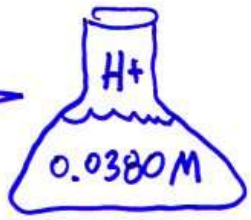
Friday: SHORT PERIOD. Test. BRATS $2.

PURPOSE HOW DO WE FIND CONJUGATES?

WARMUP

Find the pH

Find the $[OH^-]$



answers: 1.42 pH

2.63×10^{-13}

#1 SOME ACID REACTIONS RUN BACKWARDS AND FORWARD

$$HCl + NH_3 \rightleftharpoons NH_4^+ + Cl^-$$

ACID BASE ACID BASE

#2 SHOW HNO_3 IN WATER.

HNO_3 IS AN ACID.

SHOW HNO_3 GIVING AN H^+

$$HNO_3 \longrightarrow H^+_{(aq)} + NO_3^-{}_{(aq)}$$

$$HNO_3 + H_2O \longrightarrow NO_3^- + H_3O^+$$

H_3O^+ is called HYDRONIUM

#3 FILL IN THE MISSING CONJUGATE OF EACH PAIR

ACID	BASE
HBr	
	NO_3^-
	H_2O
	HSO_4^-
HSO_4^-	

TECHNIQUE The conjugate base is missing an H^+.

TECHNIQUE The conjugate acid has an extra H^+.

Conjugate Acids and Bases

CλeMis+ry: http://genest.weebly.com

Stop in for help every day at lunch and Tues,&Thurs after school!

Name HINTS

Period_____

1. Give the formula of the conjugate acid of each: NO_3^-, H_2O, HSO_4^- ANSWER HNO_3, H_3O^+, H_2SO_4

Identify the acid, base, conjugate acid and conjugate base for each of the following.

2. $HClO_4(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + ClO_4^-(aq)$ (BASE, ACID; ACID, BASE)

3. $H_2SO_3(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HSO_3^-(aq)$

4. $HC_2H_3O_2(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + C_2H_3O_2^-(aq)$

5. $H_2S(g) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HS^-(aq)$

6. These are all either acids or bases. **Draw a slash** through the molecule to show the half that would fall off. How many pieces will this fall apart into if made into an aqueous solution? (circle your choice)

$NaOH_{(aq)}$	1? 2? 3? 4? 5?	HBr	1? 2? 3? 4? 5?
$HNO_{3(aq)}$	1? 2? 3? 4? 5?	KOH	1? 2? 3? 4? 5?
H_2CO_3	1? 2? 3? 4? 5?	$HCH_3COO)_2$	1? 2? 3? 4? 5?

7. Circle the CATION element in each.

Circle any element that is a metal	This substance is...	When one of these dissolves, how many aqueous ions form?
$H_2SO_{4(aq)}$	acid / base / neither	
$Mg(OH)_{2(aq)}$	acid / base / neither	

Circle any element that is a metal	This substance is...	When one of these dissolves, how many aqueous ions form?
$NaOH_{(aq)}$	acid / base / neither	
$HNO_{3(aq)}$	acid / base / neither	

8. Give the formula for the conjugate acid of CH_3NH_2 See #1 HINT

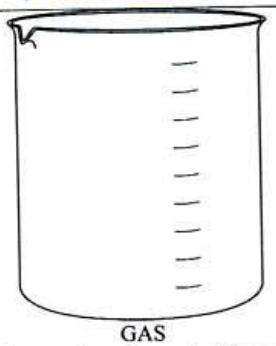
ANSWERS

9. Give the conjugate base of each: HCl, HBr, HI,

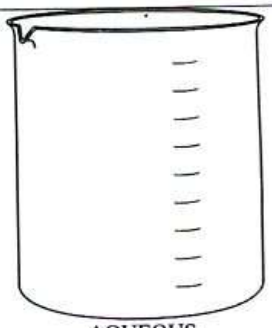
(Cl^-) ( ) ( )

technique: Remove an H^+ from each!

10. Draw gas in the left beaker and aqueous, per the following instructions:



GAS
In gas phase draw a half dozen molecules of the only substance in HCl(g)



AQUEOUS
In gas phase draw three particles of all three substances present in HCl(aq)

11. Write a balanced equation that shows $HClO_4$, losing a H+ to form its conjugate base.

$HClO_4 \longrightarrow H^+ + ClO_4^-$

12. Write a balanced equation that shows HNO_3, losing a H+ to form its conjugate base.

13. What happens to hydroxide concentration in water when base is added?
(it rises / it falls / it doesn't change)

14. What happens to the hydronium concentration in water when base is added?
(it rises / it falls / it doesn't change)

15. The following substances act as Bronsted acids in water. Write a chemical equation for each that illustrates its reaction with water.

ammonium ion, NH_4^+	$NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$
H_3PO_4	$H_3PO_4 + H_2O \rightarrow H_2PO_4^- + H_3O^+$
HBr	$\rightarrow$

16. The following substances act as Bronsted bases in water. Write a chemical equation for each that illustrates its reaction with water.

CHOO⁻	$CHOO^- + H_2O \rightarrow HCHOO + H_3O^+$
hydride ion: H-	→
ammonia NH_3	→

17. What is the conjugate acid of HSO4- ?

18. What is the conjugate base of HSO4-?

Just remove a H+

ANSWER SO_4^{2-}

Identify the acid, base, conjugate acid and conjugate base for each of the following.

19. $HSO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_3^{2-}(aq)$

BASE ACID

ACID BASE

20. $NH_3(g) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

21. $HF(aq) + HSO_3^-(aq) \rightleftharpoons F^-(aq) + H_2SO_3(aq)$

22. $HNO_2(aq) + HS^-(aq) \rightleftharpoons NO_2^-(aq) + H_2S(aq)$

23. What is the formula for the conjugate acid of water? ANSWER: H_3O^+

JUST ADD ANOTHER H+

24. What is the formula for the conjugate base of water?

ANSWERS

Acid #2

CλeMis+ry: http://genest.weebly.com

Start making a one sided, hand-written cheat sheet for the final exam. See tips on the class webstie: httP://genest.weebly.com

Name_____

Period_____

1. Circle ~~three~~ substances that could make phenolphthalein turn pink: table on page 2 shows PINK if base

$NH_{3(aq)}$ $KOH_{(aq)}$ $CH_{4(aq)}$ $CO_{2(aq)}$ $HCl_{(aq)}$ $CH_3OH_{(aq)}$ $Ba(OH)2_{(aq)}$ $HNO_{3(aq)}$

2. Circle *three* things that could make methyl orange turn red:

$NH_{3(aq)}$ $KOH_{(aq)}$ $CH_{4(aq)}$ $CO_{2(aq)}$ $CH_3COOH_{(aq)}$ $CH_3OH_{(aq)}$ $Ba(OH)2_{(aq)}$ $HNO_{3(aq)}$

SKIP! You DON'T need to know this rule

3. Take things from the box at the right and write them onto the correct lists below. You should end up with 3 things per list.

take these and write them under the ← four lists at left.

O^{2-}	$Ca(OH)_2$	CH_4	Li^+
Na^+	HBr	Ca^{2+}	OH
NaOH	CH_3OH	CO_3^{2-}	H_2CO_3
HNO_3	C_2H_5OH	I^-	Br^-

BASES
$Ca(OH)_2$
NaOH

cations	anions	acids
~~basic~~ Li+	O^{2-}	HBr
Na^+	CO_3^{2-}	H_2CO_3
Ca^{2+}	I^-	HNO_3
	Br^-	

Chemists around 1920 proposed a theory:
An acid is anything that donates a proton to another species.
A base is anything that *accepts* a proton from another species.

4. In each case below for any substance on the LEFT side of the arrow, mark it as follows: write "base" under anything that is acting as a Bronsted-Lowry Base and write "acid" under anything that is acting as a Bronsted-Lowry Acid.

a. $HSO_4^- + H_2O \rightarrow SO_4^{2-} + H_3O^+$ (ACID, BASE)

b. $H_2O + NH_3 \rightarrow OH^- NH_4^+$ (ACID, BASE)

c. $H_3PO_4 + NH_3 \rightarrow NH_4^+ + H_2PO_4^-$ (ACID, BASE)

d. $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} H_3O^+$ (ACID, BASE)

5. What color is phenolphthalein in very basic solution?

PINK (according to the table on the next page)

Common Acid–Base Indicators

Indicator	Approximate pH Range for Color Change	Color Change
methyl orange	3.1–4.4	red to yellow
bromthymol blue	6.0–7.6	yellow to blue
phenolphthalein	8–9	colorless to pink
litmus	4.5–8.3	red to blue
bromcresol green	3.8–5.4	yellow to blue
thymol blue	8.0–9.6	yellow to blue

6. (choose only one letter)A sample of a solution with a pH of 10 is tested separately with phenolphthalein and litmus indicator. The colors of the indicators are as follows
   a. litmus is blue; phenolphthalein is pink
   b. litmus is red; phenolphthalein is pink
   c. litmus is blue; phenolphthalein is colorless
   d. litmus is red; phenolphthalein is colorless

7. What color is phenolphtalein in a beaker full of concentrated H_2SO_4?
   COLORLESS (based on the chart above)

8. An indicator was used to test a water solution with a pH of 12. Of the combinations below, what is *the only one* that could possibly be observed in this situation?
   a. colorless phenolphthalin
   b. red litmus
   c. colorless litmus
   d. pink phenolphthalein

9. A blue solution containing an acid-base indicator was tested with a pH meter and found to have a pH of 5.5. Which of the indicators shown on the table shown here could be this indicator?
   BROMOCRESOL GREEN

10. A solution was yellow in bromthymol blue and blue in bromcresol green. According to the table here, what could be the pH of this solution?
    > below 6.0 AND above 5.4

11. Acid was added to a solution containing an indicator until the solution turned from blue to yellow. Which of the following would be the most acidic?
    a. a yellow solution containing bromthymol blue <6.0
    b. a yellow solution containing bromcresol green <3.8
    c. a yellow solution containing thymol blue

12. If a beaker contains 0.00000593 moles of H+ ions, in 30.0 mL of water,

a. What is the [H+]?

$\frac{\text{moles}}{\text{Liter}}$ = Concentration $\qquad \frac{0.00000593 \text{ moles}}{0.0300 \text{ L}} = 1.98 \times 10^{-4} \text{ M}$

b. what is the pH?

pH = 3.704 (notice it is positive!)

13. If during a titration a student finds that 466 mL of HNO_3 acid contains 0.00033 moles of H+

a) What is the [H+]?

$\frac{0.00033 \text{ moles}}{0.466 \text{ L}} = 7.08 \times 10^{-4} \approx 7.1 \times 10^{-4} \frac{\text{moles}}{\text{liter}}$

b) what is the pH?

pH = 3.15

14. If a beaker contains 4.89×10^{14} H+ ions, in 0.790 liters of water,

a. What is the [H+]?

First, change to moles: $4.89 \times 10^{14} \text{ ions} \times \frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ ions}} = 8.12 \times 10^{-10} \text{ moles}$

then find concentration: $\frac{8.12 \times 10^{-10} \text{ moles}}{0.790 \text{ liters}} = 1.03 \times 10^{-9} \text{ M}$

b. what is the pH?

the pH is 8.987

c. find the number of H+ ions that would be in a 690.mL (units!) volume of a solution that had the same molarity you found in answer A.

Tough question. You need to (1) set up our old equation Molarity $= \frac{\text{moles}}{\text{L}}$

(2) rearrange it (molarity)(L) = moles

(3) change the moles to ions

(molarity)(L) = moles

$(1.03 \times 10^{-9} \frac{\text{mol}}{\text{L}})(0.690 \text{ L}) = \text{moles}$

$7.107 \times 10^{-10} = \text{moles}$

$7.107 \times 10^{-10} \text{ moles} \times \frac{6.02 \times 10^{23} \text{ ions}}{1 \text{ mole}}$

Answer: 4.28×10^{14} ions

15. In each case below for any substance on the LEFT side of the arrow, mark it as follows: write "base" under anything that is acting as a Bronsted-Lowry Base and write "acid" under anything that is acting as a Bronsted-Lowry Acid.

a. $SO_4^{2-} + H_3O^+ \rightarrow HSO_4^- + H_2O$

BASE ACID

b. $NH_4^+ + H_2PO_4^- \rightarrow H_3PO_4 + NH_3$

ACID BASE

16. Fill in the chart using the rule: **[H+] multiplied by [OH-] equals $1x10^{-14}$**

A	1×10^{-2}	1×10^{-12}
B	1×10^{-9}	1×10^{-5}
C	1×10^{-6}	1×10^{-8}
D	1×10^{-11}	1×10^{-3}
E	1×10^{-3}	1×10^{-11}

17. Fill in the chart using the rule: **pH = - log[H+]**

F	5.77×10^{-6}	5.239
G	1×10^{-5}	5.0
H	1×10^{-8}	8
i	$1.58 \times 10^{-4} \approx 1 \times 10^{-4}$	3.8