CHGN121 TOC

> CHGN121 - 2023-08-21
>
> #chemistry #notes #chgn121
>
> - Email ajameer@mines.edu
>   - Actually send the email, nothing weird, use mines email
> - Chemistry: A molecular approach, Tro, 5th edition
>   - Readings are assigned out of the textbook
> - You can really get by with anything between 2nd and 6th edition
> - Calculator to every class and lab
>   - Scientific
>   - Lab director is going to talk about stuff
> - Mastering Chemistry is part of Tro, and register through canvas
> - iClicker
>   - Must have hand held clicker or the iClicker mobile app
>   - Register using directions on canvas
>   - Physics also requires iClicker
>   - September 5th
> - Slides will be posted after class
>   - and, y'know, they're never really complete
> - Entrance survey is Exam 1 bonus credit! Yippee!!
>   - 20MC questions, it'll close on the 24th
>   - Need a periodic table + probably don't need a calculator
> - Challenge Exam to test out of chem
>   - Very low success rate
>   - Until the 24th at 3pm
> - When purchasing mylab & mastering, go ONE SEMESTER
> - All assignments are due by that unit exam (ie unit 1 is Friday, September 29th)
>   - No late assessments for any reasons
> - As long as at least 80% of the class is responding to the survey, everyone gets +0.5%
> - NO CHEM LAB - email from lab director
> -

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Fall '22 Cohort Advice

1. Preview topics before class
2. Treat Mastering homework like a test
3. Study as if you're going to teach someone
    1. I mean yeah, that's good study habits, go teach someone
4. Office hours
5. Sleepytime

- Uncertain
    - Estimate ONE past last certain digit
    - We know it's between 15.0 and 15.1
    - So it was actually 15.00

Significant Figures Rules

Significant Digits

- Non zero numbers are always significant
- Leading zeroes are never significant (because they could be replaced by scientific notation)
- Interior zeroes between numbers are significant
- Trailing zeroes are significant **IF** the number has a decimal
    - (otherwise they could be replaced by scientific notation)
- You gotta use scientific notation or it'll be marked wrong (I, cringe, loser)
-

Algebra Rules

Adding or Subtracting

- Always go by the least number of decimal places
- So whatever your final answer is, round to the last number of decimal places

Multiplying or Dividing

- Go by the least number of significant figures
-

Measurements

	Quantity	Unit	Symbol		Prefix name	Symbol	Factor
	Length	meter	m		Giga	G	10^9
	Mass	kilogram	kg		mega	M	10^6
	Time	seconds	S		kilo	k	10^3
	Temperature	Kelvin	K		deci	d	10^-1
	Amount of substance	mole	Mol		centi	c	10^-2
	Volume	Liters	L		milli	m	10^-3
					micro	Funny u	10^-6
					nano	n	10^-9
					Pico	P	10^-12

There's a bunch of unit conversions in the workbook / equation sheet! Wow!

Conversion factors are considered exact - don't worry about it!

Sig figs are only for measurement values we don't consider exact

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Talking some more about Measurements

We use conversion factors a lot!

We start with unit wanted * (united wanted ÷ unit given)

- Base unit would for instance be (g) for grams, prefix changes it to be for instance (kg) kilograms

1000g in scientific notation is $1 * 10^3$ g

Example: Convert 6.73 nm to dm

Subtract the exponents and take absolute value: $| (-9 - (-1)) | = 8$

$6.73nm * 1dm \div 10^8dm$

$= 6.73 * 10^{-8}dm$

$15.9\,km \rightarrow mm$

$$15.9\,km \cdot \frac{10^6\,mm}{1\,km} = 1.59 \cdot 10^7\,km$$

$$\frac{(3-(-3))}{-6}$$

$5.84\ Mg \rightarrow cg$

$5.84\ Mg \cdot \frac{10^8\ cg}{1\ Mg} = 5.84 \cdot 10^8$

$(6-(-2)) = 8$

kkk"""

5 m/s -> km/hr

$$\frac{5m}{s} * \frac{1km}{1000m}$$

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Recap

What happened last week?

- Dimensional analysis
- Scientific Notation
- Sig figs

Review?

Precision vs Accuracy

- Precise measurements are close to each other (reproduceable)
- Accurate measurements are close to the target/expected value
- All measurements have a degree of uncertainty
- Repeat measurements several times to increase confidence in a result

Percent error

$$\% \, error = \frac{experimental \ value - true \ value}{true \ value} * 100$$

Standard deviation exists

Structure -> Properties -> Function

- Chapter 2 going to start on Friday, should be about done with Chapter 1

Classifying [States of Matter]

Solids (s)

- Ordered
- Close packing
- Fixed locations
- Particles vibrate
  - (as long as we're above 0K, absolute zero)
- Rigid shape
- Fixed volume

Liquid (*l*)

- Close packing
- Free to move
- No fixed shape
- Fixed volume

Gas (g)

- Lots of space
- Free to move
- Compressible
- Assume shape and volume of container

(aq) aqueous solution

Change

Physical Change

- Changing states is a physical change - there's no change in physical state
- Ex: Dry Ice
  - Solid CO_2 sublimates directly to a gas, but is still CO_2
- Ex: Dissolution
  - Dissolving sucrose $C_{12}H_{22}O_{11}$

Chemical Change

- Ex: Rust
  - Pure iron nail oxides, this is chemical change
  - $4 Fe + 3O_2 \rightarrow 2Fe_2O_3$

ch 4 is solutions, joy

Properties of Matter

Extensive Properties

- Depends on the amount of substance present
- Like mass, volume
- "Value" is directly proportional to amount

Intensive Property

- Does not depend on how much of the substance is present
- Density, temperature, boiling point
- Can be used to identify substance

Examples

- Plants making sugar from carbon dioxide and water is an example of a physical change
  - FALSE

C $_{12}H_{11}$

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15m^3 to L

$$\frac{15m^3}{1} * \frac{1L}{1 * 10^{-3}} = 1.5 * 10^4 L$$

Classifying Matter (Based on composition)

Pure Substance

- Composition does not vary based on where you look, how you look, what you look, whatever - the bottle of water just has water in it, you'll just find water molecules!

```
[H] [O] [H]
```

Further breakdown of pure substances

- Can either be composed of a single element (like random He floating around)
- Or compounds - stuff like water!
    - We can break these down further still
    - Molecular compounds (ie H_2O)
    - Ionic compounds ie(NaCl)

Mixture

- Is there more than one component in there?
    - If so, mixture!

Heterogeneous Mixture

- Composition can vary - like wet sand, some parts might have more water than sand or vice versa

Homogenous Mixture

- Uniform composition, something like tea with sugar - it's the same throughout (even though its a mixture)
- All compounds are molecules, but not all molecules are compounds
-

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Clicker stuff

- Physical clicker is going to be on frequency AA, if I ever get one
    - 10 points per class session
        - 5 for participation
        - 5 for correctness
    - 2-3 questions per day, 30 seconds to 4 minutes to answer
    - If you missed a day, don't worry about it
    - Lowest 15% of clicker stuff will be dropped

    - No need to email about clicker stuff unless you are missing literal weeks of clickers
- Metalloids have metal & nonmetal properties

Atomic Stuff

- We use Carbon-12 as a scale for amu
  - Carbon 12 weighs EXACTLY 12 amu
    - 12.0000000000000000 amu
- Charges are handled in +1 for protons, -1 for electrons
  - Coulombs are objectively cool, but harder to do math with
- 1amu = 1/12 mass of C-12 atom = $1.66054 * 10^{-27}$
- Particle stuff
- $\frac{A}{Z}$X
  - A is mass number
  - Z is atomic number
    - Unique for every number
  - X is Chemical symbol
    - Fe for iron
- Atoms are always electrically neutral
- Ions have charges n such things
- On the periodic table is the weighted average (in amu)
  - Not all neon(or any other element) atoms are created equal
    - The difference is the number of neutrons in the nucleus
    - This is called an Isotope
      - For isotopes only, they'll be formatted like C-12 (Chemical name, mass number)
  - individual isotope mass and mass numbers are NOT on the periodic table
  - For practice
    - Gallium has two naturally occurring isotopes: Ga-69 with a mass of 68.9256 amu and a natural abundance of 60.11%, and Ga-71. Use the atomic mass of gallium from the period table to find the mass of Ga-71
- All the fun chemistry happens at the atomic scale
  - Unfortunately we live in the macroscopic scale
  - How can we bridge the two worlds of the fun stuff vs where we live?

Avogadro's Constant

- $6.022142 * 10^{23} =$ 1 mole of stuff
  - Like 12 things arein a dozen
  - Aluminum has a mass of 26.982 g/mol
  - Copper is 63.546 g/mol

Other thing

- 1 water molecule, 2 hydrogen and 1 oxygen
- = 18.02amu
- Multiply by Avogadro's, mass of water is 18.02g
  - 2 moles of hydgen = 1 mol oxygen
-

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14.01 + 3 = 17.01 amu

- Use Avogadro's to convert between amu to g/mol, blah blah, unit conversions, yadayada
  - Look, whoever else is reading this, I got bored
    - People are asking silly questions

Scratchwork

- 595kg Cs
  - Cs 132.9g /mol
- $$\frac{595\text{kg Cs}}{1} * \frac{1000\text{g}}{1kg} * \frac{1\text{mol Cs}}{132.9\text{g Cs}} = 4.48 * 10^3\text{g Cs}$$
- $$\frac{595\text{kg Cs}}{1} * \frac{1000\text{g}}{1kg} * \frac{1\text{mol Cs}}{132.9\text{g Cs}} * 6.022 * 10^{23} = 2.70 * 10^{27}\text{particles cesium}$$
- 154.363642g nickel * 1000 = 154,363.642
- $1.54 * 10^5$

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Clicker Question Answers

1. A (5.29)
2. A($9.83 * 10^{20}$)
3. B(Palladium)

Notes (probably)

- just work no notes me too lazy
- oh shit i lied

Chapter 3 (Preview)

- There is a lot of possible molecules
- We're going to be talking about bonding n such jazz on Monday
- Protons are going to stay constant
  - Neutrons might vary by isotopes, but are largely the same
    - Electrons are up to some *buuuuuullllll*shit
- We're going to talk about intramolecular forces
  - It's bonds. It's just bonds. It's that simple.
- Intermolecular forces
  - Weak attraction *between* molecules that hold them in liquid or solid form
  - Definitely **NOT** bonds
-
  - Week 4 preclass
  - Math review
  - Extra practice exists
  -

CHGN121 - 2023-09-11

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- Electrons have mass?

- I didn't even know they were Christian!
- oh boy, phet time

Intramolecular Bonds

- They're stronger than intermolecular bonds, losers
- Even within intramolecular bonds, they vary in strength
  - Ionic bonds are metal + nonmetal
  - Covalent are nonmetal + nonmetal

Electron Shenanigans

- Fog plot, electron distributon plot, yadayada
  - Electrons are just kinda floating around, there are different probabilities of them showing up at a given point
  - On a fog plot, the darker the color, the higher the probability of finding an electron
  - Isosurface exists
    - 90-95% of finding electrons within the surface
    - The rest are outside
- Three general different distributions
  - Equally shared
  - Shifted completely to one side, practically to the point of a transfer
  - or shifted slightly to one side
- Forming a bond is a release in energy, creating stability
- Breaking a bond takes in energy
- Electronegativity is how different atoms attract electron distributions
  - Pauli or Pauling?
- $\Delta EN = |EN_{Atom\ 1} - EN_{Atom\ 2}|$

Electron Distribution Examples

- Ionic bonds, at the gen chem level, we should assume a complete transfer
  - With this, we go from atoms to ions
- **Cat**ions are **paw**sitive, always
  - that wasn't in the notes, it's just funny
- Anions are bigger because they have more electrons

- Ionic bonds tend to have a ΔEN > 2
- Covalent bonds
  - Can either be polar or nonpolar
  - Nonpolar have equal sharing, electronegativity is basically the same
    - ΔEN must be ≤ 0.4
  - Polar have unequal sharing, resulting in a partial charge on atoms
    - (not to the ionic bond level)
    - ΔEN should be ≥ 0.5
    - Good news: we're lazy, and don't have to worry about partial charges numerically
- ONLY THING we're doing to identify an ionic bond at the genchem level is metal + nonmetal
- Metallic bonds are communist, and are attracted to the general sharing of electrons
  - Electronegativity values are between 0 and basically nothing

Ionic Bonds

- Cations and anions coming together for neutrality
- atoms have charges don't be an idiot
  - We're going to have 3 clicker questions
- I should go do the mastering
-

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quickest clicker questions known to man

- a
- c
- b
- c
- memorizing polyatomic ions, again, hip hip
  - (table 3.4 in 3.5)

notes ig

Ionic Compounds

- ionic compounds have a super strong bond
- Mostly solids at room temperature
- High melting and boiling points
- Only conductive as a liquid - not as a solid
- Soluble as shit
    - (in water, or other polar compounds)
    - ch5 is solubility (yipeee)

Covalent Compounds

- Can be damn near whatever at room temperature
- Relatively low boiling & melting points
- Basically no conductivity, ever
- Solubility can vary

Metals

- Solid at room temperature
    - (mercury is quirked up)
- Conductive as a solid
- High melting & boiling points
- Malleable, ductile
- Effectively insoluble
    - I mean, you can toss metals in other metals to make alloys, but we don't talk tooooo much about that
-

IMFS

- We say that ionic compounds do not have IMFs (Van der Waals is angry ahh hell)
- For intramolecular bond breaking, it's a physical change
    - Much less energy to break compared to intramolecular bonds
- Solids have strong IMFs
    - Liquids are strong....ish, not as strong as solids

    - Gas is weak as shit. Losers. Hit the gym. (Weak to no IMFs)
- Ionic compounds have a lattice structure, only intramolecular forces
    - That doesn't feel right.
- Covalent compounds have discrete units, which have IMFs
- Metals have a lattice structure, only intramolecular forces

Quick Examples

Structural Formulas

```
C=O
```

They're the shape

Molecular Formulas

Exact # of atoms in one unit (ie, CH_2O)

Empirical Formulas

- Type of atoms in lowest whole # ratio

Ionic vs Molecular

- Ionic compounds are already in their empirical formulas (neat)
- Empirical formulas exist for molecular ocmpounds (ie, Glucose, $C_6H_{12}O_6$)

good god someone is going to ask some stupid questions about empirical formulas

Quick calc examples

- Mass of C = 1*12 = 12g
- Mass of H = 2*1 = 2g
- Mass of O = 1*16 = 16g
- Grand total of ~30g

- % carbon is 40.00%
- %H = 6.7%
- %O = 53.28%
-

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- If the empirical formula is P_2O_5, what's the conversion factor if the molecular weight is 283.88 g/mol
  - 2, for the record
- Work in 100g increments for mass percent -> empirical formula
  - It's the same as high school chem, I have no motivation to write this out
- Empirical -> molecular is some factor (and vice versa)

---- Ethylene Glycol
MW = 62.07 g/mol

38.7g C, 9.7g H, 51.6g O

3.225mol C
9.7 mol H
3.225 mol O

Divide allat by 3.225

CH_3O

Molar mass = 31g/mol

Molecular formula is
$C_2H_6O_2$

0.8233 g sample of C H O produces 2.445g of CO_2 and 0.6003 g of H_2O

Find the empirical formula of the compound

$C_xH_xO_x + O_2$ =2.445g CO_2 +0.6003g H_2O

0.6668181818g C
0.0667g H
0.0896g O

0.056 mols C
0.0667 mols H
0.0056 mols O

missed a 0 on the O, whooopsies

10C
12H
1O

Final answer:
$C_{10}H_{12}O$

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C_4H_8O E
B $C_6H_{15}O_6$

Chemical Naming

There's four categories

1. Binary Ionic (MgF_2 would be Magnesium Flouride)
2. Polyatomic Molecules ($(NH_4)_2CO_3$ Ammonium Carbonate)
3. Molecular (or covalent compounds) (SO_2, Sulfur Dioxide
4. Acids (H_3PO_4 is phosphoric acid)

Quick reminder:

- Changing oxygen content does not change the charge
- Acid names exist, yuh
- You're allowed to lose 2 oxygens or gain 1 oxygen without changing charge

NaH is a thing that exists, which would be sodium hydride

HCl is hydrochloric acid, HCl is just hydrogen monochloride

activity 7 naming practice is homework (one per person) **CRINGE**

oh thank god we finally got to talking about reactions

- Chemical reaction is scrambling the way things are bound together
- The coefficients in stoic say how many moles there are. Wow! Crazy!
- conservation of mass exists
- If you're being all right and proper, you should write out the state of matter for everything
    - that's a loooot of work

yep balancing is easy

$$y - 6 = \frac{1}{3}(x - 4)$$

CHGN121 - 2023-09-20

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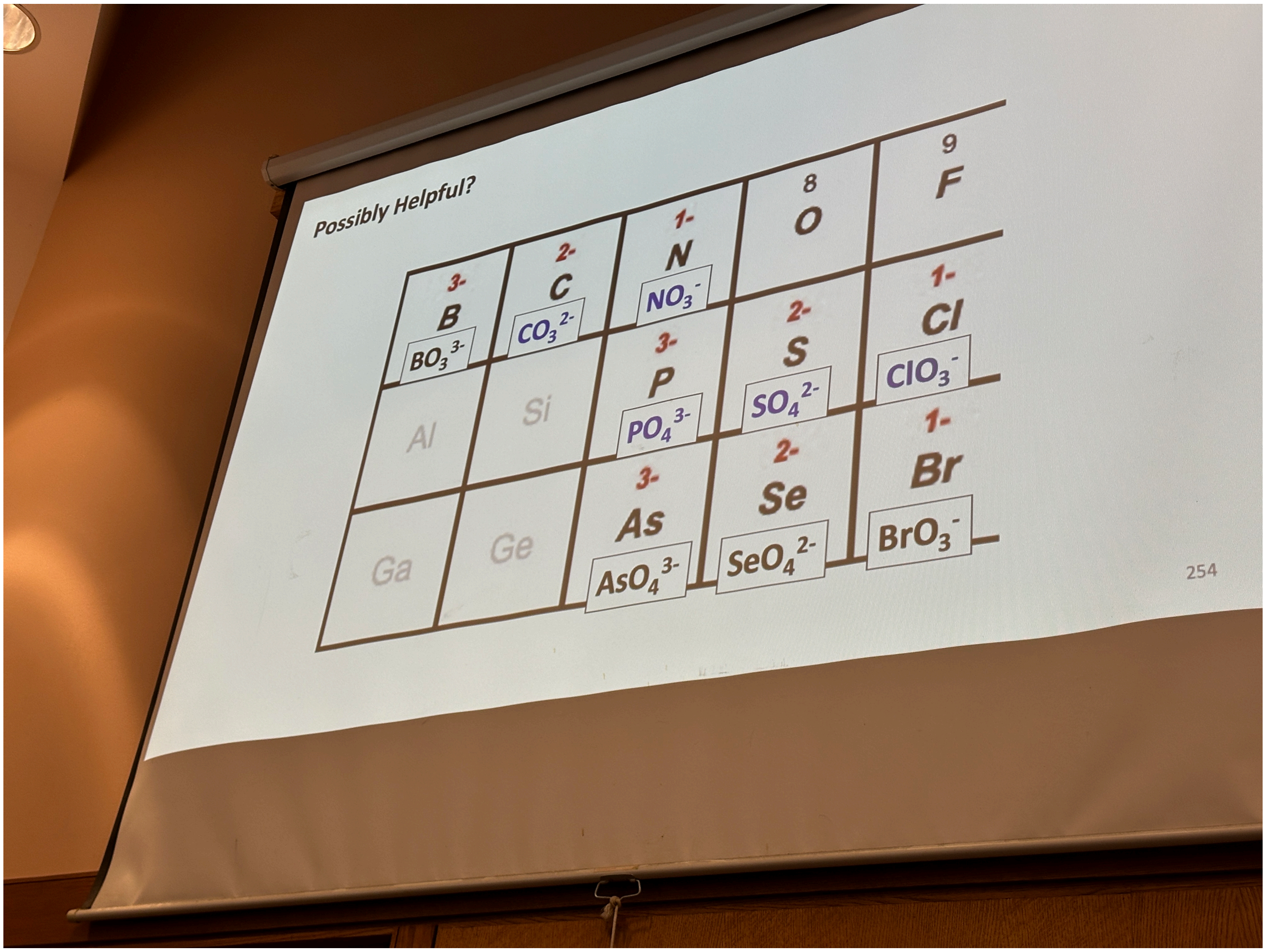
Quick nonmetal image
oh wait the ones I don't know are the ones we don't need to care about, damn



actual notes

- cadmium, zinc, something and something

12 on left
12 on right

scratchwork

$4A + 6B_2 = 4AB_3$

$2A + 3B_2 = 2AB_3$

actual notes (real)

- thank god we're actually writing a reaction (ch. 4, chemical quantities and aq. reactions)
- Stoich time

    - $2H_2 + O_2 = 2H_2O$
    - 2 molecules of hydrogen, 1 molecule of oxygen, makes 2 molecules of water
    - 10 h, $5o_2$, 2 molecules of water
    - 2(avogadro) hydrogen, 1(avogadro) oxygen, 2(avogadro) of water
    - For realsies, 2 moles H_2 + 1 mole O_2 = 2 moles H_2O
    - If we were to convert into grams, 4.03g H_2 + 32.00g O_2 -> 36.03g H_2O
- fake equation for fakers
    - 2A -> 3B
    - The relationship between these two is the moles of A to Moles of B (2A:3B)
        - and wowie, we can convert from molar mass -> mass and from molar mass -> particles
- slightly more real equation for slightly more real folks
    - Fe2O3 + C -> Fe + CO2
    - 2 Fe_2O_3 + 3C -> 4Fe + $3CO_2$
    - how much would we produce from 150g Fe_2O_3
    - 0.94
    - 3/2 = 0.94/x
    - 2x = 3(0.94)
    - 1.41 moles CO_2
    - 62.04g CO_2

2NaOH + Cl_2 -> NaCLO + NaCl + H_2O
Aiming for 0.353 mols NaCLO
Final answer is 28.2g NaOH, I leave the math as an exercise to the reader

---

hw

- we're going to have clickers
- done go do your damn mastering, you lazy bastard
-

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Preclass Clickers

- Q1: A, 0.29 moles
- Q2:
  - $2SO_2$ + $1O_2$ + $2H_2O$ -> $2H_2SO_4$
  - 25kg SO_2
  - 0.39 moles
  - 98
  - 38.22 kg
  - A, 38 kg

Real notes time

- week 6 survey n shit is due
- theoretically produce 70.5g of MgO from reaction
  - 2Mg + O_2 -> 2MgO with 42.5g Mg
- we only make 65.0g
  - womp womp, 92% yield
- 70.5g MgO and reaction is 92.9% efficient
- $$\frac{70.5}{y} = \frac{0.929}{1}, y = 75.88$$
- 1.88 moles, 45.8g of Mg
  - (yippee)

What if we were given volume of reactant instead of mass?

- you convert it back into mass, goobers, use the density

grilled cheese (reprise)

- 2 breads + 1 cheese = 1 sandwich
- 28 breads + 11 cheeses = 11 sandwiches
- 2Na + Cl -> 2NaCl
- 5.8g Na and 6.7g Cl_2
- 0.25 moles Na

    -
- 0.094 moles Cl
    - Cl is definitively the limiting
- 2.81 g of NaCl
    - Or maybe it's 11? wth did I do wrong
        - found what i did wrong, i can't do basic bitch fractions

---

42.g Mg and 33.8g oxygen produces MgO

- $2Mg + O_2 \rightarrow 2MgO$
    - 1.72 moles Mg
    - 1.05 moles O_2
    - 0.19 moles O_2
    - Mg is the limiting
- 1.72 moles of MgO
- 69.316g of MgO
-

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survey review stuff

- 4.18 g Li_3N
- 6.something
- the second one is 3 moles excess consumed, i have no idea why she bothered to go throuhg that much work

more fun stoich

- we could just add more reactants, which, so silly, so quirky
- How much HCn do we make

$2NH_3 + 3\ O_2 + 2CH_4 \rightarrow HCN + 6\ H_2O$
10g NH_3
20g O_2
5g CH_4
how much of each reactant would remain if we produced 5g of HCN?

strategies?

- do stuff, do your calculations well

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clickers

- c
- d

Unit Two (dun dun dun)

Chapter 5: Solutions & Aqueous Solutions

yippeeee

- we're using molarity now!
- it's mols / volume (in L). shocker.
- we did some molarity practice questions, I am waaaay too lazy to write these out, but I got them right, I don't care.
- Most of the time when we're working lab, we have a high concentration stock solution, and we gotta dilute it to get something reasonable
- Moles that you take out of your concentrated flask is the same thing as the moles you put in the new sheet
- Molarity is mol / l
- Molality is mol / kg
- Mole fraction is mol / mol

- Parts by mass is mass / mass * conversion factor
  -

CHGN121 - 2023-09-29

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Clickers

- B, 1.21 * 10^21
- B, 0.0337
- B, 40 ml

actual notes

- solutes and solvents like each other, ooooooo
- What holds solutes to solutes?
  - What holds solvents to solvents?
- What holds solutes and solvents together?
- When we're dissolving something, we
  - Break oslutes apart (taking energy)
- Solute-solvents stick together, which releases energy

---

example time

- Dissolve NaCl in water
  - We gotta break them apart
  - If you were to write this out, you would show it separating into ions
- When we dissolve sucrose ($C_{12}H_{22}O_{11}$) in water, the different molecules of sucrose split up, but overall they stay together
  - If you were to write this out, the only difference is going from $_{(s)}$ to $_{(aq.)}$
- fun fact: you can still use CiVi = CfVf with molarities, moles, ionss, yadaya
- We're eventually going to talk about electrolytes, which is quirky
  - ions are electrolytes, covalent compounds are not (except for those quirky little acids that are so cute and quirky)

-

CHGN121 - 2023-10-02

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- yeah my test is going to be here in CO 209
- what in the world is the name distribution A-D, E-Hn, Ho-Z
- Quick aside, mercury is quirky ahh hell, and has Hg_2^+2
- We're not worrying about partial solubility at all, we consider things either infinitely soluble or completely insoluble
  Chem 1 level

Three Reasons for a reaction to occur

1. Precipitate is formed
2. Water is formed (acid base)
3. Transfer of Electrons
   1. Redox, combustion

Precipitation Reactions

- A precipitate is formed when soluble ionic reactants yield insoluble solids that condense themselves out of the solution
- If we make a precipitate, the reaction actually happens
  - If we have no precipitate, womp womp, there's no reaction, get trolled, L, bozo
- How do you do one of these?
  - Swip swap the cations, check if they're soluble, if one of em isn't we have a reaction, hip hip

Reaction
$NaCl + AgNO_3$ -> $AgCl_{aq} + NaNO_{3(s)}$

CHGN121 - 2023-10-04

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- remember to actually do activity 12 that you walked out of class for

- Maybe go loot activities from Coolbaugh 114
- $NH_4OH + FeCl_3$ -> blah blah i got the clicker

notes

- Molecular equation is all the molecules stuck together, complete *ionic* is everything that's soluble in ion form

So we'd have something like $2Na^+ + SO_4^{2-} + Pb^{2+} + 2NO_3 \rightarrow 2Na^+ + 2NO_3^- + PbSO_4$

What we actually care about is the net ionic equation, so we gotta get rid of the stuff that hangs around like a bunch of loafers on both sides

$SO_4^{2-} + Pb^{2+} + \rightarrow PbSO_4$

- Spectator ions are hanging out from electrostatic boredom
- When no precipitate is formed, if you were to draw the complete ionic equation, you would get
- {nothing} -> {nothing}
-

acid base time

- if we makin water, we cookin
- acids are going to be covalent a bunch of the time, and they're going to dissolve and ionize in water (yippee)

acids

- Arrhenius Acid: substance that dissolves in water and produces H^+ or H_3O^+ (protons or hydronium)
  - For example, if we were to dissolve HCl and make H^+ and Cl^-
    - we're actually making H_3O^+ and Cl^-
  - obligatory reminder that arrhenius acid is cringe
- Bronsted-Lowry Acid: substances that donates H^+ ions to ANY substance
  - as long as we're giving hydrogen to somebody, we don't give a shit if it's happening with water or whatever else
- $HCl + NH_3 \rightarrow NH_4^+ + Cl^-$

bases

- Arrhenius Base: substance that when dissolved produces hydroxide ions (OH^-)
  - $NaOH \rightarrow Na^+ + OH^-$
  - $H_2O + NH_3 \leftrightarrow NH_4^+ + OH^-$
    - we're expected to know that ammonia is a base
      - Neat? ig?
  - Ammonia or any amines are Arrhenius bases
- Bronsted-Lowry Base: substance that accepts H+ ions from any substance to form hydroxides
- $HCl + NH_3 \leftrightarrow NH_4^+ + Cl^-$

Acidic means we have more hydroniums (H_3O) than hydroxides (OH^-)
Basic means we have more hydroxides than hydroniums

Important notation:

- Single arrow
  - 100% ionization
  - No reactant, only products
  - Strong electrolytes (acids, bases, or salts)
- Double arrow
  - Partial ionization
  - Mixture of reactant and product
  - Weak electrolyte (acid, base, salt)

CHGN121 - 2023-10-11

#chemistry #notes #chgn121

- pre class work for week 8
- activity #16 from workbook due 10/18 beginning of class
- should probably do mastering but like.... the review week before the test kinda went hard last time

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activity series

- some reactions only work in one direct, we can use the activity series to predict whether or not a reaction occurs
- Friyay we're going to go into it
- Differences between our 3 kinds of reactions

CHGN121 - 2023-10-13

#chemistry #notes #chgn121

baby clicker questions for babies

- decreasing pressure increases volume
- STP is definitely not 298K
- 0.0820582 *273.15* 0.85 = d, 19 L
- 0.15L of gas when you increase it
- e, lowering pressure by a factor of 3

activity series stuff

- we're going to use the activity series when predicting if things will actually react with ionic compounds
- hydrogen is our reference point
- anything above hydrogen will easily react in water to go from a metal to a cation
- lithium would *love* to lose an electron, lead can be coerced into it
- anything below the hydrogen reference are more inclined to gain electrons, especially compared to hydrogen
- A redox reaction occurs if the free, elemental metal can displace the ionic metal in the series
    - It can do this if it's higher in the activity series
    - So nickel can displace lead

- we will always form a homogenous solution with gasses
    - don't talk about densities of various gasses

- KMT - gasses will always occupy the available space in containers
- We must assume that gasses have no intermolecular forces, and that they experience elastic collisions
- Density = P*molecular weight / gas constant * temp
-

CHGN121 - 2023-10-18

#chemistry #notes #chgn121

gas law shenanigans or something idfk

- use ideal if we're looking at one set of conditions, use combined if there's multiple sets of conditions, use density... never, it's just the ideal gas law with some stuff stapled on it
- Stoich is the same with gasses! Love that
- Friday we're going to talk about Dalton's law of partial pressures
- clickers for friday
- Ch. 6 mastering q 11 should be fun

CHGN121 - 2023-10-20

#chemistry #notes #chgn121

Clickers

- it was actually A I just punched in the wrong numbers
- E, 32.9 L

partial pressures

- The total pressure is the sum of the partial pressures (wow)
    - this is technically Dalton's law, but he's lame
- We can calculate partial pressures out of a total mixture if we know their individual components
- We can figure out moles of each gas, the total moles, the total pressure, the pressure of each gas, this shit's *wiiiiiiiiiiiiiiiiiiiild*

- If we're in the same container, temperature and volume are going to be samesies, so the ratio of individual pressure / total pressure
- A mole fraction is represented with a χ
- Individual pressure is χ * P_{total}
-

time to talk about why ideal is cringe

- We're going to have a bunch of postulates saying why this shit happens
    - This is KMT
        - Gases are tiny particles, and they move about at random
        - Volumes of particles themselves is incredibly tiny relative to the total volume - gas is mostly empty space
        - We assume that gas particles act independently with no forces between particles
        - Gasses have energy transfer when they collide, but we assume fully elasti collisions so the average kinetic energy does not change
        - Average kinetic energy is proportional to temeprate in K of sample
- Yeah, kinetic energy is relevant
- $KE = \frac{1}{2}(mv^2)$, so the lighter the gas, the faster it has to go
    - We're not going to do calculations, but you do need to consider how increasing mass reduces speed
- Diffusion is us mixing with other things
    - Path it takes for gas to get to somewhere else is the mean free path, which is neat to know
    - Diffusion rate scales with speed
- Effusion is very specifically looking at gasses moving through a membrane or a pinhole
    - Effusion rate is also proportional to molecular speed and therefore mass
        - we used effusion in uranium enrichment, which is cute

Get real.

- Volume of gas is larger than what gets predicted by the ideal gas law
- Attraction between molecules does actually happen, and it's more important at high pressures or low temperatures
- Let's go check up on a mol
    - Yeah, uh, that shit's not always 1

- Welcome to the real world
- This means that real gasses are not infinitely compressible! You start getting liquids at high pressures and/or low temperatures

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CHGN121 - 2023-10-23

#chemistry #notes #chgn121

yippee quantum mechanics

- spdf is the shape of the robital
- You can also draw the boxes, if you're crazy
- we can use our periodic table to place electrons in energy levels
- Pauli Exclusion Principle
    - A single orbital can hold two electrons with opposing spins
- Hund's Rule
    - in the same energy level, we half fill everything first with parallel spins before we start going wild
- Aufbau (Building in Deutsch)
    - Fill lower energy levels first
- for transition metals, we also count the d orbital when considering valence electrons

CHGN121 - 2023-10-25

#chemistry #notes #chgn121

- Francium is fat
- Each electron in anything other than hydrogen is attracted to the nucleus and repulsed by other electrons
    - Atomic radius is how effectively they shove each other around
- We use coulomb's law to do this $\frac{kq1q2}{r^2}$
    - q is charge, r is distance between charges
        - Protons and electrons have the same charge, so that's neat

    - Repulsive force if charges match (+ +, - -), attractive if they don't (negative sign in front of the force)
  - That and effective nuclear charge, which is another trip
- We're going to break that up to look at penetration and shielding effect
  - From there we can look at trends n shit, like atomic radius, ionization energy, electron affinity, and electronegativity
    - Francium is fat
    - Fluorine is electronegative
- Shielding causes electrons to have reduced electrons to the nucleus
  - Number of core electrons influence how close outer electrons can get to the nucleus
    - Ex: for every core electron, neutralize a nuclear charge (proton in nucleus)
  - Neon has less shielding than oxygen
  - Nucleus has a greater grip on valence electrons as we go left to right
- Penetration is how close an electron can get ot eh nucleus
  - Based on energy level and orbital
- Orbitals witht he same shell number are not degenerate, because some of them can get closer to the nucleus
  - So like, $4s^2$ and $4p^6$ aren't degenerate, because $4s^2$ can get closer to the nucleus

CHGN121 - 2023-10-27

#chemistry #notes #chgn121

quick review of wednesday

- some electrons can penetrate and almost experience the full charge of the nucleus
  - Depending on the energy level, we'll have different orbitals
    - s can penetrate better than p, and p can penetrate better than d
- outer electrons will get shielded by inner electrons, and will not experience the full charge
  - Effective nuclear charge = #protons - #core electrons
  - ex, oxygen
    - 2 core electrons, 8 total, valence electrons will experience a +6 charge

ion sizes

- cations are always going to be smaller than their parent, because we have a higher proton to electron ratio (>1)
- anions are bigger than their parent, because we have a smaller proton to electron ratio (<1)
- same number of electrons are isoelectronic species
  - in order to compare their sizes, compare ratio of protons to electrons
  -

CHGN121 - 2023-10-30

#chemistry #notes #chgn121

Niobium for 7? That or antimony

lecture *stuff*

- Octet rule, noble gasses have eight in their valence, and they happy ahh hell
  - helium has a duet

Ionization Energy

- Energy needed to remove one outermost e^- from neutral atom in gaseous state
-

CHGN121 - 2023-11-01

#chemistry #notes #chgn121

- forming a bond lowers potential energy
- there were probably other notes for today I just really didn't care
- we're gonna talk about different types of chemical bonds
- As we form bonds, atoms are trying to get a complete octet (or duet for H)
-

CHGN121 - 2023-11-03

#chemistry #notes #chgn121

oh boy, clickers for monday

- NH_4^{+1}
- PCl_3
- XeI_2
- CS_2

formal charge

- # of valence electrons - # of electrons attached
  - Use electrons straight up strapped on + half of bond
  -

CHGN121 - 2023-11-06

#chemistry #notes #chgn121

0, +1, -1
-1, +1, 0
-1, +1, +1

Resonance structures are where you can't use formal charge to decide which one is the best, they're equivalent, yadayadayada

- Bond angles and lengths are all equivalent
  Expanded octects are electrons in the 3rd period that can shove excess electrons into their d orbitals
- Free radical is a molecule/ion with odd number of electrons
- Aluminum, beryllium, and boron will form incomplete octets (it makes them explosive as shit!)
  - Coordinate covalent bond is using the lone pair from one molecule with a lonely boron
- Put double arrows where there are resonance structures
- Check formal charges

- Remember ion shiz

CHGN121 - 2023-11-10

#chemistry #notes #chgn121

- Dipole moment, holy shit, two
  - One end has a lot of electrons, one area does not
    - Shit crazy.
-

CHGN121 - 2023-11-15

#chemistry #notes #chgn121

hydrogen bond quick stuff

- You can either have the hydrogen on your molecule connected to O, N, or F, in which case you'll be hookin' up with an oxygen
  - Oooooor, if you have an oxygen floatin around, you can hook that up with a hydrogen and that'll be a happy pairing
- MgO Strongest

property shenanigans

- Vapor pressure can only be really observed in a closed system
- Larger surface area means a faster rate of vaporization
  - That's because these transitions are the outermost molecules skedaddling - very hard to convince the innermost ones to scamper away, since they're so well held on all sides
  - Surface area does NOT affect vapor pressure - the same pressure of gas is going to leave, no matter surface area
- Temperature lets more atoms hit "escape velocity" and they can run away
-

CHGN121 - 2023-11-27

#chemistry #notes #chgn121

Thermo! YIPPEEEEEE!

q = mCΔT
313.5 kJ

- How can we find energy? A lot of ways, and a lot of them are the same
  - Calorimetry
    - Constant pressuer calorimetry, System is equal to the loss of heat in the surroundings
      - Enthalpy change is equal to heat exchange
        - Anything from the reaction is absorbed by solution
      - $38 * (65.4 - x) * 0.385 = 95.7 * (22.7 - x) * 4.184$
      - $965.802 - 14.63x = -9089.27976 + 400.4088x$
      - 415.0388x - 9089.27976 = 965.802
      - 415.0388x = 10,055.08176
      - 24.23
      -
  - Stoichiometry
    - Heat is an extensive property, meaning it does depend on how much mass you have
    - 3.004868913858
    - 5.32g of CH_4
    -
  - Bond Dissociation
    - Remember, positive to break bonds, negative to form bonds
    -
  - Heats of Reaction
  - Heats of formation
  -

CHGN121 - 2023-11-29

#chemistry #notes #chgn121

- Exothermic reactions are creating more stable products, endothermic reactions (which take energy) are probably less stable
- The heat change across a reaction is the sum of the bonds broken minus the number of bonds formed
  - there's a longass reaction we did for warmup, but the answer is -2,428
    - don't forgor the moles of the thing if you're
- 119.5 g
  - 0.06694560669 moles
  - -23 kj/mol
- Δ H is an extensive property, so if combustion releases energy, forming the reactants is going to be endothermic
- Hess's Law: overall enthalpy change is the same as the sum of all the lil baby reactions

CHGN121 - 2023-12-04

#chemistry #notes #chgn121

431 * 4 = 1724 + 384 = 2108 kj / mol

1656

-391 kj/mol