Name:_____

Per:____

1. List four characteristic properties of acids and four characteristic properties of bases.

Acids	Bases
Tart or sour taste	Bitter Taste
Form electrolytic solutions (conduct electricity)	Form electrolytic solutions (conduct electricity)
React with metals to form hydrogen gas	Feel slippery (soapy)
Cause acid-base indicators to change color	Cause acid-base indicators to change color

2. Fill in the chart below by providing simple definitions.

	Acid	Base
Arrhenius's Definition	H^+ Producer	OH^- producer
Brønsted-Lowry Definitions	Proton Donor	Proton Acceptor

3. a. Write the correct symbol for the hydrogen ion: H^+

   b. Write the correct symbol for a hydronium ion: H_3O^+

4. Define the term ***amphoteric.***

   Amphoteric refers to a substance which can function as an acid or a base, depending on the specific environment.

5. Write balanced equations for the:

   a. Dissociation of calcium hydroxide, $Ca(OH)_2$

   $Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$

   b. Ionization of nitric acid, HNO_3

   $HNO_3 \rightarrow H^+ + NO_3^-$

6. Write the equation for the ionization of nitric acid, HNO_3, showing the formation of the hydronium ion.

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

7. Identify the hydrogen-ion donor & acceptor (present on the reactant side of each equation) in each of the following reactions:

	H^+ donor (the acid)	H^+ acceptor (the base)
a. $HNO_3\ (l) + H_2O(l) \rightarrow H_3O^+\ (aq) + NO_3^-\ (aq)$	HNO_3	H_2O
b. $C_2H_5NH_2\ (l) + H_2O(l) \rightarrow C_2H_5NH_3^+\ (aq) + OH^-(aq)$	H_2O	$C_2H_5NH_2$
c. $CH_3CO_2H(l) + H_2O(l) \rightarrow CH_3CO_2^-(aq) + H_3O^+(aq)$	CH_3CO_2H	H_2O

8. For each acid listed in question 7, identify it's conjugate base.

	Acid (Reactant side of equation)	Conjugate Base
a.	HNO_3	NO_3^-
b.	H_2O	OH^-
c.	CH_3CO_2H	$CH_3CO_2^-$

9. Write the formulas for the conjugate base of each of the following acids.

a. H_2SO_3 — HSO_3^- or SO_3^{2-}

b. HCO_3^- — CO_3^{2-}

c. NH_4^+ — NH_3

10. Write the formulas for the conjugate acid of each of the following bases.

a. H_2O — H_3O^+

b. CO_3^{2-} — HCO_3^-

c. PH_3 — PH_4^+

11. For each of the following reactions, identify the Brønsted-Lowry acid and Brønsted-Lowry base on the reactant side of the equation, and the conjugate acid and conjugate base on the product side.

a. $HSO_4^-(aq) + CO_3^{2-}(aq) \rightarrow SO_4^{2-}(aq) + HCO_3^-(aq)$

Acid	Base	Conj Base	Conj Acid

b. $HCO_3^-(aq) + OH^-(aq) \rightarrow CO_3^{2-}(aq) + H_2O(l)$

Acid	Base	Conj Base	Conj Acid

12. Consider the following two reactions. In which reaction does $H_2PO_4^-$ act as a base? In which does it act as an acid?

		Is $H_2PO_4^-$ an acid or base?
a.	$H_2PO_4^-(aq) + H_2O(l) \rightarrow H_3PO_4(aq) + OH^-(aq)$	$H_2PO_4^-$ a base
b.	$H_2PO_4^-(aq) + H_2O(l) \rightarrow HPO_4^{2-}(aq) + H_3O^+(aq)$	$H_2PO_4^-$ an acid

13. Calculate the pH's of strong acid solutions with the following H^+ concentrations. Show your work.

a. 1.0 M
$pH = -\log [H_3O^+]$
$pH = -\log [1.0]$
$pH = 0.0$

b. 1.0×10^{-5} M
$pH = -\log [H_3O^+]$
$pH = -\log [1.0 \times 10^{-5}]$
$pH = 5.0$

c. 1.5×10^{-5} M
$pH = -\log [H_3O^+]$
$pH = -\log [1.5 \times 10^{-5}]$
$pH = 4.8$

d. 2.0×10^{-5} M
$pH = -\log [H_3O^+]$
$pH = -\log [2.0 \times 10^{-5}]$
$pH = 4.7$

e. 3.00×10^{-12} M
$pH = -\log [H_3O^+]$
$pH = -\log [3.00 \times 10^{-12}]$
$pH = 11.5$

f. 1.125×10^{-15} M
$pH = -\log [H_3O^+]$
$pH = -\log [1.125 \times 10^{-15}]$
$pH = 14.95$

g. 12.0 M
$pH = -\log [H_3O^+]$
$pH = -\log [12.0]$
$pH = -1.08$

h. 0.875×10^{-10} M
$pH = -\log [H_3O^+]$
$pH = -\log [0.875 \times 10^{-10}]$
$pH = 10.1$

14. Calculate the H_3O^+ concentrations for solutions with the following pH's. Show your work.

a. 2.00
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-2.00}$
$[H_3O^+] = 1.00 \times 10^{-2}$ M

b. 2.25
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-2.25}$
$[H_3O^+] = 5.62 \times 10^{-3}$ M

c. 2.5
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-2.5}$
$[H_3O^+] = 3.2 \times 10^{-3}$ M

d. 3.0
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-3.0}$
$[H_3O^+] = 1.0 \times 10^{-3}$ M

e. 7
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-7}$
$[H_3O^+] = 1 \times 10^{-7}$ M

f. 9.50
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-9.50}$
$[H_3O^+] = 3.16 \times 10^{-10}$ M

g. 12.15
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-12.15}$
$[H_3O^+] = 7.079 \times 10^{-13}$ M

h. 14.0
$[H_3O^+] = 10^{-pH}$
$[H_3O^+] = 10^{-14.0}$
$[H_3O^+] = 1.00 \times 10^{-14}$ M