**Unit 7: Chemical Equations**  Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Evidence of a chemical reaction:

A reaction has occurred if the chemical and physical

properties of the reactants and products differ.



For a reaction to occur, particles of reactants must

collide, and with sufficient energy 🡪

activation energy:

Chemical reactions release or absorb energy.

catalyst: speeds up reaction wo/being consumed

…

|  |  |  |
| --- | --- | --- |
| AE | AE |  |

time time

Examples:

**Reaction Conditions and Terminology**

Certain symbols give more info about a reaction.

(s) = solid



NaCl(s)

NaCl(aq)

(l) = liquid

(g) = gas

(aq) = aqueous (dissolved in H2O)

More on aqueous…

-- “soluble” or “in solution” also indicate that a substance is dissolved in water (usually)

-- acids are aqueous solutions

Other symbols…

means “yields” or “produces”



 means heat is added to the reaction MgCO3(s) MgO(s) + CO2(g)

400oC

Temp. at which we perform rxn. might be given. C6H5Cl + NaOH C6H5OH + NaCl

Pt

The catalyst used might be given. C2H4(g) + H2(g) C2H6(g)

precipitate: a solid product that forms in an aqueous solution reaction

|  |  |
| --- | --- |
| Factors that influence  the rate of a reaction | To make reaction  rate increase… |
| concentration of reactants |  |
| particle size |  |
| temperature |  |
| mechanical mixing |  |
| pressure |  |
| catalyst | use one |
| nature of reactants | N/A |

In a reaction:

**Balancing Chemical Equations**

EX. solid iron reacts with oxygen gas to yield solid iron (III) oxide

If all coefficients are 1…

If we change subscripts…

Changing a \_\_\_\_\_\_\_\_\_\_\_ changes the substance. To balance, only modify \_\_\_\_\_\_\_\_\_\_\_\_\_. Right now, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ don’t enter into our “balancing” picture.

\_\_ Fe(s) + \_\_ O2(g) 🡪 \_\_ Fe2O3(s)

Hint: Start with most complicated substances first and leave simplest substances for last.

solid sodium reacts w/oxygen to form solid sodium oxide

Aqueous aluminum sulfate reacts w/aqueous calcium chloride to form a white precipitate of calcium sulfate. The other compound remains in solution.

Methane gas (CH4) reacts with oxygen to form carbon dioxide gas and water vapor.

\_\_\_CaC2(s) + \_\_\_H2O(l) 🡪 \_\_\_C2H2(g) + \_\_\_CaO(s)

\_\_\_CaSi2 + \_\_\_SbI3 🡪 \_\_\_Si + \_\_\_Sb + \_\_\_CaI2

\_\_\_Al + \_\_\_CH3OH 🡪 \_\_\_Al(CH3O)3 + \_\_\_H2

**\*\*** \_\_\_C2H2(g) + \_\_\_O2(g) 🡪 \_\_\_CO2(g) + \_\_\_H2O(l)

**\*\*** \_\_\_C3H8 + \_\_\_O2 🡪 \_\_\_CO2 + \_\_\_H2O

**\*\*** \_\_\_C5H12 + \_\_\_O2 🡪 \_\_\_CO2 + \_\_\_H2O

**\*\*** =

Write equations for the combustion of C7H16 and C8H18.

**Classifying Reactions** 🡪 four types

synthesis: simpler substances combine to form more complex substances

oxygen + rhombic sulfur 🡪 sulfur dioxide

sodium + chlorine gas 🡪 sodium chloride

decomposition: complex substances are broken down into simpler ones

lithium chlorate 🡪 lithium chloride + oxygen

water 🡪 hydrogen gas + oxygen gas

single-replacement: one element replaces another

chlorine + sodium 🡪 sodium + bromine

bromide chloride

aluminum + copper (II) 🡪 ?

sulfate

double-replacement:

iron (III) + potassium 🡪 ?

chloride hydroxide

lead (IV) + calcium 🡪 ?

nitrate oxide

***How do we know if a reaction will occur?***

For single-replacement reactions, use Activity Series. In general, elements above replace elements below.

\_\_Ba + \_\_FeSO4 🡪

\_\_Mg + \_\_Cr(ClO3)3 🡪

\_\_Pb + \_\_Al2O3 🡪

\_\_NaBr + \_\_Cl2 🡪

\_\_FeCl3 + \_\_I2 🡪

\_\_CoBr2 + \_\_F2 🡪

For double-replacement reactions, reaction will occur if any product is:

\_Pb(NO3)2(aq) + \_KI(aq) 🡪

\_KOH(aq) + \_H2SO4(aq) 🡪

\_FeCl3(aq) + \_Cu(NO3)2(aq) 🡪

**Ions in Aqueous Solution**

Pb(NO3)2(s) Pb(NO3)2(aq)

Pb2+(aq) + 2 NO31–(aq)

Pb2+

NO31–

NO31–

NO31–

Pb2+

add

water

NO31–

dissociation:

NaI(s) NaI(aq)

Na1+(aq) + I1–(aq)

Na1+

I1–

I1–

Na1+

Mix them and get…

Balance to get overall ionic equation…

Cancel spectator ions to get net ionic equation…

Mix together Zn(NO3)2(aq) and Ba(OH)2(aq):

Zn(NO3)2(aq) Ba(OH)2(aq)

Zn2+(aq) + 2 NO31–(aq) Ba2+(aq) + 2 OH1–(aq)

Zn2+

NO31–

Ba2+

OH1–

OH1–

NO31–

Mix them and get…

Balance to get overall ionic equation…

Cancel spectator ions to get net ionic equation…

**Polymers and Monomers**

polymer: a large molecule (often a chain) made of many smaller molecules called monomers

Polymers can be made more rigid if the chains are linked together by way of a cross-linking agent.

**Monomer** **Polymer**

amino acids………………………………..

nucleotides (w/N-bases A,G,C,T/U)……..

styrene……………………………………...

PVA…………………………………………

**Quantitative Relationships in Chemical Equations**

4 Na(s) + O2(g) 🡪 2 Na2O(s)

|  |  |  |  |
| --- | --- | --- | --- |
| Particles |  |  |  |
| **Moles** |  |  |  |
| **Grams** |  |  |  |

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When going from moles of one substance to moles of another, use coefficients from balanced equation.

4 Na(s) + O2(g) 🡪 2 Na2O(s)

How many moles oxygen will react with 16.8 moles sodium?

How many moles sodium oxide are produced from 87.2 moles sodium?

How many moles sodium are required to produce 0.736 moles sodium oxide?