Chemistry 3A

Introductory General Chemistry

Experiment 10a

Types of Reactions

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Introduction

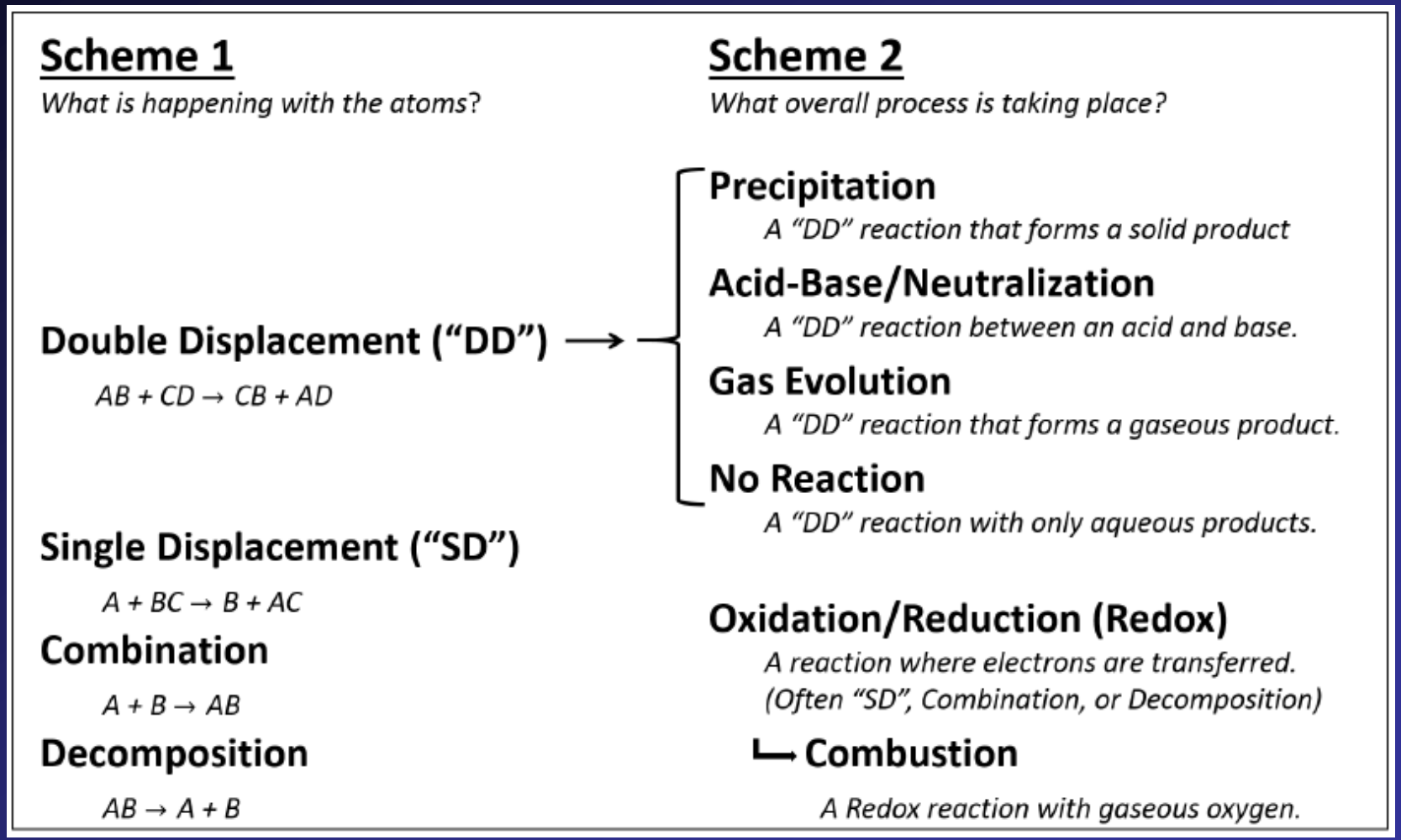
There are countless chemical reactions that can occur

But reactions fall within certain types, certain categories

This experiment is about studying one of each reaction that falls within a certain type or category

Background

With the types/categories of reactions, two "schemes" emerge
Scheme 1 is "what happens with atoms?" Scheme 2 is about process



Background

With the types/categories of reactions, two "schemes" emerge

Scheme 1 is "what happens with atoms?"

Double displacement (DD), single displacement (SD), combination, decomposition

Scheme 2 is about process: precipitation (DD), neutralization (DD), gas evolution (DD), dissolution only; redox, combustion

Precipitation		
Salt (*aq*) + Salt (*aq*)	→	New Salt (*s*) + New Salt (*aq*)
2 NaCl (*aq*) + $Pb(NO_3)_2$ (*aq*)	→	$PbCl_2$ (*aq*) + 2 $NaNO_3$ (*aq*)

Acid-Base / Neutralization		
Acid (*aq*) + Base (*aq*)	→	Salt (*aq*) + Water (*l*)
HNO_3 (*aq*) + KOH (*aq*)	→	KNO_3 (*aq*) + H_2O (*l*)

Background

Gas Evolution		
Salt (*aq*) + Acid (*aq*)	→	New Acid (*s*) + New Salt (*aq*)
New Acid (*aq*)	→	Gas (*g*) + Water (*l*)
Na_2SO_3 (*aq*) + 2 HCl (*aq*)	→	H_2SO_3 (*aq*) + 2 NaCl (*aq*)
H_2SO_3 (*aq*)	→	SO_2 (*g*) + H_2O (*l*)

No Reaction
The mixing of compounds in aqueous solution can sometimes result in none of the reactions mentioned

Background

Oxidation-Reduction (Redox)		
2 Na (*s*) + 2 H_2O (l)	→	H_2 (*g*) + 2 NaOH (*aq*)
2 Al (*s*) + 3 Cl_2 (*g*)	→	2 $AlCl_3$ (*s*)
Cu (*s*) + $Pd(NO_3)_2$ (*aq*)	→	Pd (*s*) + $Cu(NO_3)_2$ (*aq*)

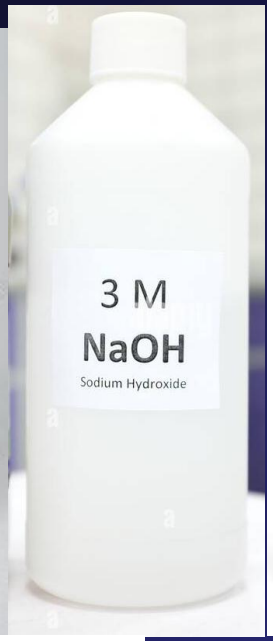
Combustion		
Hydrocarbon (*g,l,s*) + Oxygen (*g*)	→	Carbon Dioxide (*g*) + Water (*g*)
C_2H_4 (*g*) + 3 O_2 (*g*)	→	2 CO_2 (*g*) + 2 H_2O (*g*)
Metal (*s*) + Oxygen (*g*)	→	Metal Oxide (*s*)
2 K (*s*) + O_2 (*g*)	→	K_2O (*s*)

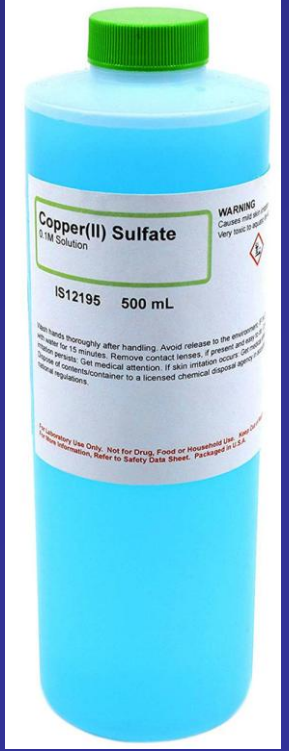
LAB SAFETY

- This laboratory session involves the use of seriously caustic chemicals
- Goggles and coat—AND ESPECIALLY GOGGLES—must be worn OVER THE EYES at all times if you are within 15 feet of any test tube with an ongoing reaction or containing a caustic chemical, whether you are managing the tube/reaction or not
- If you need to take off your goggles for whatever reason, exit the lab room and safely remove them
- You should wash your hands before putting your hands on face as a precaution if exiting lab
- Failure to observe safety is a reason for excusing you from the lab and taking a zero for the session

Equipment You Will Use

Consumables





Procedure

- All reactions will be done in test tubes. Do not concern yourself with measuring out exact quantities
- Consider "1 mL reagent" to ~20 gtt (drops) from a transfer pipet or a finger width in height in the test tube
- **1 g** reactant is about a pea size: don't weigh in balance
- Complete the stations in any order
- Waste containers are provided: do not dump in sink unless given instructions

Procedure

Station 1

a) Place **~3 mL** 6.0 M HCl in tube

b) Add a few Zn pellets, record observations

c) Get another empty test tube, invert it over reaction tube. Hold capture tube at angle still upside down, light a match and bring it to mouth of tube. What happens?

Station 2

a) Place **1 mL** 0.1 M $BaCl_2$ in tube

b) Add **1 mL** 0.1 M Na_2SO_4 to it, and mix/swirl. Record observation

c) Wait 3-5 minutes and record observation: what is the insoluble product?

While you are waiting at last step, perhaps go to another station and start that experiment

Procedure

Station 3

a) Place **1 mL** 0.1 M $BaCl_2$ in tube

b) Add **1 mL** 0.1 M Na_3PO_4 to it, and mix/swirl. Record observation

c) Wait 3-5 minutes and record observation: what is the insoluble product?

While you are waiting at last step, perhaps go to another station and start that experiment

Station 4

a) Place **2 mL** 1.0 M Na_2CO_3 in tube

b) Add **1 mL** 6 M HCl to it, and mix/swirl. Record observation

If you observe a gas, what is the gas. What is the reaction equation?

Procedure

Station 5

a) Place **~1 g** (small scoop) of $KClO_3$ in tube.

b) Grab the tube with a clamp at the TOP of the tube

c) In the fume hood, hold the tube at an angle and heat ONLY the bottom of the tube with blue cone flame of Bunsen burner. Let the $KClO_3$ melt, let it bubble, and heat until nothing happens

Did anything come out of tube. Record observations.

Station 6

a) Mix **1 mL** 0.1 M $CaCl_2$ with 1 mL 0.1 M Na_2CO_3

Record immediate observations. Then record observations after 3-5 minutes. Use the solubility tables to determine what product formed.

Procedure

Station 7

a) Mix **1 mL** 6.0 M HCl with **2 mL** 3.0 M NaOH

b) Record observations. Were there temperature changes (use your hand/fingers carefully to see if the mixture is cold or hot). Use understanding of chemistry to predict product(s)

Station 8

a) Mix **1 mL** 0.1 M KNO_3 with 1 mL 0.1 M $BaCl_2$

Record immediate observations. Then record observations after 3-5 minutes. Use the solubility tables to determine what product formed.

Procedure

Station 9

a) Transfer **2 mL** of 0.1 M $CuSO_4$ to tube

b) Add a few **Zn** pellets. Record immediate observations and after 3-5 minutes. Check if there are solid products what they look like. What accounts for the blue color?

Station 10

a) Mix **1 mL** 4.0 M NH_4Cl with **1 mL** 3.0 M NaOH. If there is a gas, what is it?

b) Moisten red litmus and hold it over the mouth of the tube: what is the color change and what causes it?

c) Take 2 fingers and waft the air from tube toward yourself: is there any strong odor? Do NOT put your nose or face over the tube!

Example Data Analysis

No example data is available for this laboratory since this is basically an in-lab exam of your knowledge of chemical reactions and the ability to write and balance chemical equations

So giving you the answers directly does not help the learning process

After the reports are submitted, the answers will be supplied for the report if they are not provided otherwise during the laboratory session

Clean Up

- The contents of the test tubes you make are to be dumped into waste beakers provided at each station
- Wash the Zn pellets with DI water, remove with forceps. The pellets will probably be collected by instructor in larger beaker, rewashed, prepared for drying and later re-use
- Most test tubes will likely be put in aqueous inorganic waste
- Solids can be flushed from tubes into waste container with minimal water flushing