Unit 12 Review - Acids/Bases

$$[H_3O^+][OH^-] = 1x10^{-14}$$

$$pH = -\log[H_3O^+] \qquad pOH = -\log[OH^-]$$
$$[H_3O^+] = 10^{-pH} \qquad [OH^-] = 10^{-pOH}$$

$$pH + pOH = 14$$

LT1: I can differentiate between the Arrhenius and Brønsted-Lowry definition of acids and bases

1. Complete the following table with the definitions of acid and base

	Acid	Base
Arrhenius Definition	produce H^+ in an aqueous solution (H is in the formula)	produce OH^- in an aqueous solution (OH^- is in the formula)
Brønsted-Lowry Definition	proton (H^+) donor	proton (H^+) acceptor

2. What limitations are there with the Arrhenius definition?
   It doesn't include many bases.
3. How did the Brønsted-Lowry definition improve upon the Arrhenius definition?
   It included more bases, accounted for amphoteric substances.
4. Classify the following as Brønsted acids, bases or both.
   a. H_2O both
   b. OH^- base
   c. NH_3 both
   d. NH_4^+ acid
   e. NH_2^- base
   f. CO_3^{-2} base
5. What does it mean when we call a particular chemical amphoteric? Give an example.
   It can behave like an acid or a base. water is the most common.

$$H_2O + HCl \leftrightarrow H_3O^+ + Cl^-$$

$$H_2O + NH_3 \leftrightarrow NH_4^+ + OH^-$$

LT2: I can identify the common physical and chemical properties of acids and bases

6. Complete the table with the properties of acids and bases

	Acid	Base
pH values	$0<7$	>7
how do $[H_3O^+]$ and $[OH^-]$ compare?	more $[H_3O^+]$ than $[OH^-]$	more $[OH^-]$ than $[H_3O^+]$
taste	Sour	bitter
feel	—	Slippery
Color it changes litmus paper	blue → red	red → blue
conducts electricity?	yes	yes

7. Soluble ionic salts and strong acids and bases are good conductors or electrolytes. What do these have in common and why do they conduct electricity? Explain.

They produce ions when placed in water. When ions are free to move they conduct electricity

LT3: I can identify Acid/Base conjugate pairs

8. What is a conjugate acid or conjugate base? How is it related to an acid or base?

Conjugate acid is what is formed when a base gains a proton

9. What are the conjugate bases of the following acids?
   a. $HClO_4$ ClO_4^-
   b. NH_4^+ NH_3
   c. H_2O OH^-
   d. HCO_3^- CO_3^{-2}

10. What are the conjugate acids of the following bases?
   a. CN^- HCN
   b. SO_4^{-2} HSO_4^-
   c. H_2O H_3O^+
   d. HCO_3^- H_2CO_3

11. Identify the acid-conjugate base pair and the base-conjugate acid pair. Label A-acid, CB-conjugate base, B-base, CA-conjugate acid.

a. $CH_3COOH + H_2O \leftrightarrow H_3O^+ + CH_3COO^-$

A B CA CB

b. $NH_4^+ + H_2O \leftrightarrow NH_3 + H_3O^+$

A B CB CA

c. $H_2PO_4^- + OH^- \leftrightarrow HPO_4^{-2} + H_2O$

A B CB CA

LT4: I can explain what Ka and Kb constants indicate about an acid or base

12. What does the size of the Ka tell us about the strength of an acid?

Ka tells us how much an acid dissociates, or how strong it is. The stronger the acid, the larger the Ka

13. The Ka of a weak acid is greater than, less than or equal to 1 — less than 1

14. The Ka of a strong acid is greater than, less than or equal to 1 — greater than 1

15. Rank these acids in order from strongest to weakest based on their Ka values.

Acid	K_a
A	7.0×10^{-12}
B	1.7×10^{-8}
C	1.8×10^{-2}
D	3.2×10^{-10}
E	7.5×10^{-4}

C, E, B, D, A

16. Write the Ka expression for the following equation:

$$CH_3COOH_{(aq)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$$

$$K_a = \frac{[H_3O^+][CH_3COO^-]}{[CH_3COOH]}$$

LT5: I can calculate the concentration of the H^+ and OH^- using the Kw

LT6: I can describe the pH scale and calculate the pH of an acid or base solution

17. For every change in pH of 1, how much does the $[H_3O^+]$ change?

$[H_3O^+]$ changes 10x for each pH change of 1

18. Complete the following table

	$[H_3O^+]$	$[OH^-]$	pH	pOH	Acid, Base or Neutral
0.025 M HNO_3	.025	4.0×10^{-13}	1.60	12.40	acid
0.00150 M NaOH	6.67×10^{-12}	.00150	11.176	2.824	base
	6×10^{-12}	2×10^{-3}	11.2	2.8	base
	5.46×10^{-3}	1.83×10^{-12}	2.263	11.737	acid
	3×10^{-4}	4×10^{-11}	3.6	10.4	acid

LT7: I can recognize a neutralization reaction

19. Complete and balance the following equations representing neutralization reactions:

a. 2 CsOH + ___ H_2CO_3 → $2H_2O + Cs_2CO_3$

b. 2 HF + ___ $Mg(OH)_2$ → $2H_2O + MgF_2$

c. 3 HNO_3 + ___ $Al(OH)_3$ → $3H_2O + Al(NO_3)_3$

LT8:I can calculate the concentration of an unknown sample using titration data

20. What is an indicator and what is it used for?

An indicator is a substance that changes color. The color can indicate acid/base or specific pH values.

21. What is a titration? What is the underlying assumption about titrations and neutralization reactions?

Titration - technique for determining the concentration of an unknown by using a standard (known) titrant uses a neutralization reaction.

At equivalence point $[H_3O^+] = [OH^-]$

22. What is the molarity of an HCl acid solution, 30.0 mL of which is neutralized by 48.0 mL of 0.100 M NaOH?

mol base = .100M x .048L
= .0048mol

mol acid = .0048mol

$M = \frac{mol}{L} = \frac{.0048mol}{.030L}$

= .16M

23. Exactly 50.0 mL of HOCl solution of unknown concentration was titrated with 0.100 molar NaOH. An end point was reached when 38.5 mL of the base was added. Calculate the molar concentration of the HOCl solution.

mol base = .100 M x .0385 L
= .00385 mol

mol acid = .00385 mol

$M = \frac{mol}{L} = \frac{.00385\ mol}{.050L}$

= .077M