

SPRING FINAL EXAM REVIEW

1ST SEMESTER + CHAPTER 8 TOPIC IDENTIFICATION REVIEW POSTERS

Disclaimer

These posters were edited by students in class – there may be incorrect information on these posters. If you notice anything incorrect please let your teacher know so they can try and update the photo.

Chapter 1: Basics and Atomic Structure

- Significant Figures - leading zeroes not significant
 0.05 ← if there's number after 01
- Atomic Theory ① All matter is made up of atoms ② All atoms of a specific element have the same size/mass/properties
- Dimensional Analysis - convert units
- Isotopes - atoms of same element w/ diff. masses
- Scientific Notation: $\times 10^{\square}$ or E^{\square}
base #: $1 < \text{base\#} < 10$
 $\neq 0$
- Metric conversions
King Henry Died By Drinking Chocolate Milk
- Particles of an Atom
↳ proton, neutron, electron
 $+1$ 0 -1
- Chemical / Physical properties
P: an altered state of appearance
C: altering the composition
- Types of matter
↳ pure substances: can be elements / compounds
↳ mixtures: can be heterogenous / homogenous
• homogenous: uniform throughout
• heterogenous: not uniform throughout
- ③ Atoms cannot be destroyed / created / divided
- ④ Atoms combine to form whole number ratios
chemical
- Gold Foil experiment
• nucleus found
• cathode ray tube
• electron

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Chapter # 2: Nuclear Chemistry

- Types of Decay - alpha, β , γ , positron
 - $\alpha \rightarrow {}^4_2\text{He}$
 - $\beta^- \rightarrow {}^0_{-1}\text{e}$
 - $\beta^+ \rightarrow {}^0_{+1}\text{e}$
 - $\gamma \rightarrow \gamma$
- Half Life - $A_t = A_0(0.5)^{t/t_{1/2}}$
 - Exponential growth
- Decay Series
 - ${}^{238}_{92}\text{U} \rightarrow {}^4_2\alpha + {}^{234}_{90}\text{Th} \rightarrow {}^{234}_{91}\text{Pa} \rightarrow {}^{234}_{92}\text{U} \rightarrow {}^{230}_{90}\text{Th} \rightarrow {}^{226}_{88}\text{Ra} \rightarrow {}^{222}_{86}\text{Rn} \rightarrow {}^{218}_{84}\text{Po} \rightarrow {}^{214}_{82}\text{Pb} \rightarrow {}^{214}_{83}\text{Bi} \rightarrow {}^{214}_{84}\text{Po} \rightarrow {}^{214}_{82}\text{Pb} \rightarrow {}^{210}_{82}\text{Pb} \rightarrow {}^{210}_{83}\text{Bi} \rightarrow {}^{210}_{84}\text{Po} \rightarrow {}^{210}_{82}\text{Pb} \rightarrow {}^{206}_{82}\text{Pb}$
- Types of Radioactive Particles - Alpha, Beta, Gamma
 - Heavy: α
 - Light: β
 - Light: γ

~~Absorption~~ / Emission

- Nuclear/Regular
- Effects of nuclear Power (Applications)

Balancing Nuclear Equations

Nuclear Fission - splits nucleus

Stability

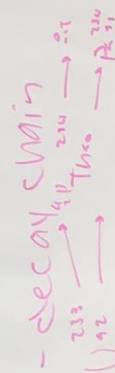
- look at periodic table

very stable
Atomic # 1-20

marginally stable
Atomic # 21-82

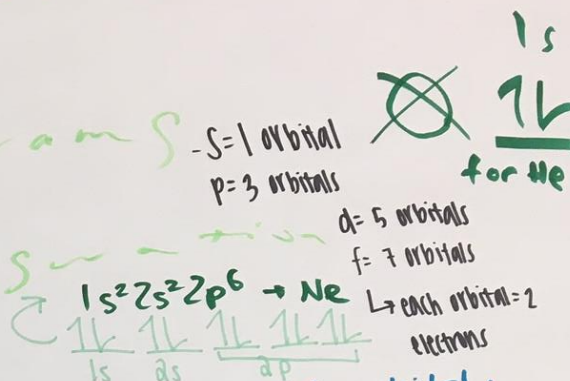
unstable/radioactive
Atomic # > 82

Chemical vs. Nuclear Rxns



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Electron Configuration



- Principles & Rules - Aufbau Principle: fill lowest possible orbital, Pauli Exclusion, no 2 electrons can be in same place and spin, Hund's: electrons fill equal before pairing spread out by putting them in a pair
- Noble Gas Configuration
 - ↳ take largest noble gas smaller than element, write out shells after noble gas that are filled
- Periodic Table Trick
 - use s, p, d, f - blocks and count
- Atomic Absorption/Emission - absorption: energy absorbed, electron pushed to higher level \Rightarrow only specific energies, different chemicals make different colors

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CHAPTER 4: PERIODIC TABLE

GROUPS OF ELEMENTS: alkali metals, alkaline earth metals, halogens, noble gases, transition metals, metalloids, nonmetals

ion don't bond never form cations

PERIODIC TRENDS: ionization energy, electronegativity, atomic radius, electron affinity, reactivity

(→ highest) (↑ highest) (↑ down) (→ right)

Effective Nuclear Charge

: relative charge after taking inner into account

$Z_{eff} = Z - S$ ← previous noble gas e⁻ and d/f block e⁻ if necessary

Isoelectric Species - same # of electrons

C^{4-} N^{3-} O^{2-} F^{-} Ne Na^{+} Mg^{2+} Al^{3+}

- **Shielding:** inner electrons keep valence electrons from "seeing" nucleus

- **Reactivity:** periodic table: increase non-metals, decrease for metals, close to shielding

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ch. 5 - Bonding/Structure

Main Ideas

- finding polarity through - lone pairs
Lewis structures
- **VSEPR** - Molecular Geometry, **AXE**, hybrid orbitals sp, sp^2, sp^3
 $\begin{array}{c} sp \\ \searrow \nearrow \\ sp^2 \\ \searrow \nearrow \\ sp^3 \end{array}$
- **IMFs** - ^{weakest} London Dispersion, ^{strongest} Hydrogen Bonding, ^{middle} Dipole-Dipole
- **TYPES OF BONDS** - Covalent, Ionic, metallic
_{polar, nonpolar}
- **Lewis Structures** - Single, Double, Triple Bonds, Octet rule
- **Writing Neutral Formulas** - Crossing Over: Barium Fluoride
 $\begin{array}{c} Ba^{2+} + 2F^{-} \\ \swarrow \searrow \\ BaF_2 \end{array}$
- **Naming compounds**: ionic, cation + anion (ide)
_{covalent: prefixes}
- **Polarity**: symmetric = nonpolar, asymmetric = polar, polar has one positive end (δ^+) and one negative (δ^-) lone pairs
- **Bulk Solids**: (Network Covalent), (Ionic lattice), (metallic)
_{e.g. BN, diamond, quartz}

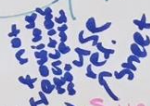
exceptions

H-2
Li-2
Be-4
B-6
P-10
S-12

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CHAPTER 6



Reactions

Types of Reactions

- Single replacement, double, combustion, Synthesis, decomposition

Predicting Products

- Net ionic, recognize type of reactions, **CROSS OVER!**

Balancing Equations

- coefficients **2** (subscripts), Law of Conservation of Mass

Molar Mass + conversions

- g/mol

(Dimensional Analysis)

PHASES OF ELEMENTS

- gas, solid, liquid, ^{aq} _{phase}

PARTS OF EQUATIONS

- Reactants, Products

skeleton: $A + B \rightarrow C + D$

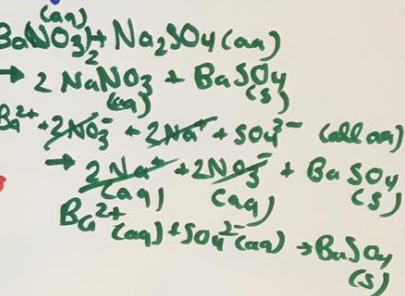
word \rightarrow self-explanatory

\rightarrow hydrogen + chlorine \rightarrow hydrogen chloride

Net Ionic Equations

- Spectator Ions removed

generic (not really for ionic) $\rightarrow A + B \rightarrow C + D$



Avogadro's Number

- 1 mol = 6.022×10^{23} molecules

\rightarrow conversion factor from moles to molecules

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Chapter 7: Stoichiometry

* Mole Ratio - Coefficients & Dimensional Analysis

* Limiting Reagents (one of the reactants is used up completely, while there is excess of the other) - Excess Reagent
 use mole ratios

Mole Highway - Grams $\xrightarrow{\text{molar mass}}$ Moles $\xrightarrow{\text{mole ratios}}$ Dimensional Analysis

use periodic table \leftarrow Molar Mass - grams/moles \rightarrow consider diatomics when calculating $\text{H}_2, \text{N}_2, \text{O}_2, \text{Br}_2, \text{I}_2, \text{F}_2, \text{Cl}_2$ STP for gases: $\frac{22.4 \text{ L}}{1 \text{ mol}}$

- Theoretical/Actual Yields (use these in experiments)
 \rightarrow percent yields
 Theoretical yield - quantities stoichiometry equations should make
 Actual yield - the quantity you should make in lab experiment
 $\therefore \text{yield} = \frac{A}{T} \times 100\%$
- Real-life stoich
 - check answers and see if you're actually answering the ?

Ex:

$$\frac{2 \text{ g Na}}{22.99 \text{ g}} \times 1 \text{ mol}$$

$$= \frac{2}{22.99} \text{ mol}$$

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CHAPTER #8:

Chemical Compositions

- **Combustion Analysis** — compounds containing C, H, O (addition of N)
• find C using CO_2 & H using H_2O
- **Empirical / Molecular Formula** — *• 7 for add H₂O & H₂O*
→ simplest, most reduced (smallest molar ratio)
version of formula
real formula
- **Percent Mass**: $\frac{\text{partial}}{\text{whole}} \times 100\% = \text{percent composition}$
- **Mole Ratio for $\text{CO}_2, \text{H}_2\text{O}$** ($1 \text{ mol } \text{CO}_2 = 1 \text{ mol C}$
 $1 \text{ mol } \text{H}_2\text{O} = 2 \text{ mol H}$)
- **Conservation of Mass** (you cannot make nor destroy matter)
- **Ionic Formulas** (always empirical)
- **Covalent Formulas** (sometimes empirical, sometimes not)

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CHAPTER 1 - Basics and atomic structure

Chemical change
- new molecule
- new composition
Physical change
- alter the state
- appearance, not
composition
- color change

• dimensional analysis - ex.

$$\frac{\text{Unit 1}}{\text{Unit 1}} = 1 \text{ Unit 2}$$

• sig figs - 3.0010 has 5 sig figs

$$\frac{3 \text{ yards} | 3 \text{ feet}}{1 \text{ yard}} = 9 \text{ feet}$$

• metric conversions

$$\frac{2 \text{ feet} | 12 \text{ inch}}{1 \text{ foot}} = 24 \text{ inches}$$

• Scientific notation 3,655 = 3.655 x 10³

• physical + chemical changes

• Atomic Structure - protons (+), neutrons (neutral), electrons (-)

• Atomic numbers and Isotopes

• Mixtures + Compounds

• Lab Safety - Don't drink acid!!!

MSD

- Avg. mass

$$(Mass_1)(\% \text{ abundance}_1) + (Mass_2)(\% \text{ abundance}_2) \dots$$

Physical
Chemical
Changes
and
Properties

isotopes have a # of neutrons different from # of protons

Milk
Chocolate
Drinking Dec.
Base
Died
Henry
King
Kilo
Hecto
Deca
Base
Centi
Milli
Micro
Nano

heterogeneous
homogeneous

EXERCISES

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NUCLEAR CHEM #2

Half life - $A_E = A_S \cdot (0.5)^n$ - using logarithms to solve

Nuclear equations

alpha - ${}^4_2\text{He}$ beta - ${}^0_{-1}\text{e}$

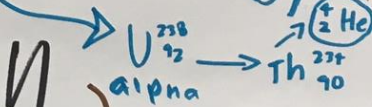
gamma - γ - penetration power of particles

Decay series

Fusion vs. Fission
coming together splitting apart

types of decay

nuclear stability



gamma
→ ALPHA

A_E = amount end at
 A_S = amount at start
 n = # of half-lives passed

→ Beta

Positron ${}^0_{+1}\text{e}$
neutron ${}^1_0\text{n}$

$n = \frac{t}{h}$
 t = time passed
 h = length of half life



Gamma often occurs w/ alpha or beta, NOT individually.

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Chapter 3: Electrons

Electron Configuration

→ s, p, d, f

→ $1s^2 2s^2 2p^6 3s^2 3p^3$

(Chlorine)

Absorption & Emission

— analysis of wave lengths of light absorbed

Orbital Diagrams

→ Aufbau, Pauli Exclusion, Hund's

Noble Gas Configurations

→ $[Xe] 6s^2$

(Barium)

Configuration of ion

→ take off from the highest energy level

Atomic absorption

Noble Gas Configuration

$Li^+ : 1s^2$

Shape + types of orbitals

s, p, d, f

electrons

Each orbital holds

Aufbau — electrons occupy the lowest energy orbital they can

Hund's — No 2 electrons in the same atom can have same 4 quantum #
Pauli exclusion — electrons will fill an orbital 1 e^- at a time before filling in another e^-

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d 6f

Each orbital can only have 2 e^- spin up spin down
s p d f
s p d f
s p d f
s p d f

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Chapter 4: Periodic Table

• Periodic trends

• Z_{eff} and Shielding $Z_{\text{eff}} = \# \text{ protons} - \# \text{ inner } e^-$

• noble gases

• Electron Affinity

Different from electronegativity

atomic/ionic radius

electronegativity

ionization energy

reactivity

valence electrons

Periodic table structure

• Classes of elements

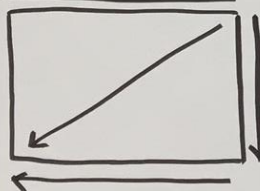
• ionizing energy

metals

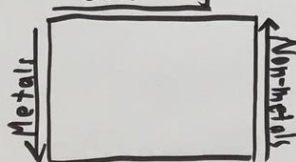
metalloid

non-metals

Atomic Radius

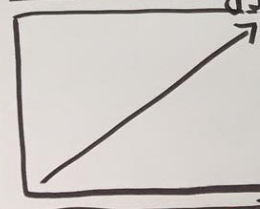


Reactivity



ionic radius - radius of an ion

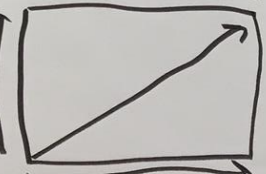
ionization energy



*also applies for electronegativity & electron affinity

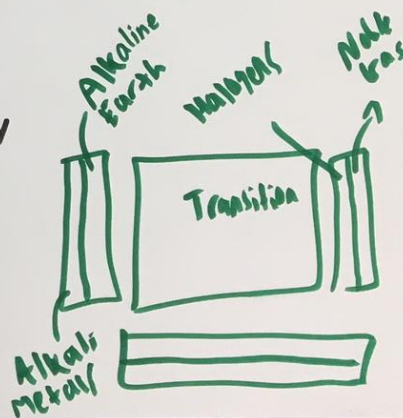
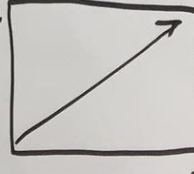
*except for noble gases

Electron Affinity



Electronegativity

Reactivity



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Chapter 5: Bonding and Structure

- Lewis Structures -
- Nomenclature of compounds
- VSEPR + molecular geometry (AXE) ^{→ bond angles}
- Polarity
- intermolecular forces → hydrogen, London dispersion, dipole-dipole
- types of bonds → ionic, covalent, metallic (sea of electrons)
- neutral ionic formulas
↳ Ba^{2+} and F^- → BaF_2 (1 and 2)
Bulk Solids - ionic lattice, metallic, & network covalent
- naming ionic compounds
↳ NaCl = Sodium Chloride
- Octet Rule (8 valence electrons) ^{Full shell}
exceptions: H-2ve, B-6ve, P-10ve, S-12ve
- Hybridization: sp, sp^2, \dots DOES NOT include d orbitals

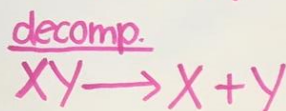
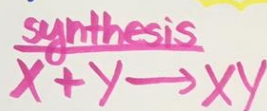
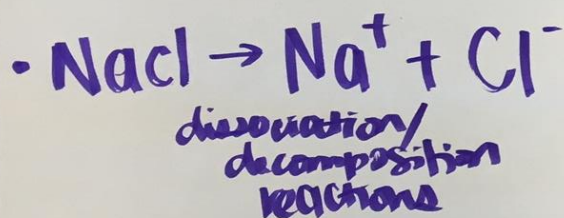
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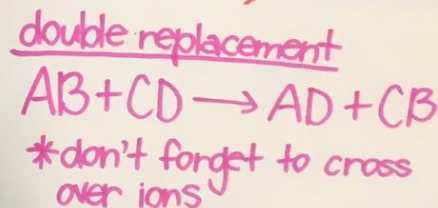
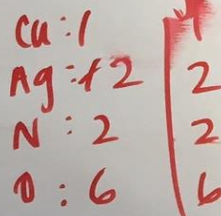
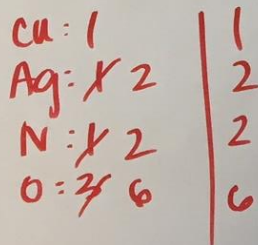
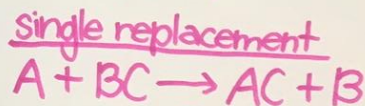
Chapter 6 Reactions

- Types of Reactions - single/double replacement, synthesis, combustion
- Predicting Products and Balancing reactions - subscripts and superscripts of ions
- Molar conversions - $\text{mole} \leftrightarrow \text{grams}$ (molar mass), $\text{mole} \leftrightarrow \text{molecules}$ (Avogadro's #)
- Net ionic equations - cross out similar ions
- Activity Series
- Solubility Rules - polarity of polarity, nonpolar

Molar mass ex) CO_2 $\text{C} = 12.01 \text{ g}$ $\text{O} = 16.00 \text{ g}$ $\text{CO}_2 = 12.01 + 2(16) = 44.01 \text{ g/mol}$



Balancing equations



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Chapter 7: Stoichiometry

★ limiting/excess reagents - Order of Steps

★ mole ratio and stoichiometry - $\frac{1 \text{ mol C}_2\text{H}_2}{2 \text{ mol C}}$

★ Percent Yield:

★ actual vs theoretical yield - How much we make vs. how much we should make
 $\% \text{ error} = \frac{a-t}{t}$

★ Mole Highway - go from grams \longleftrightarrow moles \longleftrightarrow # of molecules/particles
 mol. mass g/mol \longleftrightarrow Avogadro's # 6.02×10^{23}

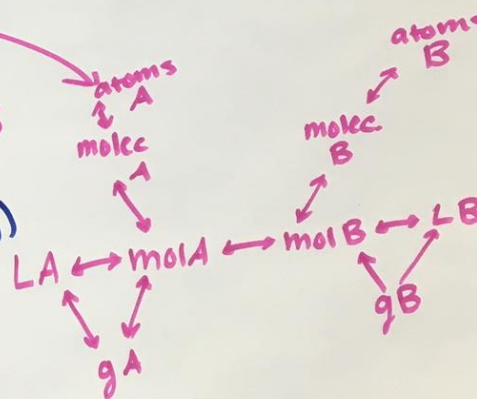
★ real-life examples

★ molar mass - go from grams to moles (moles to grams)

★ units - mL, L, kL, g, mg, kg, moles



$$\frac{90 \text{ g NaN}_3}{65.02 \text{ g NaN}_3} \times 1 \text{ mol NaN}_3$$



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Chapter 8:

CHEMICAL COMPOSITIONS

(simplest, reduced form) (real form)

• **Empirical / Molecular Formulas** - ionic formulas always empirical

• **Combustion Analysis** - hydrocarbons and oxygen [COMBUSTION reactions]

• **Percent composition** - % steps: $\frac{\text{Part}}{\text{Whole}} \cdot 100\%$

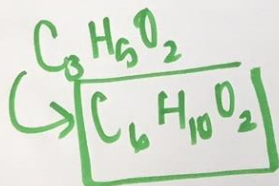
• **Problems w/ Nitrogen**

- Empirical formula
of $C_3H_5O_2$.
Molecular mass is
146 g/mol.

$$3(12.01) + 5(1.01) + 2(16) = 130.08 \text{ g/mol}$$

$$\frac{146}{130.08} = 1.127 \rightarrow 2$$

Round



to find empirical formula:

- Percent to mass

- Mass to moles

- Divide by small

- multiply by whole

ex: 0.6 = 8.58g yield 16.9g + 9.6g H₂O

16.9g C 1 mol C 1 mol C = 0.544 mol C

9.6g H₂O 1 mol H₂O 2 mol H = 1.088 mol H

0.364 mol C 12 g C 1 mol C = 4.37 g C

1.09 mol H 1.01 g H 1 mol H = 1.10 g H

8.58g sample - 4.37g C - 1.10g H = 2.91 g O

2.91g O 16 g O 1 mol O = 0.182 mol O

$\frac{0.544}{0.182} = 3$ $\frac{1.088}{0.182} = 6$ $\frac{4.37}{0.182} = 24$

$\frac{1.10}{0.182} = 6$ $\frac{2.91}{0.182} = 16$ $\frac{4.37}{0.182} = 24$

$\frac{1.09}{0.182} = 6$ $\frac{2.91}{0.182} = 16$ $\frac{4.37}{0.182} = 24$

$\frac{1.09}{0.182} = 6$ $\frac{2.91}{0.182} = 16$ $\frac{4.37}{0.182} = 24$

hydrogen always ends up in H₂O
carbon always ends up in CO₂ + H₂O

$C_6H_{10}O_4$