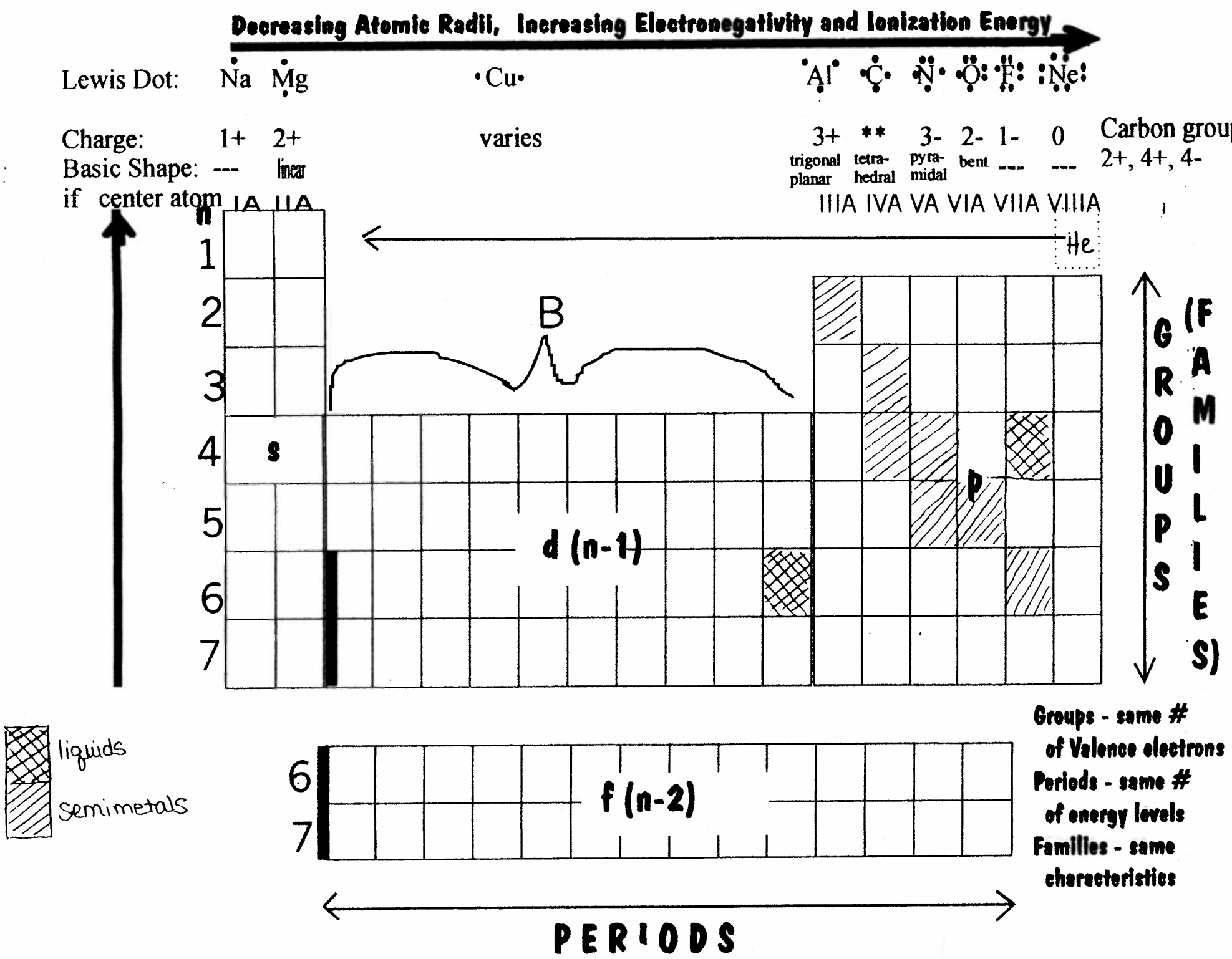
Decreasing Atomic Radii, Increasing Electronegativity and Ionization Energy
Lewis Dot: Na Mg •Cu• Al C N O F Ne
Charge: 1+ 2+ varies 3+ ** 3- 2- 1- 0
Basic Shape: --- linear trigonal planar tetra-hedral pyra-midal bent --- ---
if center atom
Carbon group 2+, 4+, 4-
IA IIA IIIA IVA VA VIA VIIA VIIIA
H
He
1
2
3
4
5
6
7
B
s
d (n-1)
p
f (n-2)
GROUPS (FAMILIES)
PERIODS
liquids
semimetals
Groups - same # of Valence electrons
Periods - same # of energy levels
Families - same characteristics

APPENDIX E Important Formulas, Equations, and Constants

Density (d)

$$\text{density} = \frac{\text{mass}}{\text{volume}} \qquad d = \frac{m}{V}$$

Percent Error

$$\text{percent error} = \frac{\text{measured value} - \text{accepted value}}{\text{accepted value}} \times 100\%$$

Percent Yield

$$\text{percent yield} = \frac{\text{actual yield}}{\text{expected yield}} \times 100\%$$

Percentage Composition

$$\text{percentage composition by mass} = \frac{\text{mass of element}}{\text{mass of compound}} \times 100\%$$

Planck's Equation

$E = h\nu$

where h is Planck's constant, E is energy, and ν is frequency

Kinetic Energy (KE)

$$\text{kinetic energy} = \frac{\text{mass} \times \text{velocity}^2}{2}$$

$$KE = \frac{mv^2}{2}$$

Gravitational Potential Energy (GPE)

gravitational potential energy = mass × acceleration due to gravity × height

$GPE = mgh$

Amount of Gas (n) in a Sample

$$n = \frac{\text{mass}}{\text{molar mass}} = \frac{m\,(\text{g})}{\mathcal{M}\,(\text{g/mol})}$$

Boyle's Law

$P_1V_1 = P_2V_2$

Combined Gas Law

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Charles's Law

$V_1T_2 = V_2T_1$

Avogadro's Law

$V = k_3n$

where k_3 is Avogadro's law constant and n is the number of moles

Dalton's Law of Partial Pressures

$P_T = P_a + P_b + P_c + \cdots$

Ideal Gas Law

$PV = nRT$

Molarity (M)

$$\text{molarity} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

Molality (m)

$$\text{molality} = \frac{\text{moles of solute}}{\text{kilograms of solvent}}$$

Mole Fraction (χ)

$$\text{mole fraction} = \frac{\text{moles of solute or solvent}}{\text{total moles of solution}}$$

Boiling Point Elevation

$\Delta T_b = K_b m$

where K_b is the molal boiling point elevation constant

Freezing Point Depression

$\Delta T_f = K_f m$

where K_f is the molal boiling point elevation constant

Rate of Reaction

$\text{rate} = k[A]^x[B]^y$

where [A] and [B] are molar concentrations of reactants and k is a rate constant

Entropy Change

$\Delta S = S_{\text{products}} - S_{\text{reactants}}$

Gibbs Free Energy

$\Delta G = \Delta H - T\Delta S$

Avogadro's number	6.02×10^{23}
Speed of light in a vacuum	3.00×10^{8} m/s
Atomic mass unit (amu)	1.66054×10^{-27} kg
Charge of an electron	1.60×10^{-19} C
Mass of an electron	9.11×10^{-31} kg
	0.0006 amu
Mass of a proton	1.0073 amu
	1.6726×10^{-27} kg
Mass of a neutron	1.0087 amu
	1.6749×10^{-27} kg
Planck's constant (h)	6.6262×10^{-34} J-s
Gas constant (R)	0.08206 atm-L/mol-K
	8.314 Pa-qm³/mol-K
	8.314 J/mol-K
Molar volume of a gas at STP	22.4 L

Specific Heat (C_p)

$H = m \bullet \Delta T \bullet C_p$

Enthalpy (H)

$\Delta H_{\text{reaction}} = \Delta_{\text{products}} - \Delta_{\text{reactants}}$

pH

$pH = -\log [H_3O^+]$

Wavelength (λ)

$\lambda = \nu/c$ (where c = speed of light)

Molar Mass (m.m.)

$$\#\text{ of moles} \times \frac{\text{atomic mass}}{1\text{ mole}} =$$

Stoichiometry: **Mole → Mole**

$$\#\text{ of mol A} \times \frac{\text{molar}}{\text{ratio}} =$$

Mass → Mass

$$\#\text{ of grams A} \times \frac{1\text{ mol A}}{\text{molar mass A}} \times \frac{\text{molar}}{\text{ratio}} \times \frac{\text{molar mass B}}{1\text{ mol B}} =$$

Mass → Volume

$$\#\text{ of grams A} \times \frac{1\text{ mol A}}{\text{molar mass A}} \times \frac{\text{molar}}{\text{ratio}} \times \frac{22.4\text{ L B}}{1\text{ mol B}} =$$

Volume → Volume

$$\#\text{ of liters A} \times \frac{1\text{ mol A}}{22.4\text{ L A}} \times \frac{\text{molar}}{\text{ratio}} \times \frac{22.4\text{ L B}}{1\text{ mol B}} =$$

Conversions:

1 000 000 000 m = **1 Gm** (giga)
1 000 000 m = **1 Mm** (mega)
1 000 m = **1 Km** (kilo)
100 m = **1 Hm** (hecta)
10 m = **1 dam** (deca)
1 meter (or other base unit)
1 m = **10 dm** (deci)
1 m = **100 cm** (centi)
1 m = **1000 mm** (mili)
1 m = **1000 000 µm** (micro)
1 m = **1000 000 000 nm** (nano)

2.54 cm = 1 inch $1\text{ cm}^3 = 1\text{ ml}$