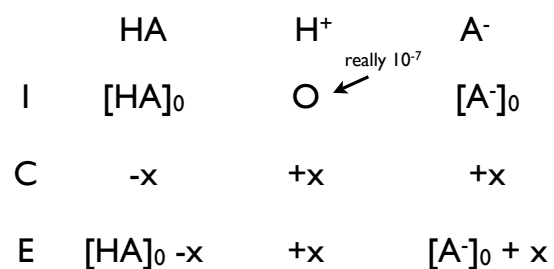
$$14 = \text{pH} + \text{pOH}$$

For the next exam

Which of the following would be more helpful

- A. More worksheets
- B. Suggested back of the book problems
- C. Suggested problems on eduspace
- D. other

Buffer Both HA and A-



$$K_a = \frac{[\text{H}^+][\text{A}^-]}{[\text{HA}]} = \frac{(x)([\text{A}^-]_0 + x)}{[\text{HA}]_0 - x} = \frac{(x)([\text{A}^-]_0)}{[\text{HA}]_0} \quad \text{assuming } x \ll C$$

pH in a buffer solution

$$K_a \approx \frac{[\text{H}^+][\text{A}^-]_0}{[\text{HA}]_0}$$

we have approximated a small change

$$\log(K_a) \approx \log \frac{[\text{H}^+][\text{A}^-]_0}{[\text{HA}]_0} = \log[\text{H}^+] + \log \frac{[\text{A}^-]_0}{[\text{HA}]_0}$$

$$\text{pKa} = \text{pH} - \log \frac{[\text{A}^-]_0}{[\text{HA}]_0}$$

$$\text{pKa} = \text{pH} - \log \frac{[\text{A}^-]_0}{[\text{HA}]_0}$$

initial conjugate base

initial weak acid

|  |  |  |
|--|--|--|
| $[\text{A}^-]_0 = [\text{HA}]_0$                 | $[\text{A}^-]_0 < [\text{HA}]_0$                 | $[\text{A}^-]_0 > [\text{HA}]_0$                 |
| equal acid/base                                  | more acid  | more base  |
| $-\log \frac{[\text{A}^-]_0}{[\text{HA}]_0} = 0$ | $-\log \frac{[\text{A}^-]_0}{[\text{HA}]_0} > 0$ | $-\log \frac{[\text{A}^-]_0}{[\text{HA}]_0} < 0$ |
| pH = pKa   | pH < pKa   | pH > pKa   |

What is the pOH of a 0.01M solution of HClO<sub>4</sub>?

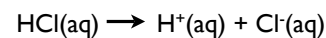
- A. 1
- B. 2
- C. 7
- D. 10
- E. 12 ←  $[H^+] = 10^{-2}$  pH = 2 pOH = 12

## Strong Acids and Bases

"Strong" means one thing

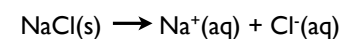
The substance dissociates 100% in water

Strong Acid



$$K_a = \frac{[\text{H}^+][\text{Cl}^-]}{[\text{HCl}]} \approx \infty$$

Strong Electrolyte



$$K_{sp} = [\text{Na}^+][\text{Cl}^-] \approx \infty$$

What is the pH of a 10<sup>-10</sup>M solution of HCl?

- A. 2
- B. 4
- C. 7
- D. 10
- E. very slightly less than 7

When do we get into problems with approximations

What approximations are we making

Typically that  $[H^+]_0 = 0$   
no H<sup>+</sup> at the start

not a problem along as the concentration of acid or base is large enough

what is large enough big compared to 10<sup>-7</sup>

When do we get into problems with approximations

What approximations are we making

That the change is small  
what is required for this

K should be small (weak acid, weak base)  
The initial concentration should be large

$C-x$  is approximately  $C$   
this is a comparison between  $C$  and  $x$

For which of this will our approximations fail?

- A. 0.1 M solution of sodium acetate
- B. 1 M solution of HF
- C.  $10^{-6}$  M solution of benzoic acid
- D. 0.5 M solution of HCl
- E. 0.2 M solution of NaOH

The  $pK_a$  of HF is 3.18. What is the pH of solution of 100 mL of 0.1 M HF and 100 mL of a 0.2 M NaF?

- A. slightly less than 3.18
- B. 3.18
- C. slightly more than 3.18

$$pK_a = pH - \log \frac{[A^-]_0}{[HA]_0}$$

initial conjugate base

initial weak acid

if the initial acid and base are similar in concentration than the pH is close to the  $pK_a$

For the pH to be 1 unit different than the  $pK_a$   
the difference in concentrations  
must be at least 10 X!