

UNIT 1 -- Concepts!

Proving atoms exist	integer ratios (= represent units of mass= atoms)		
Law of conservation of mass	atoms/are not created nor destroyed only rearranged		
Atomic Molecular Theory	All matter is made up of atoms	Elements can't be decomposed into simpler substances, composed of identical atoms, all elements are defined = elements are composed of atoms	Compounds are chemical substances of elements
	#s and masses of atoms are conserved in a chemical RXN	Compounds are composed of molecules	Atoms of the same element are identical (=identical mass)
All atoms of a single element have the same characteristic mass.	Each compound consists of identical molecules, which are small, identical particles formed of atoms combined in simple whole number ratios.	The number and masses of these atoms do not change during a chemical transformation. Each element is composed of very small, identical particles called atoms.	Each small atom is surrounded by molecules, which allow bonds to form between neighboring atoms.

Law of definite Proportions (aka LAv of Constant Compositions)	elements combine in definite proportions <i>by mass</i> to make a certain compound	compound composed of <i>fixed ratio</i> of elements by mass	<i>NO INTEGERS</i>
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UNIT 1 -- Concepts! (cont)

	Same compound do not compare <i>different</i> compounds		
Law of Multiple Proportions	compare multiple compounds made of the same elements if we fix the mass of one element, the other elements' masses across those compounds will be related in a simple integer ratio	must include examples where a specific element/atom bonds to the same element with different simple integer ratios	INTEGERS
Law of Combining Volumes	At fixed temp and pressure gases combine in simple integer ratios by volume	Avogadro's Law= At a fixed Temp and Pressure <i>equal volumes</i> of gases contain <i>equal #s of particles</i>	
Diatomic particle : H2 O2 N2 F2 Cl2 Br2 I2			
Rutherford's gold foil experiment	alpha particles shot through a thin gold foil sheet		
	most went straight through = atoms are mostly made of empty space	some slightly deflected= positively charged nucleus	very few bounced back=
Moseley's Xray frequency data	sqrt of frequency is proportional to atomic number	= atomic number measures # protons since	



Unit 1 -- Concepts!!

Empirical Formula simplify ratios?? $P_4O_{10}=P_2O_5$

Molecular Formula as is no simplification

Determining moles $M=n/V$ where M = Molarity
n = moles (of solute)
V = volume in liters (in solution)

Unit 2 -- Concepts!

Rutherford's gold foil experiment alpha particles shot through a thin gold foil sheet

most alpha particles went straight through = atoms are mostly empty space

some slightly deflected = positively charged nucleus

very few bounced back = nucleus is much more massive than alpha particle and really small in position

nuclei are **tiny positively** charged **small** and **massive**

Moseley's X-ray frequency data sqrt of frequency is proportional to atomic number = measures # protons since

integer units - counting something = protons correlated mass

Ionization Energy minimum amount of energy required to remove an electron {{IE felt relative to specific electron}}

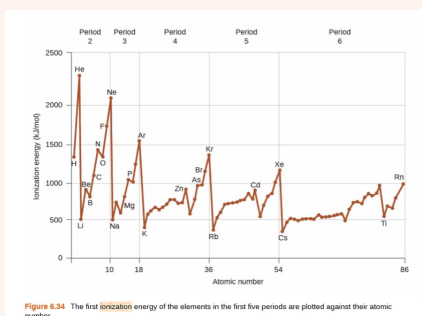
COULOMBS LAW
 $V(r)=(q_1 * q_2)/r$

$V(r)$ is potential energy
negative because opposite charges attract
Positive when salike chgs repel

Unit 2 -- Concepts! (cont)

Periodic trend: left to right -> charges increase PE
top to bottom: radius increases lowering PE decreasing IE

Ionization Energy Graph



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Ionization Energy (con't) electron electron repulsion decreases ionization energy of electron

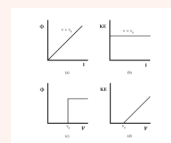
Successive IE large drop indicates new shell e^- must be removed from

Photoelectric effect $E=h\nu$ where ν is frequency and h is Planck's constant
 $c=\lambda \cdot \text{frequency}$
 $E = (hc)/\lambda$

Planck's constant (h)=
speed of light (c)=

Rydberg's equation :
Rydberg's constant: 1.097×10^{-7}

Photoelectric effect graphs



graph relationships

More intense light above threshold frequency produces more electrons, greater current	More intense light above threshold frequency does not produce electrons with greater kinetic energy	When intensity is fixed: presence of threshold frequency implies relationship between frequency and energy – if light is above frequency threshold, the current remains fixed	Kinetic energy of electrons increases when frequency is increased – simple linear relationship
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§ Summary of experimental results: light which has sufficiently high frequency will eject electrons whether the intensity is low or high–

increasing intensity gives more electrons but not more energetic electrons–

increasing frequency gives more energetic electrons but not more of them

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frequency of light = color of light and amount of energy carried	intensity of light = number of e ⁻	KE of electron = increases as frequency increases and <i>not</i> affected by intensity	current = affected by intensity (increase current there is an increase intensity) unaffected by change in frequency
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must reach **threshold frequency** of no electrons will be emitted

Unit 2 – Concepts!

Photo emission	electrons jump down energy levels emit light absorbed when electrons jump up (get excited)	specific frequencies of light emitted because between specific energy levels and energy is quantized *
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Unit 2 – Concepts! (cont)

quantum numbers	n= size 1s, 2p 3d	l= shape 1s, 2p, 3d 0 to n-1	m(l) = orientation (ex: 2p-x, 2p-y, 3d-xy) m(s) = spin + 1/2 -1/2 Range: -l to +l
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Rydberg equation	n=shell n1= 1st energy shell n2= second energy shell mn	use to calculate Energy emitted when e ⁻ moves between shells
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(if E(light) fixed)
E(light)=hv = IE(e⁻)+IE(e⁻)

Visible light range	~400-750 nm	Ultraviolet - lower energy less than ~ 375nm	Infrared - higher frequencies past ~800
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Rydberg Equation

$$\frac{1}{\lambda} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

(1.097x10⁷)m⁻¹ = Rydberg's constant

Unit 2 – Concepts!

LEWIS DOT STRUCTURES	A: Available (valence electrons (number of atoms)) N: Needed (8(number of element)+ 2(number of element)) B: S/2 S: N-A U:
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8 - octet if follow octet rule
2 for duet if follow duet rule

Calculations

Core Charge	# protons (atomic number) - # inner shell electrons
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Calculations (cont)

CAN calculate for e^- added and use to figure which has a greater electron affinity

Formal Charge = valence electrons - bonds- lone electrons (*not lone pairs*)

Finding Limiting reagent: take moles of substance A and find how many moles of B gotten

take moles of substance B and find moles of substance A needed

compare moles of each substance

moles A/1 * moles B/moles A (in equation)= moles B needed

moles B/1 * moles A/moles B (in equation)= moles A needed

moles A : moles B (calculated) mol A: mole B in equation

Finding Empirical formula: find moles of each substance

find corresponding element's moles based off of

empirical formulas in combustion: * calculate g of C and H and subtract from original compound's mass which gives O's mass

then calculate moles of O

compare ratio of C:H:O and this gives empirical sub numbers

Finding molecular formula: after calculating Empirical, given molecular weight divide by that of Empirical

multiply ratios by this for sub numbers

Bond Order = $\frac{1}{2} (\# \text{ electrons bonding} - \# \text{ electrons antibonding})$

Calculations (cont)

Proving Law of Multiple proportions: fix one element and

OXIDATION RULES

Molarity = mol/L

Oxidation Rules

- The oxidation number of an atom in an elemental substance is zero.
 - The oxidation number of a monatomic ion is equal to the ion's charge.
 - Oxidation numbers for common nonmetals are usually assigned as follows:
 - Hydrogen: -1 when combined with nonmetals, -1 when combined with metals
 - Oxygen: -2 in most compounds, sometimes -1 (so-called peroxides, O_2^{2-}), very rarely $-\frac{1}{2}$ (so-called superoxides, $O_2^{-1/2}$), positive values when combined with F (values vary)
 - Halogens: -1 for F always, -1 for other halogens except when combined with oxygen or other halogens (positive oxidation numbers in these cases, varying values)
 - The sum of oxidation numbers for all atoms in a molecule or polyatomic ion equals the charge on the molecule or ion.
- Note: The proper convention for reporting charge is to write the number first, followed by the sign (e.g., 2^-), while oxidation number is written with the reversed sequence, sign followed by number (e.g., -2). This convention aims to emphasize the distinction between these two related properties.

Crystalline Structures

Type of Solid	Type of Particles	Type of Attractions	Properties	Examples
ionic	ions	ionic bonds	hard, brittle, conducts electricity as a liquid but not as a solid, high to very high melting points	NaCl, Al_2O_3
metallic	atoms of electropositive elements	metallic bonds	shiny, malleable, ductile, conducts heat and electricity well, variable hardness and melting temperature	Cu, Fe, Ti, Pb, U
covalent network	atoms of electronegative elements	covalent bonds	very hard, not conductive, very high melting points	C (diamond), SiO_2 , SiC
molecular	molecules (or atoms)	IMFs	variable hardness, variable brittleness, not conductive, low melting points	H_2O , CO_2 , I_2 , $C_{60}H_{12}O_{11}$

Table 10.4

Bonds ~ metallic ionic covalent

metallic bonding: between two metals low EA/ IE/ EN

ionic bonding: forms salts (nonmetal and metal)

metallic solids: shiny conductors insoluble in water "ductile" malleable moderate-high melting points

ionic solid -- salts: hard and brittle white soluble in water *not* good conductor (unless in solution (dissolved) or melted) very high melting point



Bonds ~ metallic ionic covalent (cont)

covalent solids	hard high melting points	high IE/EN/EA?
molecular solids	soft low melting pt	
metallic solids	shiny because... band theory where the d and s electron energy levels are so close together and in a lattice there are so many and they are so close they seem to form almost a band that has many energy levels for electrons to jump to.	malleable because in the lattice the electrons are delocalized while the nuclei are not. This means that when manipulated the electrons can freely move making the structure malleable

unit cells



Webassign questions to look at

Webassign	Question
HW 02: WebAssign Questions (Homework)	HELP: 8, 9, 13 Solidify: 10, 11, 14,
HW 02: CDS Questions (Homework)	1 REVIEW: 2

Assessing the Student Response tips

LoMP	make sure one element (<i>mass</i>) is fixed	make sure ra
LoDP		

Unit 3 -- Concepts!

Unit 4 -- Concepts!

Review! dummy

Test	Question
Unit 1 Test	Question 3 Question 5 Question 7
Unit 2 Test	

