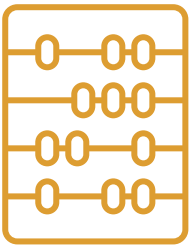
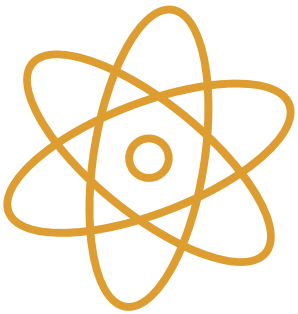
General Chemistry Must Knows!





Formula sheet

$$°\mathrm{F} = (1.8 \times °\mathrm{C}) + 32$$

$$\lambda v = c \quad where\ c = 2.998\ \times 10^{8} m/s$$

$$E = hv = \frac{hc}{\lambda} \quad where\ h = 6.626 \times 10^{-34} J \cdot s$$

$$Formal\ charge = [\#\ valence\ e^{-} on\ neutral\ atom] - [(\#\ lone\ e^{-} pairs) + \left(\frac{1}{2} \#\ bonding\ e^{-}\right)]$$

$$K_w = [H^+][OH^-]$$

$$q = mc\Delta T$$

$$M = \frac{n}{V}$$

$$PV = nRT\ where\ R = 0.08206\ \frac{L \cdot atm}{mol \cdot K}$$

$$N_A = 6.022 \times 10^{23}\ formula\ units/mol$$

$$Density\ (d) = \frac{m}{V}$$

$$Percent\ mass = \frac{mass\ analyte}{total\ mass} \times 100$$

$$M_1V_1 = M_2V_2$$

$$pH = -\log [H^+]$$

$$[H^+] = 10^{-pH}$$

Why do we need chemistry?

Chemistry is everywhere!

Agriculture

- **Improving soil fertility**
- **Developing pesticides**

Daily Life and Safety

- **Cooking**
- **Cleaning**
- **Cosmetics**

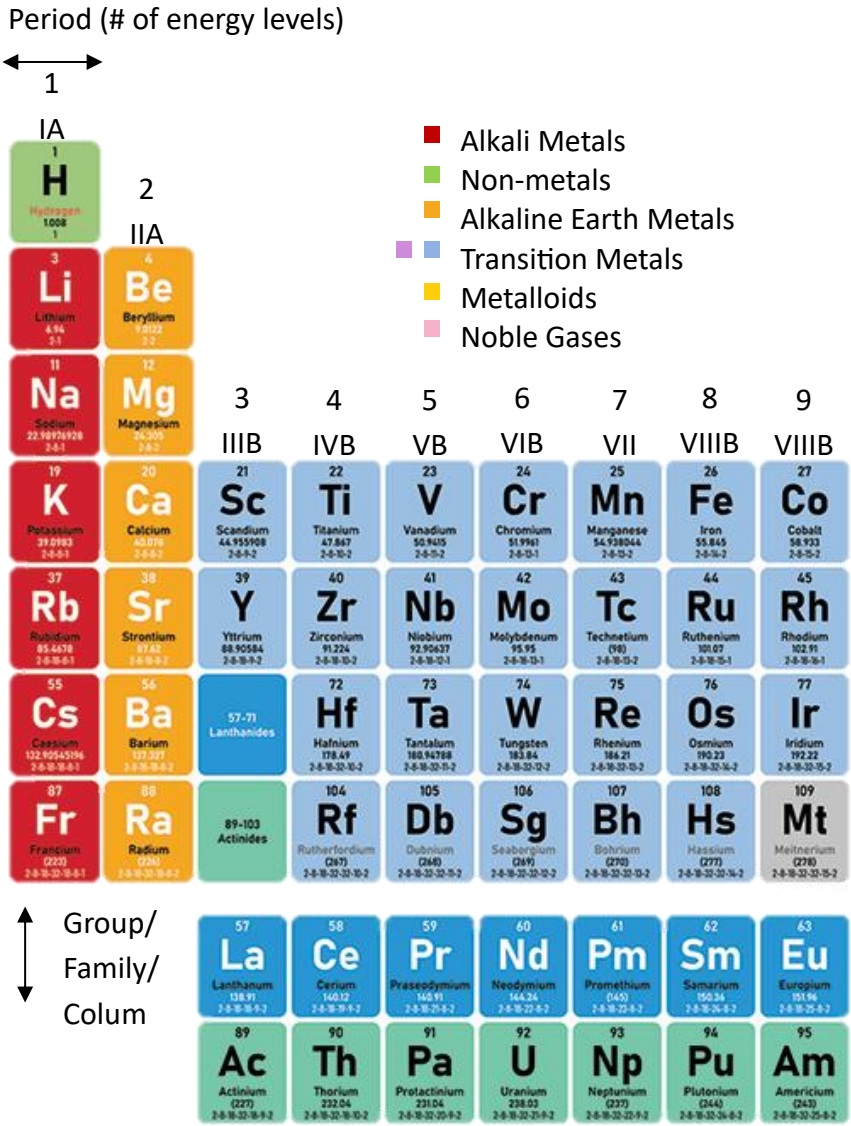
Medicine

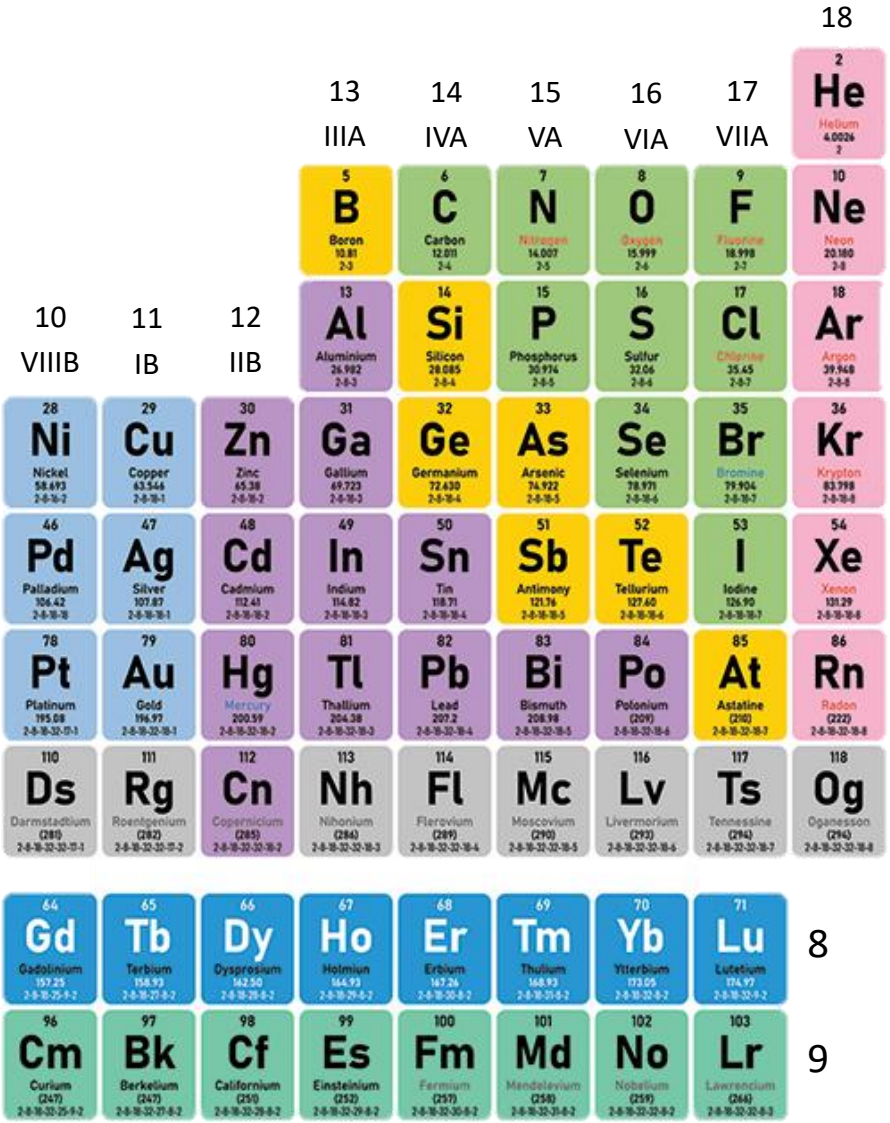
- **Critical for developing drugs**
- **Understanding body processes**
- **Maintaining health**

Environment Solutions

- **Reducing contaminants**
- **Recycle waste**
- **Combat climate change**

The Periodic Table




18
13 IIIA
14 IVA
15 VA
16 VIA
17 VIIA
10 VIIIB
11 IB
12 IIB
8
9

Significant Figures

Used to indicate the precision of a measured number

RULES

- All non-zero digits are significant
  - Ex. 125 ⇒ 3 SF
- All zeros between non-zero digits are significant
  - Ex. 101 ⇒ 3 SF
- Zeros following a non-zero and a decimal are significant
  - Ex. 0.3500 ⇒ 4 SF
- Zeros to the left of non-zero digits are NOT significant
  - Ex. 0.001 ⇒ 1 SF
- Zeros following a non-zero digit only are NOT significant
  - Ex. 100 ⇒ 1 SF
- The last digit is always an estimate (Trailing zeroes only count if there is a decimal)
  - Ex. 100.0 ⇒ 4 SF

TRY THESE!

0.0053567	2.60	6
670	542000.	6271.91

ADDITION & SUBTRACTION

Same # of decimal places as the # with the least # of decimal places

Ex.

11.31 + 33.264 + 4.1 = 48.674 ⇒ 48.7

MULTIPLICATION & DIVISION

Same # of sig figs as the # with the least # of sig figs

Ex.

5.282 × 3.42 = 18.06444 ⇒ 18.1

Scientific Notation

$4500000 = 4.5 \times 10^{6}$

Coefficient — Base — Exponent

$0.00453 = 4.53 \times 10^{-3}$

Try these:

0.0006	0.2
540,000,000	6.95

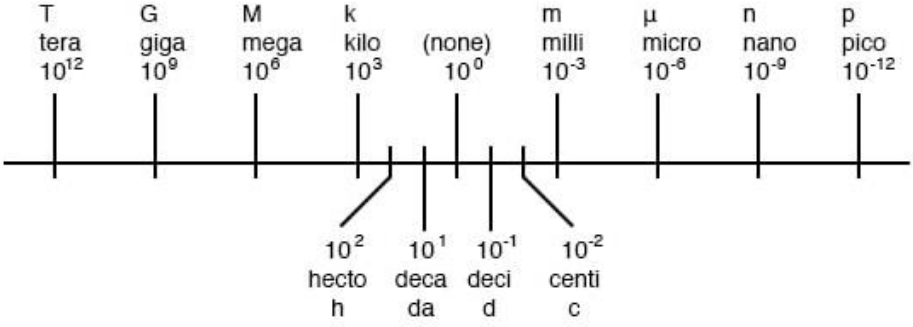
SI units and measurements

Quantity	Symbol	SI unit
Length	l	Meter (m)
Mass	m	Gram (g)
Time	t	Second (s)
Temperature	T	Kelvin (K)
Amount	n	Moles (mol)
Electric current	I	Ampere (A)

Derived Units (Combination of base units)

Area	A	Square meter ($\boldsymbol{m^2}$)
Volume	V (l*w*h)	Cubic meter (m^3)
Molar mass	M	g/mol

Unit conversions



The Great Man King Henry Died Drinking Chocolate Milk Many Nights

SUBTRACT EXPONENTS!!!

Ex.

0.0075 Gm = _____ Km

9-(3) = 6

0.007500 Gm⇒ 7500 Km

TRY THESE!

244,475.3 μs = _____hs

0.0002 μg = _____mg

2,103.55 s = _____ks

0.00091 TL = _____ML

4,096 MB = _____ GB

448.5 cg = _____g

0.00046 ks = _____ cs

210 hm = _____cm

0.00034 μL = _____cL

11,120.33 ng = _____ cg

104 km = _____m

2500 m = _____ km

198 g = _____kg

0.0000012 Gm = _____ mm

Dimensional Analysis

A conversion factor is the relationship between two units

$$\frac{1\ L}{1000\ ml} \qquad \frac{1\ ft}{12\ inches}$$

$$\frac{1\ hr}{60\ min} \qquad \frac{Molar\ mass}{1\ mole}$$

$$\frac{1\ mole}{6.022 \times 10^{23} atoms}$$

Ex. 30 ft = ? inches

$$\frac{30\ \cancel{ft} \mid 12\ inches}{\qquad\quad 1\ \cancel{ft}} = 360\ inches$$

Try this:

How many atoms in 32.0 g of KNO_3?

The Scientific Method

Number the steps of the scientific method.

- Hypothesis formation
- Observation
- Experimentation
- Conclusion
- Prediction

Atoms

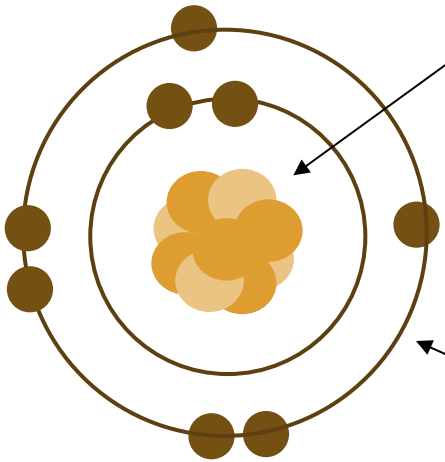
- The smallest piece of an element
- Invisible to the human eye
- Made up of subatomic particles:
  - Protons
    - Has a (+) charge
  - Neutrons
    - No charge
  - Electrons
    - Has a (-) charge

MATTER

Anything that has mass and takes up space

ATOM

Smallest unit of matter



Nucleus
- Protons & neutrons

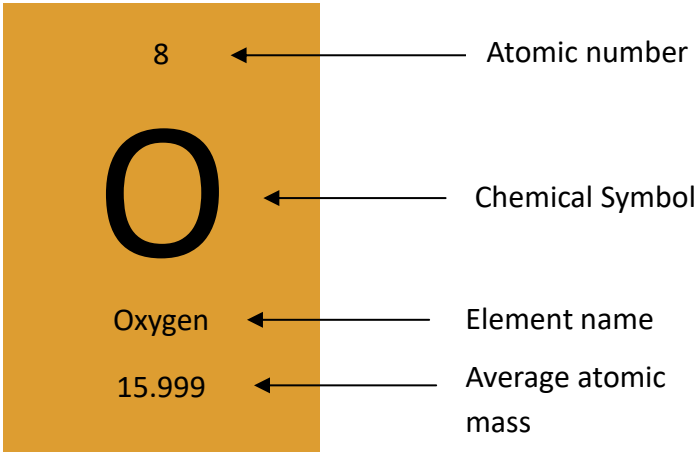
Electron

Orbital/Shell
- # energy levels

Oxygen

Atomic number defines elements

- Atomic number = # protons = # electrons
  - Chemical behavior ⇒ determined by # and arrangement of electrons (e^-)
  - Atoms are electrically neutral aka. the ones in the periodic table
- Protons + Neutrons = Mass #
- Period # = # of shells
- Valence electrons ⇒ # of electrons in their outer shell
  - Members of groups A
    - Group # = # valence electrons
- Element
  - Substance that cannot be broken down by ordinary chemical means



Ions

- Charged particles
  - Cation $\Rightarrow$ less electrons = net positive charge
  - Anion $\Rightarrow$ more electrons = net negative charge

Using the periodic table, fill in the following table

# protons	# electrons	Overall charge	Element symbol & charge	Neutral (N) Cation (C) Anion (A)
+7	-10			
+12	-10			
+19		1+		
			P^{-3}	
+8		0		

Isotopes

- Different # of neutrons, same # of protons
- Radioactive isotopes – unstable (break apart) and emit radiation

Using the periodic table, fill in the following table

	Carbon-12	Carbon-13	Carbon-14
# protons			
# neutrons			
# electrons			

Chemical Bonds

Intramolecular forces

Covalent bonds

- Between 2 non-metals or/and metalloids
- Share 2 valence electrons per bond
- Strength $\Rightarrow$ # of shared e^-
  - Single bond ($2e^-$)
  - Double bond ($4e^-$)
  - Triple bond ($6e^-$)

Ionic bonds

- Between a metal and a nonmetal
- Transfer of electrons
- Oppositely charged ions
  - Ex. $Na^+ + Cl^- \Rightarrow$ NaCl

Intermolecular forces

Hydrogen bonds

- Between polar molecules
- Strong and transitory; cumulative
- Electropositive hydrogen – electronegative nitrogen, oxygen, or fluorine (NOF)

London Dispersion Forces

- Weak – not a chemical bond
- In all molecules but the only one in non-polar molecules

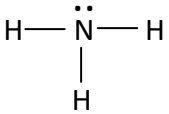
Lewis Structures

How to Draw a Lewis Structure:

1. Find total valence electrons
2. Draw skeleton structure using single bonds
3. Assign remaining valence electrons
4. Make multiple bonds if all octets aren't filled

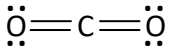
Ex. NH_3

$5 + 3(1) = 8\ e^-$



CO_2

$4 + 2(6) = 16e^-$



A single bond

↓

$2e^-$

Try these:

BCl_3

H_3O^+

CCl_4

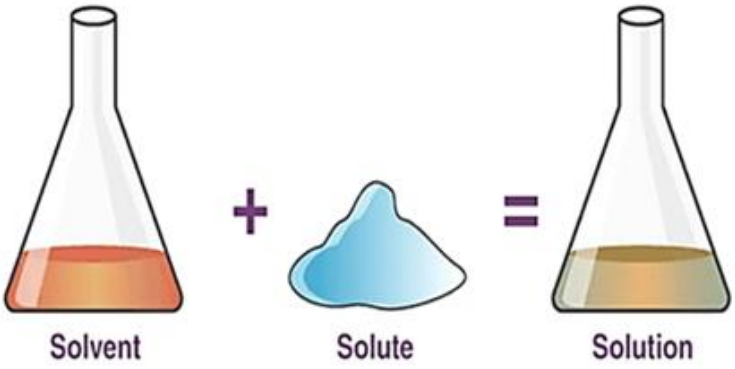
H_2CO

Pure substances, mixtures & solutions

- Pure substances ⇒ Made of a single compound or element
  - Ex. water (H_2O)
- Mixture ⇒ Made of different substances
  - There are 2 kinds of mixtures:
    - Heterogeneous a.k.a. you can see the different components
      - Cereal in milk
      - Ice in soda
      - A salad
    - Homogeneous a.k.a. you can't see the different parts (it's uniform)
      - Steel
      - Air
      - Salt water

If solvent is water then it's an aqueous solution (aq)

Sometimes homogeneous mixtures are called <u>solutions</u>.



Acids and Bases

Acid

- Strong acids dissociate in water $\Rightarrow$ increases $[H^+]$
  - Lowers pH
  - Makes it more acidic
- Stronger acid – lower pH

Base

- Strong bases dissociate in water $\Rightarrow$ increases $[OH^-]$
  - Lowers $[H^+]$
  - Raises pH
  - Makes it more basic

Buffers

- Weak Acid + Weak Base $\rightarrow$ Conjugate Base + Conjugate Acid

  $H_2O(l) + NH_3(aq) \rightarrow OH^-(aq) + NH_4^+(aq)$
- Resist changes in pH when an acid or base is added
- Keeps pH relatively constant