Unit 1 Notes

Moles, substances, and mixtures, ch 1, 2, 3

Practice 1

1. Increasing number of particles
2. Increasing mass
3. Increasing mole amounts

Mass spectroscopy—what are the big take-aways?

Percent composition: Calculate the percent by mass of $C_{12}H_{22}O_{11}$

Steps for calculating empirical formulas:

1. Turn % into mass (g)
2. Turn g into moles
3. Divide by smallest # of moles
4. Use whole numbers

Determine the empirical formula for a compound that is 40.92% carbon, 4.58% hydrogen, and 54.50% oxygen by mass.

Determining molecular formulas: $Multiplier = \frac{MF}{EF}$

A compound has an empirical formula of $C_3H_4O_3$ and a molecular mass of 264.31 g/mol. Calculate the molecular formula.

Practice 2

1. Determine the percent by mass composition of aluminum carbonate. (23.06% Al, 15.40% C, 61.54% O)

2. Calculate the empirical formula of a compound that is 44.88% potassium, 18.40% sulfur, and 36.72% oxygen. (K_2SO_4)

3. Determine the molecular formula of ethylene glycol, which is 38.7% carbon, 9.7% hydrogen, and 51.6% oxygen. Ethylene glycol has a molar mass of 62.1 g/mol. ($C_2H_6O_2$)

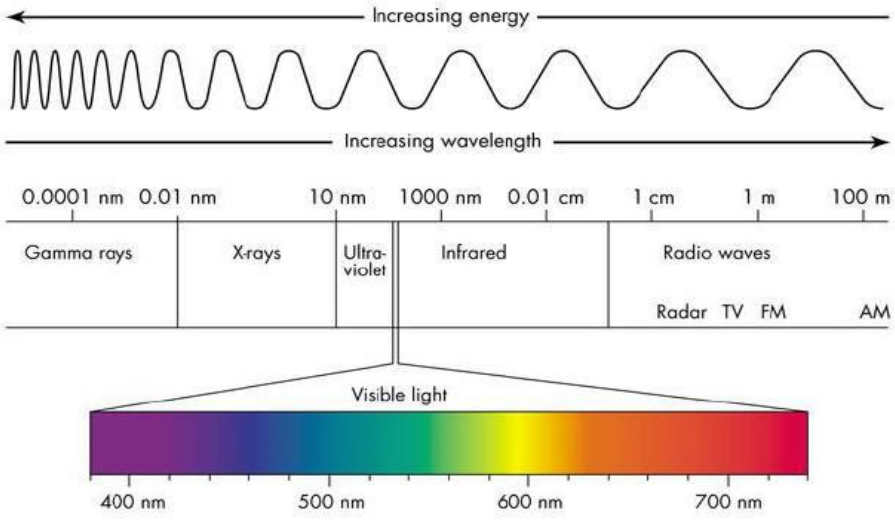
Combustion analysis: A sample of rubbing alcohol is composed of carbon, hydrogen, and oxygen. Combustion of 0.255g of rubbing alcohol yields 0.561 g of carbon dioxide and 0.306 g of water. Calculate the empirical of rubbing alcohol.

Practice 3

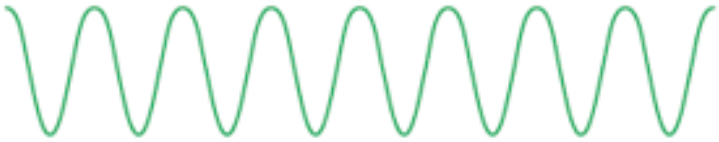
1. Combustion of 0.225 g caproic acid (composed of C, H, and O, and responsible for dirty sock smell) yields 0.512 g carbon dioxide and 0.209 g water. What is the empirical formula of caproic acid? (C_3H_6O)

2. What is the molecular formula of caproic acid if the molar mass is 116 g/mol? ($C_6H_{12}O_2$)

The electronic structure of the atom, ch 6



Label the wavelength on the wave below. Determine the frequency if the total time is 5 s.



Equation for calculating wavelength and frequency of a wave:

$c = 2.998 \times 10^{8}$ m/s

Practice 1

1. The red light given off by a neon lamp used has a wavelength of 470 nm. What is the frequency of this radiation?

2. A wave has a frequency of 90.1 MHz. Calculate the wavelength. What type of electromagnetic radiation is this?

Equation for calculating the energy of one photon:

$h = 6.626 \times 10^{-34}$ J·s

Practice 2

1. Calculate the energy of one photon of red light that has a wavelength of 470 nm.

2. Calculate the energy of one mole of these photons.

What is the photoelectric effect?

How is light like a wave? How is it like a particle?

What is an emission spectrum?

Rydberg equation: $\Delta E = -R_H \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$ $R_H = 2.18 \times 10^{-18}$ J

Practice 3

1. Calculate the energy change when an electron in a hydrogen atom moves from $n_i = 4$ to $n_f = 2$.

2. –ΔE indicates energy is gained/released. +ΔE indicates energy is gained/released. *Circle 1*

de Broglie's equation:

Practice 4:

1. What is the velocity of an electron with a de Broglie wavelength of 9.05×10^{-9} m? The mass of an electron is 9.11×10^{-31} kg.

2. Use your mass in kg (1 kg = 2.2 lbs) to calculate your wavelength when you are walking with a velocity of 1.0 m/s.

Heisenberg uncertainty principle:

What is electron density?

What do the quantum numbers describe?

What do the following quantum numbers indicate in terms of electron configurations?

Principle quantum number (n)

Angular momentum (*l*)

Magnetic (m_l)

Spin (m_s)

Sketch and label one each of the different orbital shapes

Electron configuration rules

Aufbau principle:

Hund's rule

Pauli Exclusion Principle

Define the following and give an example and an orbital diagram for each:

Diamagnetic

Paramagnetic

Practice 5 and 6

1. Write the electron configuration for:
    a. Copper

    b. Iron

Why do some elements have electron configurations that are exceptions?

Write the electron configurations for copper and chromium and explain why these elements are more stable with electron configurations that do not follow the Aufbau principle.

Coulomb's law and PES

Coulomb's law: $\boxed{F = \frac{k\, q_1 q_2}{r^2}}$ F = force; k = Coulomb's constant; q = charge; r = radius/distance

If one of the charges doubles, what happens to the attractive force? Explain.

If the distance between two charges doubles, what happens to the attractive force? Explain.

Sketch a possible photoelectron spectrum and label each peak. Label the axes. Identify your element.

Periodic Trends, ch 7

Horizontal rows are called _____. *(Review)*

Vertical columns are called _____. *(Review)*

The 7 diatomic elements are _____. *(Review)*

Why do the alkali metals wish to lose 1 electron? *(Review)*

Why do the halogens wish to gain 1 electron? *(Review)*

You should be able to label a periodic table with the charges. *(Review)*

What is effective nuclear charge?

What affects the nuclear charge acting on an electron?

What is electron shielding/screening?

As you go down a column on the periodic table, atomic radius tends to _____ because:

As you go across a period on the periodic table, atomic radius tends to _____ because:

How are effective nuclear charge and atomic radius related?

Anions are _____ than their atoms because:

Cations are _____ than their atoms because:

An isoelectronic series is:

What is the relationship between charge on an ion, nuclear charge, and the ionic radius in an isoelectronic series?

What is ionization energy?

If an electron is easy to remove, it has a _____ ionization energy. If an electron is hard to remove, it has a _____ ionization energy.

Why does it take more energy to remove a second electron from an element as opposed to the first?

As you go down a column on the periodic table, the first ionization energy tends to _____ because:

As you go across a period on the periodic table, the first ionization energy tends to _____ because:

What is electron affinity?

If an added electron has a strong attraction for an atom, what kind of electron affinity does it have?

Atoms that do not strongly attract an added electron have _____ electron affinity.

What kinds of elements have a strong attraction for electrons?

What kinds of elements do not gain an additional electron? Why?

What is electronegativity? How is it different from electron affinity?

Why do metals increase in reactivity as you go down a column and decrease as you go across a period on the periodic table?

The most reactive metal is _____.

Why do nonmetals decrease in reactivity as you go down a column and increase as you go across a period on the periodic table?

The most reactive metal is _____.