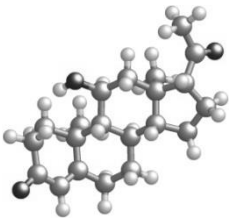

Chem!stry

Name: …… **( )**

Class: ……

Date: …… **/** …… **/** ……

Defining Rules for the Reactions of Acids

Part One – Definition of an Acid:

The following chemicals are all classified as acids:

Note: (aq) means *aqueous* – dissolved in water. H^+ is the symbol for a *hydrogen ion*.

Name	Formula	Equation for Acid Dissolving in Water to form an Acidic Solution	Basicity	Strong or Weak Acid
hydrochloric acid	HCl	$HCl \rightarrow H^+(aq) + Cl^-(aq)$	monobasic	strong
nitric acid	HNO_3	$HNO_3 \rightarrow H^+(aq) + NO_3^-(aq)$	monobasic	strong
sulfuric acid	H_2SO_4	$H_2SO_4 \rightarrow 2H^+(aq) + SO_4^{2-}(aq)$	dibasic	strong
phosphoric acid	H_3PO_4	$H_3PO_4 \rightleftharpoons 3H^+(aq) + PO_4^{3-}(aq)$	tribasic	weak
ethanoic acid	CH_3COOH	$CH_3COOH \rightleftharpoons CH_3COO^-(aq) + H^+(aq)$	monobasic	weak

1. Study the equations for the chemicals dissolving in water to form acidic solutions and identify what they all have in common. Sodium hydrogen sulfate, formula $NaHSO_4$, dissolves in water according to the equation given below, but it is **not** classified as an acid:

$$NaHSO_4 \rightarrow Na^+(aq) + H^+(aq) + SO_4^{2-}(aq)$$

Refer to the equations given in the table along with the equation for sodium hydrogen sulfate. Use this information to write a universal statement that defines what an acid is.

……...

……...

2. Hydrochloric acid, nitric acid and ethanoic acid are *monobasic*, sulfuric acid is *dibasic* and phosphoric acid is *tribasic*. Study the equations for the chemicals dissolving in water to form acidic solutions once again. Use evidence from the equations to write statements that define what *monobasic*, *dibasic* and *tribasic* acids are.

……...

……...

……...

……...

3. Hydrochloric acid, nitric acid and sulfuric acid are classified as *strong acids*, while phosphoric acid and ethanoic acid are classified as *weak acids*. The $\rightarrow$ symbol means that the chemical change is *complete*, moving from left-to-right. The $\rightleftharpoons$ symbol means that the chemical change is *incomplete*, as the reaction can move from left-to-right, and also from right-to-left. Use this information to write statements that define what *strong* and *weak* acids are.

……...

……...

……...

……...

……...

Part Two – Reactions Between Acids and Metals:

In Chemistry, a *salt* is an ionic compound comprising of a positively charged ion (cation) and a negatively charged ion (anion). The positively charged ion is *nearly* always a metal (the exception being the ammonium ion, NH_4^+), and the negatively charge ion is always a non-metal. An example of a salt is magnesium chloride, formula $MgCl_2$, which comprises of a single positive magnesium ion, Mg^{2+}, and two negative chloride ions, Cl^-.

Study the three reactions of acids and metals given below:

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$
$$Zn(s) + 2HNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + H_2(g)$$
$$Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$$

1. What do all of the reactions have in common? Use this information to write a universal statement that describes the reaction between an acid and a metal.

……...

……...

……...

2. The reactivities of some metals are given in the table below. The non-metal, hydrogen, has been included for reference.

most reactive		**least reactive**
potassium > sodium > calcium > magnesium > zinc > iron > [*hydrogen*] > copper > silver		

Predict which metals will **not** react with water. Give an explanation for your answer.

……...

……...

……...

……...

Part Three – Reactions Between Acids and Bases:

In Chemistry, *bases* are metal oxides and metal hydroxides. Examples include calcium oxide, formula CaO, and copper(II) hydroxide, formula $Cu(OH)_2$. If the base is soluble in water, then it can be further classified as an *alkali*.

Study the four reactions of acids and bases given below:

$$CaO(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l)$$
$$Cu(OH)_2(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + 2H_2O(l)$$
$$MgO(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l)$$
$$2NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

What do all of the reactions have in common? Use this information to write a universal statement that describes the reaction between an acid and a base.

……..

……..

……..

……..

Part Four – Reactions Between Acids and Carbonates:

Metal carbonates are compounds that contain a positively charged metal ion (cation) and a negatively charged carbonate ion (anion). A common example of a metal carbonate is chalk, whose chemical name is calcium carbonate, formula $CaCO_3$, which comprises of a single positive calcium ion, Ca^{2+}, and a single negative carbonate ion, CO_3^{2-}.

Study the three reactions of acids and metal carbonates given below:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$
$$K_2CO_3(s) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + H_2O(l) + CO_2(g)$$
$$PbCO_3(s) + 2HNO_3(aq) \rightarrow Pb(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$

What do all of the reactions have in common? Use this information to write a universal statement that describes the reaction between an acid and a metal carbonate.

……..

……..

……..

……..

- Scan the QR Code to view the answers to this assignment.

http://www.chemist.sg/acids/notes_acids_bases_salts/defining_rules_for_reactions_of_acids_ans.pdf