Chemical Equations Unit

Nomenclature

There are two main types of chemicals to name:

1.
2.

Ionic

Writing Formulas

- Write the symbol of both elements or ions in the name with their valences.
- Cross down the valence numbers (in absolute value)
- Factor those numbers if possible

Naming

- Write the name of the first element
- Check to see if that element has more than one valence.
    - If it only has one, do not add the valence.
    - If it has more than one, find the valence and add it in brackets with a roman numeral.
- Write the name of the second element with an ide ending.

Practice:

Nomenclature of Binary Compounds

Please write the name of the following chemicals

AgCl	
Li_2O	
$MgBr_2$	
ZnO	
KF	
BaS	
Rb_2S	
AlN	
$CaCl_2$	
Zn_3P_2	
NaBr	
$AlBr_3$	
Cs_3P	
SrI_2	
SrF_2	

Please write formulas for the following compounds

Magnesium Phosphide	
Lithium Oxide	
Calcium Bromide	
Cesium Sulfide	
Rubidium Phosphide	
Strontium Nitride	
Aluminum Oxide	
Barium Iodide	
Silver Chloride	
Cesium Carbide	
Potassium Carbide	
Barium Oxide	
Zinc Nitride	
Strontium Iodide	
Magnesium Sulfide	

Nomenclature of Multivalent Metal Compounds

Please write the name of the following chemicals

AuCl	
NiN	
$CuCl_2$	
FeO	
MnO_2	
$NiBr_2$	
SnS_2	
PbO_2	
$CrCl_2$	
Mn_3P_2	
PtO	
$AuBr_3$	
Cu_3P	
AuI_3	
CoF_2	

Please write formulas for the following compounds

Chromium (II) Phosphide	
Manganese (IV) oxide	
Iron (III) Bromide	
Copper (II) Sulfide	
Cobalt (III) Phosphide	
Chromium (III) Nitride	
Nickel (II) Nitride	
Palladium (II) Iodide	
Tin (IV) Chloride	
Tungsten (III) Carbide	
Platinum (II) Carbide	
Platinum (IV) Oxide	
Cobalt (III) Nitride	
Lead (II) Iodide	

Nickel (II) Sulfide	

Nomenclature of Binary and Multivalent Metal

Please write the name of the following chemicals

AgCl	
SnO_2	
Mg_3N_2	
FeO	
MnC	
$BaBr_2$	
SnS_2	
NiO	
$CaCl_2$	
Zn_3P_2	
NiS	
$AlBr_3$	
Hg_3P	
AuI_3	
SrF_2	

Please write formulas for the following compounds

Magnesium Phosphide	
Dihydrogen Monoxide	
Calcium Bromide	
Copper (II) Sulfide	
Rubidium Phosphide	
Chromium (III) Nitride	
Tin (IV) Oxide	
Barium Iodide	
Silver Chloride	
Cesium Carbide	
Potassium Carbide	
Platinum (IV) Oxide	
Cobalt (III) Nitride	

Strontium Iodide	
Nickel (II) Sulfide	

ous/ic naming system

- Older system but some old scientists still use it.
- Only used for multivalent metals
- The higher valence will have an ic ending
- The lower valence will have an ous ending
- You will never name them, but you may be given the name and need to write the formula

Element	Latin	***Electrovalence***
Hg	Mercurous	1+
	Mercuric	2+
Cu	Cuprous	1+
	Cupric	2+
Fe	Ferrous	2+
	Ferric	3+
Sn	Stannous	2+
	Stannic	4+
Pb	Plumbous	2+
	Plumbic	4+
Mn	Manganous	2+
	Manganic	4+
P	Phosphorous	3+
	Phosphoric	5+
As	Arsenious	3+
	Arsenic	5+
Sb	Antimonous	3+
	Antimonic	5+

Practice:

Nomenclature of Acids:

Binary Acids (only H and an element)

- Naming: Write hydro before the element and give it an ic acid ending.
- Example:
  - HCl
  - HBr
  - HF
  - HI

Oxy Acids

- 2 Oxygens	- 1 Oxygen		+ 1 Oxygen
Hypo…ous acid	-ous acid	-ic acid	Per…..ic acid
HNO Hyponitrous acid	HNO_2 Nitrous acid	**HNO_3** **Nitric acid**	HNO_4 Pernitric acid
		$HClO_3$ **Chloric acid**	
		$HBrO_3$ **Bromic acid**	
		HIO_3 **Iodic acid**	
		H_2CO_3 **Carbonic acid**	
		H_2SO_4 **Sulfuric acid**	
		H_3PO_4 **Phosphoric acid**	

Nomenclature of Oxy Acids

Please write the name of the following chemicals

HNO_3	
$HClO_2$	
HBrO	
HIO_4	
H_2SO3	
H_2CO_2	
H_3PO_4	
HNO_4	
$HBrO_3$	
HClO	
HIO_2	
H_2SO_4	
H_2CO_3	
H_3PO5	
HNO	

Please write formulas for the following compounds

Phosphoric Acid	
Sulfurous Acid	
Percarbonic Acid	
Hyponitrous Acid	
Chloric Acid	
Bromous Acid	
Periodic Acid	
Hypophosphorous Acid	
Sulfuric Acid	
Carbonous Acid	
Pernitric Acid	

Hypochlorous Acid	
Bromic Acid	
Iodous Acid	
Perphosphoric Acid	

Oxy Acid Radicals

- 2 Oxygens	- 1 Oxygen		+ 1 Oxygen
Hypo…ite	-ite	ate	Per…..ate
NO^{1-} Hyponitrite	NO_2^{1-} Nitrite	**NO_3^{1-} Nitrate**	NO_4^{1-} Pernitrate
		ClO_3^{1-} Chlorate	
		BrO_3^{1-} Bromate	
		IO_3^{1-} Iodate	
		CO_3^{2-} Carbonate	
		SO_4^{2-} Sulfate	
		PO_4^{3-} Phosphate	

Practice:

Nomenclature of Oxy Acid Radicals

Please write the name of the following chemicals

$AgClO_3$	
$Ca(NO_2)_2$	
$Mg(NO_4)_2$	
$Fe(BrO)_3$	
$MnCO_2$	
$Ba(BrO_3)_2$	
$SnSO_2$	
$NaNO_2$	
$Ca(ClO)_2$	
$Zn_3(PO_3)_2$	
$NiSO_4$	
$Al(BrO_3)_3$	
Hg_3PO_5	
$Au(IO_2)_3$	
SrCO	

Please write formulas for the following compounds

Magnesium Phosphite	
Zinc Hypochlorite	
Calcium Bromate	
Copper (II) Sulfite	
Rubidium Perphosphate	
Chromium (III) Hyponitrite	
Potassium Periodate	
Barium Hypoiodite	
Silver Chlorate	
Cesium Carbonite	
Potassium Nitrate	

Platinum (IV) Perchlorate	
Cobalt (III) Hyponitrite	
Strontium Iodite	
Nickel (II) Sulfate	

Other Ions you are required to know:
You are required to know

- Hydroxide
- Ammonium
- Acetate

Example:
Sodium Hydroxide
Ammonium Chloride
Beryllium Acetate

Covalent Nomenclature

Memorize the following prefixes:

1	6
2	7
3	8
4	9
5	10

Naming

1. Write the prefix for the first non-metal if there is more than one of it
2. Write the name of the first element.
3. Write the prefix of the second element
4. Write the name of the second element

Practice:

Nomenclature of Covalent Bonds

Please write the name of the following chemicals

CO_2	
S_2O_5	
CH_4	
SO_2	
CO	
SO_3	
H_2O	
NO_2	
CCl_4	
NO	
S_2P_3	
NCl_3	
PF_3	
SF_6	
NCl_5	

Please write formulas for the following compounds

Nitrogen Pentachloride	
Dihydrogen Monoxide	
Sulfur Hexafluoride	
Phosphorus Trifluoride	
Nitrogen Trichloride	
Disulfur Triphosphide	
Sulfur trioxide	
Nitrogen Monoxide	
Carbon Tetrachloride	
Nitrogen Dioxide	
Carbon Monoxide	

Sulfur Dioxide	
Carbon Tetrahydride	
Disulfur Pentoxide	
Carbon Dioxide	

Nomenclature Practice

Chemical Formula	Chemical Name	Chemical Name	Chemical Formula
$LiNO_3$		Lithium Chlorate	
Ag_2SO_4		Silver Nitrite	
KNO_2		Iron (II) Chlorite	
$Fe_2(SO_3)_3$		Potassium Nitrate	
$Be(IO)_2$		Iron (III) Hypochlorite	
$MnSO_4$		Zinc Carbonate	
$NaIO_2$		Lead (II) Perchlorate	
$Ni_2(SO_3)_3$		Beryllium Sulfite	
$Mg(IO_3)_2$		Nickel (III) Iodate	
$Hg_3(PO_4)_2$		Magnesium Sulfate	
$Ca(BrO)_2$		Lead (IV) Periodate	
$Pb_3(PO_4)_4$		Calcium Phosphite	
$Ba(BrO_2)_2$		Nickel (II) Hypoiodite	
$Sn_3(PO_3)_2$		Barium Phosphate	
$LiBrO_3$		Gold (I) Iodite	
Ag_3PO_5		Lithium Perphosphate	
$KBrO_4$		Silver Phosphate	
$FeCO_3$		Gold (III) Hypoiodite	
$Be(IO_4)_2$		Potassium Phosphite	
$MnSO_4$		Copper (II) Periodate	
$NaClO$		Zinc Sulfate	
$NiSO_3$		Copper (I) Iodate	
$Mg(ClO_2)_2$		Beryllium Sulfite	
$HgSO_4$		Manganese(II) Perchlorate	
$Ca(ClO_3)_2$		Magnesium Carbonate	
$PbCO_3$		Manganese (IV) Hypochlorite	
$Ba(ClO_4)_2$		Calcium Nitrate	

$Sn(SO_4)_2$		Tin (II) Chlorite	
$ZnCO_3$		Barium Nitrite	
$AuPO_4$		Tin (IV) Chlorate	
$AgNO_3$		Tin (II) Chloride	
$AlPO_3$		Sodium Phosphide	
$Ba(ClO_2)_2$		Antimony (V) Sulphide	
$FeSO_3$		Hydrogen Iodide	
KIO_3		Potassium Nitride	
H_3PO_2		Nickel (III) Oxide	
$Sn(SO_4)_2$		Mercury (I) Oxide	
$As(NO_3)_3$		Potassium Chloride	
$NaCH_3COO$		Zinc Phosphide	
$Cr(NO_3)_3$		Iron (III) Fluoride	
$HgClO$		Lead (IV) Oxide	
$CuSO_4$		Phosphorus PentaChloride	
$(NH_4)_2CO_3$		Zinc Chloride	
$Fe_3(PO_3)_2$		Carbon Monoxide	
$Zn(ClO)_2$		Carbon Dioxide	
$SbPO_3$		Sulfur Dioxide	
$Cu(ClO_4)_2$		Sulfur Trioxide	
$KBrO_4$		Hydrogen Chloride	
$(NH_4)_2SO_4$		Carbon Tetrachloride	
K_3PO_2		Iron (II) Sulfide	
HIO_3		Barium Chloride	
Na_2O		Tin (IV) Oxide	
K_2O		Arsenic (III) Hydride	
$NaClO_4$		Diphosphorus TriOxide	
$As(NO_3)_5$		Arsenic TriHydride	
$Sb_2(SO_3)_3$		Diphosphorus TriOxide	
$Zn_3(PO_4)_2$		Diarsenic PentaSulphide	
Ag_2SO_4		Gold (I) Bromide	
$Au(ClO_3)_3$		Magnesium Iodide	
$Mg(BrO_4)_2$		Beryllium Chloride	
$Ca_3(PO_2)_2$		Boron Trihydride	

$Al_2(SO_3)_3$		Aluminum Oxide	
$MnSO_3$		Antimony (III) Iodide	
$Pb(IO_2)_2$		Cuprous Sulfide	
$Cu(BrO_4)_2$		Dihydrogen Monoxide	
H_2SO_3		Silver Chloride	
$Fe_2(SO_3)_3$		Lithium Sulfide	
$KClO_4$		Barium Sulfide	
Na_2SO_4		Strontium Phosphide	
$HgClO_2$		Ferric Iodide	
$Ca(CH_3COO)_2$		Stannic Chloride	
Ag_2CO_3		Plumbous Nitride	
$Sr(NO_3)_2$		Antimony (III) Carbide	
$(NH_4)_3PO_3$		Dihydrogen Monosulfide	
Ag_3N		Ammonia	
Cu_3N_2		Plumbic Oxide	
$LiCl$		Copper (II) Chloride	
PbO_2		Silicon Dioxide	
Na_2S		Chromium (III) Chloride	
$SnBr_2$		Nickel (III) Fluoride	
$CaBr_2$		Beryllium Oxide	
MnI_4		Carbon Disulphide	
MgI_2		Manganese (II) Oxide	
HgF		Phosphorus Trioxide	
BeF_2		Cobalt (II) Sulfide	
Au_2O_3		Carbon Tetrafluoride	
BaO		Ferrous Sulphide	
NiS		Nitrogen Trihydride	
ZnS		Cupric Oxide	
FeO		Mercury (II) Carbide	
AlN		Diphosphorus Pentoxide	
$CuCl_2$		Antimony (V) Nitride	
BF_3		Nickel (II) Bromide	
$PbCl_2$		Dichlorine Monoxide	
$AgIO_2$		Chromium (II) Sulphide	

$Zn_3(PO_3)_2$		Boron Sulfide	
$Fe(BrO_4)_2$		Aluminum Nitride	
$Ca(ClO_4)_2$		Sodium Oxide	
LiIO		Stannous Fluoride	
$SnSO_3$		Copper (I) Sulfide	
$Mg_3(PO_2)_2$		Silver Sulfide	
$As(IO_4)_5$		Lithium Carbide	
$Pb(OH)_2$		Calcium Phosphide	
$Ba(ClO)_2$		Strontium Bromide	
$HgNO_3$		Magnesium Phosphide	
K_2SO_3		Sodium Phosphite	
$(NH_4)_3PO_4$		Iron (II) Perchlorate	
H_2CO_3		Zinc Sulfite	
Ni_2S_3		Cupric Chlorite	
$Al(IO)_3$		Calcium Hypochlorite	
$NaIO_2$		Tin (IV) Chlorite	
$Pb(OH)_4$		Copper (II) Hypobromite	
$HBrO_2$		Manganic Hypophosphite	
$Mg_3(PO_3)_2$		Zinc Carbonate	
Sb_2O_5		Arsenic Nitrite	
$AgCH_3COO$		Calcium Acetate	
SnF_2		Antimonous Chlorite	
$Cu(ClO_2)_2$		Silver Acetate	
$Mn(IO_4)_4$		Tin (II) Chlorite	
$Mg(ClO)_2$		Sodium Sulphate	
Na_2SO_3		Mercury (II) Perchlorate	
$Ca(IO_3)_2$		Calcium Hypophosphite	
$Al(BrO_4)_3$		Barium Sulfite	
$Be_3(PO_3)_2$		Plumbic Phosphite	
$Sn(OH)_2$		Mercury (II) Nitrate	
$Hg(IO)_2$		Potassium Iodate	
KClO		Aluminum Hypophosphite	
NH_4NO_3		Ferric Nitrate	
CaF_2		Sodium Nitride	

$ZnBr_2$		Lead (II) Perchlorate	
CO_2		Antimony (V) Sulfite	
$SnCl_2$		Aluminum Sulfate	
CrF_2		Magnesium Carbonate	
CoO		Iron (II) Hypochlorite	
Mg_3N_2		Perbromic Acid	
$AsBr_3$		Ammonium Sulphite	
CuO		Zinc Iodate	
$AlBr_3$		Gold (III) Nitrate	
FrH		Copper(I)Hypophosphite	
OBr_2		Manganous Sulphate	
CuCl		Potassium Periodate	
MnO_2		Magnesium Hypobromite	
NH_3		Ammonium Acetate	
Cu_3N_2		Zinc Hydroxide	
MnS_2		Lithium Oxide	
SO_2		Aluminum Hydride	

Balancing Equations

$Na + O_2 \rightarrow Na_2O$

$C + O_2 \rightarrow CO_2$

$Na + Cl_2 \rightarrow NaCl$

$Hg + O_2 \rightarrow HgO$

$Mg + HCl \rightarrow MgCl_2 + H_2$

$Ca + N_2 \rightarrow Ca_3N_2$

$BiCl_3 + H_2S \rightarrow Bi_2S_3 + HCl$

$P_4 + I_2 \rightarrow PI_3$

$H_2O_2 \rightarrow H_2O + O_2$

$Fe + O_2 \rightarrow Fe_3O_4$

$CaO + C \rightarrow CaC_2 + CO_2$

$AsBr_3 + H_2S \rightarrow As_2S_3 + HBr$

$H_2 + O_2 \rightarrow H_2O$

$Br_2 + KI \rightarrow I_2 + KBr$

$FeS + O_2 \rightarrow Fe_2O_3 + SO_2$

$N_2 + H_2 \rightarrow NH_3$

$K + Cl_2 \rightarrow KCl$

$Fe + H_2O \rightarrow Fe_3O_4 + H_2$

$Al + HCl \rightarrow AlCl_3 + H_2$

$Al + O_2 \rightarrow Al_2O_3$

$H_2O \rightarrow H_2 + O_2$

$As + O_2 \rightarrow As_2O_5$

$NI_3 \rightarrow N_2 + I_2$

$H_2 + P \rightarrow PH_3$

$SbH_3 \rightarrow Sb + H_2$

$H_2 + Cl_2 \rightarrow HCl$

$KClO_3 \rightarrow KCl + O_2$

$Sb + S \rightarrow Sb_2S_3$

$C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

$C_6H_6 + O_2 \rightarrow CO_2 + H_2O$

$C_{10}H_6 + F_2 \rightarrow HF + C$

$P_2O_5 + H_2O \rightarrow H_3PO_4$

$P_2O_3 + H_2O \rightarrow H_3PO_3$

$FeCl_3 + Fe \rightarrow FeCl_2$

$CaCO_3 + HCl \rightarrow CaCl_2 + H_2O + CO_2$

$SnO_2 + C \rightarrow Sn + CO$

$Mg_3N_2 + H_2O \rightarrow Mg(OH)_2 + NH_3$

$V_2O_5 + Ca \rightarrow CaO + V$

$Na_2O_2 + H_2O \rightarrow NaOH + O_2$

$Fe_3O_4 + H_2 \rightarrow Fe + H_2O$

$Cu + H_2SO_4 \rightarrow CuSO_4 + H_2O + SO_2$

$Al + H_2SO_4 \rightarrow H_2 + Al_2(SO_4)_3$

$Si_4H_{10} + O_2 \rightarrow SiO_2 + H_2O$

$NH_3 + O_2 \rightarrow N_2H_4 + H_2O$

$C_{15}H_{30} + O_2 \rightarrow CO_2 + H_2O$

$BN + F_2 \rightarrow BF_3 + N_2$

$CaSO_4 \cdot 2H_2O + SO_3 \rightarrow CaSO_4 + H_2SO_4$

$C_{12}H_{26} + O_2 \rightarrow CO_2 + H_2O$

$C_7H_6O_3 + O_2 \rightarrow CO_2 + H_2O$

$Na + ZnI_2 \rightarrow NaI + NaZn_4$

$HBrO_3 + HBr \rightarrow H_2O + Br_2$

$Al_4C_3 + H_2O \rightarrow Al(OH)_3 + CH_4$

$Ca(NO_3)_2 \cdot H_2O + LaC_2 \rightarrow Ca(NO_3)_2 + La(OH)_2 + C_2H_2$

$CH_3NO_2 + Cl_2 \rightarrow CCl_3NO_2 + HCl$

$Ca_3(PO_4)_2 + SiO_2 + C \rightarrow CaSiO_3 + CO + P$

$Al_2C_6 + H_2O \rightarrow Al(OH)_3 + C_2H_2$

$NaF + CaO + H_2O \rightarrow CaF_2 + NaOH$

$LiH + AlCl_3 \rightarrow LiAlH_4 + LiCl$

$CaSi_2 + SbCl_3 \rightarrow Si + Sb + CaCl_2$

$TiO_2 + B_4C + C \rightarrow TiB_2 + CO$

$NH_3 + O_2 \rightarrow NO + H_2O$

NpF_3 + O_2 + HF □ NpF_4 + H_2O

NO_2 + H_2O □ HNO_3 + NO

$LiAlH_4$ + BF_3 □ LiF + AlF_3 + B_2H_6

Word Equations

The ability to transfer word equations and sentences to balanced chemical reactions, requires many rules and hints. The following are a few to help you

1. There are 7 diatomic gases. Anytime these elements are written on their own, they will always be placed as a pair.
   - Hydrogen gas
   - Nitrogen gas
   - Oxygen gas
   - Fluorine gas
   - Chlorine gas
   - Bromine gas
   - Iodine gas
2. Any element that is written on its own is just the element symbol by itself. Even if they indicate a valence, you only use that number when combining elements to make compounds.
   Example: Iron (II) is written as
3. If an acid is formed, the compound must has an H in the formula. (H^+)
   Example: An acid with a chloride is written as
4. If a base is formed, the compound must have an OH in the formula. (OH^-)
   Example: A base with a Calcium is written as
5. An indicator will let us know if a substance is an acid or a base. The following is a chart to tell you which indicator colour matches either the acid or the base.

Indicator	In Acid	In Base
Bromothymol Blue (BTB)		
Phenolphthalein		
Litmus		

6. If a substance with C, H and sometimes O is burned in Oxygen, then the products must be **CO_2** and **H_2O**.
   Example:
7. If a gas is produced and a burning splint is placed in it, it will indicate which gas is produced

Gas	Reaction when a burning splint is placed in its presence
Hydrogen	
Oxygen	
Carbon Dioxide	

Word Equations

Write a Balanced equation for the following:

1. Hydrogen Gas + Oxygen Gas □ Water
2. Aluminium Metal + Oxygen Gas □ Aluminium Oxide
3. Solid Antimony + Chlorine Gas □ Solid Antimony (V) chloride
4. Iron + Oxygen Gas □ Solid Iron III Oxide
5. Solid Copper II Oxide + Hydrogen Gas □ Copper Metal + Water
6. Hydrogen Gas + Chlorine Gas □ Hydrogen Chloride Gas
7. Solid Magnesium Bromide + Chlorine Gas □ Solid Magnesium Chloride + Bromine Gas
8. Iron Metal + Hydrochloric Acid □ Hydrogen Gas + Solid Iron II Chloride
9. Hydrogen Gas + Nitrogen Gas □ Ammonia Gas
10. Solid Calcium Chloride □ Calcium Metal + Chlorine Gas
11. Metallic iron III was heated with solid sulphur to form a single solid sulphide.
12. Potassium metal was burned in oxygen gas to produce a solid oxide.
13. Solid silicon was burned in pure bromine gas to form a single solid product.

14. Solid arsenic with a valence of 5 was burned in oxygen gas to produce a single solid white powder.

15. When a spark was passed through a mixture of nitrogen gas and hydrogen gas, the resulting explosion produced a single gaseous product.

16. When hot carbon monoxide is passed over iron ore (iron III oxide), MOLTEN iron and carbon dioxide are produced.

17. Phosphorus powder in valence state V is completely oxideized in pure oxygen gas to produce fine white powder.

18. Solid sulphur (IV) is burned in oxygen gas to produce a strong smelling gas.

19. The solid oxide of magnesium is mixed with water causing BTB to turn blue when added to the resulting solution.

20. Arsenic V oxide powder is dissolved in water to form an acid similar to phosphoric acid.

21. Calcium metal is added to water. A gas is produced that pops when a burning splint is inserted. BTB turns blue when added to the water.

22. Lithium metal when added to water melts, ignites and produces small explosions, BTB turns blue when added to the water.

23. Magnesium metal added to hydrochloric acid produces an explosive gas and a soluble binary compound.

24. When zinc metal is added to hydrochloric acid, a gas is released. This gas is the same gas that is produced when all metals react with an acid or with water.

25. A solution of copper II chloride is poured over pieces of lead. The lead rapidly takes on a crusty appearance and the blue colour of the copper ion solution fades.

26. Hot steam passed over pure carbon powder produces carbon monoxide and hydrogen gas.

Types of Chemical Reactions

Types of Chemical Reactions

1. SYNTHESIS

- Synthesis reactions are involved in the combination of smaller atoms/molecules into larger molecules.
- It is the exact opposite of decomposition reactions
- It will have more than one reactant
- It will only have one Product

The General Equation is **A + B □ AB**

Example: Carbon Dioxide + Water □ Carbonic Acid

Write the following as balanced chemical reactions

1. Hydrogen + Oxygen □ Water

2. Nitrogen + Hydrogen □ Ammonia

3. Lithium Oxide + Water □ Lithium Hydroxide

4. Sulfur trioxide + Water □ Sulfuric Acid

5. Lead (II) Oxide + Nitrogen dioxide + Oxygen □ Lead (II) Nitrate

6. When carbon is added to hydrogen gas, a single gaseous product is produced.

7. When chlorine gas was blown over calcium, a new product is formed.

8. When nitrogen monoxide is released into the air, it combines with water and oxygen gas in the clouds to produce nitric acid.

9. When Bromine gas is blown over Lead with a valence of 4+, a new product is formed.

10. When copper with a valence of 2+ is burned in Nitrogen dioxide and oxygen gas, a single nitrate product is produced.

When determining the product of a synthesis reaction, the only ones you would be required to do is ones where you are combining two elements to form a compound. When creating the product, find the valences of both elements and cross them down to form a compound. Then, balance the equation.

Example: Nickel (III) + Fluorine Gas

11. Zinc + Oxygen gas

12. Tin (IV) + Chlorine gas

13. Gold (III) + Nitrogen gas

14. Calcium + Phosphorus

15. Lithium + Carbon

Types of Chemical Reactions

Types of Chemical Reactions

2. Decomposition

- Large molecules are split or broken down into elements or smaller compounds
- It is the exact opposite of synthesis reactions
- It will only have one Reactant
- It will have more than one Product

The General Equation is **AB □ A + B**

Example: Carbonic Acid □ Carbon Dioxide + Water

Write the following as balanced chemical reactions

16. Mercury(I)oxide □ Mercury + Oxygen

17. Iron(II)oxide □ Iron + Oxygen

18. Antimony(V)oxide □ Antimony + Oxygen

19. Magnesium chlorate □ Magnesium chloride + Oxygen

20. Xenon hexafluoride □ Xenon + Fluorine

21. When an electric current is run through water, it will produce two elemental gases.

22. When Iron(III)Chloride is heated, it decomposes into it's elements.

23. When Potassium Chlorate is heated, it decomposes into Potassium Chloride and Oxygen gas.

24. When Aluminum Bromate is heated, it decomposes into Aluminum Bromide and Oxygen gas.

25. When Carbonic Acid decomposes, it produces carbon dioxide gas and water vapours.

When determining the product of a decomposition reaction, the only ones you would be required to do is ones where you are decomposing a reactant that is made up of only two elements. When creating the products, write both elements separately with a + sign in the middle. See if any are diatomic gases, if so, place the subscript 2. Then, balance the equation.

Example: Nickel(III)fluoride

26. AlN

27. Zinc Chloride

28. Gold (III) sulfate

29. Chromium (III) Iodide

30. Lead (II) Nitride

Types of Chemical Reactions

Types of Chemical Reactions

3. Single Displacement

- Single displacement reactions have the single element replaces another element in the product
- It will have an element and a compound in the reactants
- It will have an element and a compound in the products

The General Equation is **A + BC □ B + AC** **if A is a metal**
X + BC □ C + BX **if X is a non metal**

Example: Zinc + Aluminum Chloride □ Aluminum + Zinc Chloride

Fluorine + Gold (III) Nitride □ Nitrogen + Gold (III) Fluoride

Write the following as balanced chemical reactions

31. Sodium + Aluminum chloride □ Aluminum + Sodium Chloride

32. Chlorine gas + Lithium Bromide □ Bromine Gas + Lithium Chloride

33. Magnesium + Silver Nitrate □ Silver + Magnesium Nitrate

34. Lead + Copper (II) Oxide □ Copper + Lead (IV) Oxide

35. Fluorine + Aluminum Iodide □ Iodine + Aluminum Fluoride

Write the following as balanced chemical reactions

36. When Lithium Sulfide is mixed with Gold with a valence of 3+, a new ionic compound is formed.

37. When chlorine gas was blown over calcium bromide, a new product is formed and a gas was released.

38. When Nickel (III) Sulfate is mixed with Zn, a new metal is produced.

39. When Bromine gas is blown over Lead (IV) Oxide, a crusty coating appears on the oxide.

40. When Calcium is added to aqueous Copper (II) Nitrate, the solution loses its blue colour and is replaced with a dark orange metal.

41. Zinc + Potassium Oxide

42. Tin (IV) Sulfide + Chlorine gas

43. Gold (III) + Magnesium Nitride

44. Calcium Fluoride + Phosphorus

45. Lithium + Tin (IV) Sulfide

Types of Chemical Reactions

Types of Chemical Reactions

4. Double Displacement

- Single elements in different compounds replace themselves in the compounds found in the product.
- Element switch positions with another element of the same charg
- The reactants will be two compounds
- The products will be two compounds

The General Equation is **AB + CD □ CB + AD**

Example: Lithium Bromide + Calcium Oxide □ Calcium Bromide + Lithium Oxide

Write the following as balanced chemical reactions

46. Potassium Carbonate + Barium Chloride □ Barium Carbonate + Potassium Chloride

47. Sodium Carbonate + Sulfuric Acid □ Carbonic Acid + Sodium Sulfate

48. Aluminum Sulfate + Calcium Phosphate □ Calcium Sulfate + Aluminum Phosphate

49. Chromium (III) Sulfite + Sulfuric Acid □ Sulfurous Acid + Chromium (III) Sulfate

50. Zinc Phosphate + Gold (III) Sulfate □ Gold (III) Phosphate + Zinc Sulfate

51. Tin (II) Chloride + Aluminum Sulfide □

52. Calcium Oxide + Gold (III) Nitride □

53. Lead (IV) Bromide + Magnesium Sulfide □

54. Sulfuric Acid + Nickel (III) Nitrate □

55. Barium Sulfite + Lithium hypochlorite □

56. When copper (II) Nitrate is added to Lithium Hydroxide, the blue colour of the copper (II) nitrate begins to disappear.

57. When nitrous acid is poured into zinc phosphate, a new acid and a new ionic compound are formed.

58. When Ammonium Chloride and Zinc Oxide are mixed, it produces two new chemicals

59. When Phosphoric Acid is mixed with Strontium nitrate, the phosphoric acid is destroyed but when you add litmus paper to the product, it turns red.

60. When beryllium oxide is mixed with lithium hypobromite, two new chemicals are formed.

Types of Chemical Reactions

Types of Chemical Reactions

4.b) Neutralization

- Include an Acid and a Base
- Always produce an ionic salt
- Always produce water

The General Equation is **Acid + Base □ Salt + Water**

Example: Sodium Hydroxide + Hydrochloric Acid □ Sodium Chloride + Water

Write the following as balanced chemical reactions

61. Hydrochloric acid + Barium Hydroxide □ Barium Chloride + Water

62. Calcium Hydroxide + Nitric Acid □ Calcium Nitrate + Water

63. Hydrobromic acid + Potassium Hydroxide □ Potassium Bromide + Water

64. Lithium Hydroxide + Phosphoric acid □ Lithium Phosphate + Water

65. Hydrofluoric acid + Aluminum Hydroxide □ Aluminum Fluoride + Water

When predicting the products of the neutralization reaction, you follow the same rules as for double displacement. The good thing about neutralization is you know one of your products will always be water.

Example: Sodium Hydroxide + Carbonic acid □

66. Hydroiodic acid + Zinc Hydroxide □

67. Barium Hydroxide + Nitric Acid □

68. Sulfuric Acid + Lithium Hydroxide □

69. Potassium Hydroxide + hydrobromic acid □

70. Chloric acid + Magnesium Hydroxide □

71. When doing a titration reaction, sodium hydroxide is being neutralized by sulphuric acid.

72. Water was produced when nitric acid was mixed with potassium hydroxide

73. When cleaning up a sulphuric acid spill, the teacher poured lithium hydroxide on the spill before wiping it up.

74. A compound made with Calcium would turn phenolphthalein fuschia in colour, was mixed with hydrochloric acid.

75. A Neutralization reaction occurred between phosphoric acid and magnesium hydroxide.

Types of Chemical Reactions

Types of Chemical Reactions

5. Combustion

- Always involves a chemical with C, H and sometimes O.
- O_2 is always a reactant
- CO_2 is always a product
- H_2O is always a product

The General Equation is **Substance with C,H,(maybe O) + O_2 □ CO_2 + H_2O**

Example: Carbon Tetrahydride + Oxygen □ Carbon Dioxide + Water

Write the following as balanced chemical reactions

76. C_2H_6 + Oxygen □ Carbon Dioxide + Water

77. C_2H_4 + Oxygen □ Carbon Dioxide + Water

78. C_4H_{10} + Oxygen □ Carbon Dioxide + Water

79. $C_{15}H_{30}$ + Oxygen □ Carbon Dioxide + Water

80. $C_{10}H_{20}$ + Oxygen □ Carbon Dioxide + Water

When you are creating combustion questions, remember that combustion means that it is burned. When given the substance, you always have oxygen gas as a reactant and your products are always carbon dioxide and water.

Example: C_6H_6

81. C_5H_{10}

82. C_8H_{18}

83. $C_2H_4O_2$

84. $C_6H_{12}O_6$

85. $C_{10}H_{20}O$

86. When C_6H_8 is burned in the presence of oxygen, it produces a gas and water vapour

87. When CH_3COOH is burned, it produces lots of gas and water vapour

88. Burning C_3H_4O produces lots of gas

89. Water vapour and carbon dioxide is produced when $C_{10}H_{22}$ is burned

90. Carbon dioxide is one of the products when $C_{12}H_{22}O_{11}$ is burned.

Types of Chemical Reactions Worksheet

Balance the following equations and name the type of reaction.

1. H_2O → H_2 + O_2 _____
2. Fe + $CuSO_4$ → Cu + $FeSO_4$ _____
3. Mg + O_2 → MgO _____
4. Cl_2 + NaBr → NaCl + Br_2 _____
5. Mg + HCl → $MgCl_2$ + H_2 _____
6. $NaHCO_3$ → Na_2CO_3 + H_2O + CO_2 _____
7. C + O_2 → CO_2 _____
8. Li + H_2O → LiOH + H_2 _____
9. KI + $Pb(NO_3)_2$ → PbI_2 + KNO_3 _____
10. Al + O_2 → Al_2O_3 _____
11. HgO → Hg + O_2 _____
12. HCl + NaOH → NaCl + H_2O _____
13. CO_2 + H_2O → H_2CO_3 _____
14. Na_2CO_3 + $CuSO_4$ → Na_2SO_4 + $CuCO_3$ _____
15. NH_3 + H_2SO_4 → $(NH_4)_2SO_4$ _____
16. $Cu(OH)_2$ + HNO_3 → $Cu(NO_3)_2$ + H_2O _____
17. $Fe(OH)_3$ + H_2SO_3 → $Fe_2(SO_3)_3$ + H_2O _____
18. H_2CO_3 → CO_2 + H_2O _____
19. Na_2S + $Pb(NO_3)_2$ → $NaNO_3$ + PbS _____
20. Na_2O → Na + O_2 _____

The Relative Atomic Weight of Magnesium Lab

Purpose:

Atoms cannot be weighed directly. In order to assign a weight to atoms of an element such as magnesium one must compare it's weight to another element such as oxygen. This comparison weight is called a relative atomic weight. Experimentally, this is done by reacting magnesium and oxygen and using the ratio of their reacting weights as a measure of their relative weights (on an atom to atom bases). Oxygen is then assigned a specific weight in atomic mass units (u). Using the combining ratio of Mg/O, a specific weight in u is assigned to the magnesium atom. This procedure was used by John Dalton to assign atomic weights. A verification of the Law of Definite Proportions for the elements magnesium and oxygen is also investigated. Dalton's atomic theory supports this law.

Procedure and Observations:

1. Support a crucible with its lid on a clay triangle.
2. Heat the crucible intensely for one minute.
3. Let it cool for 5 minutes.
4. Remove the crucible with flask tongs and weigh the crucible. Record the weight. m=_____
5. Obtain a 10 cm magnesium ribbon and coil it to fit inside the crucible.
6. Reweigh the crucible and magnesium. Record the weight. m=_____
7. Heat the magnesium in the crucible intensely for at least 10 minutes. Slide the lid across every 30 seconds to allow oxygen to enter. CAUTION: DO NOT STARE AT THE MAGNESIUM FLAME. It produces ultraviolet rays which may harm your eyes. Observe any reaction.
8. Let the crucible cool for 5 minutes.
9. Observe the contents.
10. Re-weigh crucible and magnesium oxide. Record the weight. m=_____
11. Scrape the crucible clean with a scoopula discarding the solid into a waste container.

Calculations and Questions:

1. Calculate the original weight of the magnesium.
2. Calculate the weight of magnesium oxide formed.
3. Calculate the weight of oxygen reacted.
4. Calculate the ratio by weight of magnesium to oxygen (Mg:O).
5. Calculate the weight of one magnesium atom, in amu, given that one oxygen atom weighs 16 amu.
6. Why can't atoms be weighed directly?
7. You based your calculation on the fact that one Mg atom combines with one O atom. Suppose that 2 atoms of O combined with one Mg atom: $Mg + 2O = MgO_2$. What effect would this have on your calculation in #4.
8. Carbon could be substituted for magnesium in this experiment. What problems would exist that were not present with magnesium?
9. Why was the crucible initially heated for one minute?
10. Determine the %yield of the experiment by comparing the value of Mg from your periodic table.

% yield = (Actual amount from the experiment)/(Theoretical amount on the periodic table) x 100%

Single Displacement with the Activity Series

After completing the Reactivity of Metals lab, we are aware that not all single displacement reactions will take place. For the reaction to occur, the single element must be higher on the activity series than the element that is in the compound. If this occurs, the elements will switch places. If this does not occur, there is no reaction.

Do the following reactions take place and if so, what would be their balanced chemical equation.

Examples

$Mg + Pb(NO_3)_2$ □

$Cu\ (I) + ZnCl_2$ □

$Cl_2 + LiI$ □

$Sn\ (IV) + AgNO_3$ □

Practice Questions

1. $Fe\ (III) + CuSO_4$ □
2. $Ni\ (II) + NaCl$ □
3. $Li + ZnCO_3$ □
4. $Mg + Zn(NO_3)_2$ □
5. $F_2 + NaCl$ □
6. $Br_2 + ZnF_2$ □
7. $K + Ni(NO_3)_3$ □
8. $Cu\ (II) + MgO$ □
9. $Al + AuI$ □
10. $Cl_2 + AlBr_3$ □
11. $I_2 + AgF$ □
12. $F_2 + PbCl_4$ □
13. $Pb\ (IV) + CaO$ □
14. $Ca + Fe_2O_3$ □

Dissolving Ionic Salts in Water Equations

When ionic salts are placed in water, most will dissociate into the different ions.
Remember that ions are charged and must show a **charge** and have **(aq)** as a subscript.

Examples:

KCl □

ZnF_2 □

$CaCO_3$ □

$Ca(ClO_4)_2$ □

Practice Questions:

1. NaI □
2. $BaBr_2$ □
3. Li_3N □
4. Al_2S_3 □
5. MgO □
6. $CsNO_3$ □
7. $Pb(SO_4)_2$ □
8. K_2CO_3 □
9. $Al(IO_3)_3$ □
10. $AgBrO_4$ □
11. $Zn_3(PO_4)_2$ □
12. CuO □
13. NiN □
14. $FeCl_2$ □

Creative Chemical Equation

There are many different chemical equations that are occurring all the time at home, in our community and in the world.

Find one balanced chemical equation that happens in your life and display it in a creative form.

Remember:

1. **The equation must be balanced.**
2. **The form in which you present your equation is open to your creativity.**
3. **Please include a sheet of paper with the balanced chemical equation and where it is found in your life.**

Due Date:_____

Balancing Redox Equations

Oxidation numbers or Oxidation state - the charge an atom would have if the electrons in each bond entirely belonged to the more electronegative atom. (The apparent charge on an atom in the combined state.)

Assigning Oxidation Numbers to elements

1. Any element when not combined with atoms of a different element has an oxidation number of zero.
2. Any simple monatomic ion has an oxidation number equal to its charge.
3. The sum of the oxidation numbers of all atoms in a compound must equal zero
4. The sum of the oxidation numbers of atom in a radical ion must equal the charge of that ion.
5. The oxidation number of metals in group IA is +1, group IIA is +2, and aluminum is +3
6. H and F in compounds have +1 and -1 oxidation numbers
7. Oxygen has a -2 oxidation number
8. Group 17B has a -1 oxidation number
9. Group 16B has a -2 oxidation number
10. Group 15B has a -3 oxidation number
11. When there is a conflict between two of these rules or an ambiguity in assigning an oxidation number, apply the rule with the lower number and ignore the conflicting rule.

Examples:

H_2O NO_3^- $Na_2S_2O_3$ $CaCl_2$

OCl^- H_2O_2 C_3H_8O $Ni_2(SO_4)_3$

Oxidation - a reaction in which a reactant undergoes a loss of electrons.
Reduction - a reaction in which a reactant under goes a gain of electrons.

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Loss Electrons Oxidation ----- Gain Electrons Reduction

Oxidizing Agent - the reactant that causes oxidation - the substance that gains the electrons in a reaction.
Reducing Agent - the reactant that causes reduction - the substance that supplies the electrons in a reaction.

Identify what is oxidized, reduced, the oxidizing agent, the reducing agent

2Fe + 3Cl2 ------> 2FeCl3 Sn + O2 ------> SnO2

Redox reaction - a chemical reaction in which changes in the oxidation numbers occur

Balancing Redox Equations Using Oxidation Numbers

1. Assign oxidation numbers to the atoms in the equation.
2. Identify which atoms change oxidation number.
3. Compute the total change in oxidation number for the oxidation and reduction that occur.
4. Multiply the change by the number of atoms that are changing in its formula.
5. Make the total increase in oxidation number equal to the total decrease by multiplication using appropriate factors.
6. Balance the remainder by inspection
   - It may be easier if you balance the Oxygens last
   - It may be easier if you balance the Hydrogens second last

$$HNO_3 + H_3AsO_3 \rightarrow H_3AsO_4 + NO + H_2O$$

$$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow K_2SO_4 + MnSO_4 + Fe_2(SO_4)_3 + H_2O$$

$$NaI + HOCl \rightarrow NaIO_3 + HCl$$

$$Zn + HNO_3 \rightarrow Zn(NO_3)_2 + NH_4NO_3 + H_2O$$

$$I_2 + NaOH \rightarrow NaI + NaIO_3 + H_2O$$

Balance the following oxidation reduction reactions.

$H_2S + HNO_3 \rightarrow S + NO + H_2O$

$H_2S + HNO_3 \rightarrow H_2SO_4 + NO_2 + H_2O$

$HI + H_2SO_4 \rightarrow I_2 + H_2S + H_2O$

$HBr + H_2SO_4 \rightarrow Br_2 + SO_2 + H_2O$

$KMnO_4 + HBr \rightarrow Br_2 + MnBr_2 + KBr + H_2O$

$KMnO_4 + H_2S + H_2SO_4 \rightarrow S + MnSO_4 + K_2SO_4 + H_2O$

$K_2Cr_2O_7 + H_2S + H_2SO_4 \rightarrow S + Cr_2(SO_4)_3 + K_2SO_4 + H_2O$

$S + H_2SO_4 \rightarrow SO_2 + H_2O$

$NaOH + Br_2 \rightarrow NaBrO_3 + NaBr + H_2O$

$S + HNO_3 \rightarrow H_2SO_4 + NO_2 + H_2O$

$Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2 + H_2O$

$Fe + HNO_3 \rightarrow Fe(NO_3)_2 + NO + H_2O$

$HBr + K_2Cr_2O_7 \rightarrow CrBr_3 + KBr + Br_2 + H_2O$

$FeCl_2 + KNO_3 + HCl \rightarrow FeCl_3 + NO + H_2O + KCl$

$Zn + NaNO_3 + NaOH \rightarrow Na_2ZnO_2 + NH_3 + H_2O$

$K_2Cr_2O_7 + CH_3OH + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + K_2SO_4 + HCOOH + H_2O$

$F_2 + KOH \rightarrow KF + F_2O + H_2O$

$Pb_3O_4 + HCl \rightarrow PbCl_2 + Cl_2 + H_2O$

$Sb_2(SO_4)_3 + KMnO_4 + H_2O \rightarrow H_3SbO_4 + K_2SO_4 + MnSO_4 + H_2SO_4$

$Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + NaI$