Test 1 Equations that you need to memorize

Chapter 1

Prefix	Symbol	Factor
nano	n	10^{-9}
micro	μ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
kilo	k	10^{3}

Length

1 mile = 5280 feet
1 yard = 3 feet
1 foot = 12 inches
1 inch = 2.54 centimeters

Mass

1 kilogram = 2.2 pounds (approximately)
1 pound = 16 ounces
1 ton = 2000 pounds

Volume

1 mL = 1 cm^3
1 liter = 1.06 quarts (approximately)
1 gallon = 4 quarts
1 quart = 2 pints
1 pint = 2 cups
1 cup = 8 (fluid) ounces

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Chapter 2

$$\text{Mass number} - \text{Atomic number} = \text{number of neutrons}$$

$$\text{Atomic charge} = \text{number of protons} - \text{number of electrons}$$

$$\text{Average atomic mass} = \sum_{i} (\text{fractional abundance} \times \text{isotopic mass})$$

The indicated common charges elements and indicated names of elements

Name of Polyatomic Ion	Symbol
Ammonium	NH_4^+
Acetate	$C_2H_3O_2^-$ or CH_3COO^-
Cyanide	CN^-
Hydroxide	OH^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-
Nitrite	NO_2^-
Nitrate	NO_3^-
Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}
Carbonate	CO_3^{2-}
Phosphite	PO_3^{3-}
Phosphate	PO_4^{3-}

Chapter 3

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liter of solution}}$$

$$M_1V_1 = M_2V_2$$

$$\text{Mass percentage} = \frac{\text{g of component}}{100\text{ g of solution}}$$

$$\text{Volume percentage} = \frac{\text{mL of component}}{100\text{ mL of solution}}$$

$$\text{ppm} = \frac{\text{mg of solute}}{\text{L of solution}}$$

$$\text{ppb} = \frac{\mu\text{g of solute}}{\text{L of solution}}$$

Chapter 4

Strong Acids

Name	Formula	Ions
Hydrochloric acid	HCl	$H^+(aq) + Cl^-(aq)$
Hydrobromic acid	HBr	$H^+(aq) + Br^-(aq)$
Hydroiodic acid	HI	$H^+(aq) + I^-(aq)$
Nitric acid	HNO_3	$H^+(aq) + NO_3^-(aq)$
Perchloric acid	$HClO_4$	$H^+(aq) + ClO_4^-(aq)$
Chloric Acid	$HClO_3$	$H^+(aq) + ClO_3^-(aq)$
Sulfuric acid	H_2SO_4	$H^+(aq) + HSO_4^-(aq)$

Strong Bases

Name	Formula	Ions
Lithium hydroxide	LiOH	$Li^+(aq) + OH^-(aq)$
Sodium hydroxide	NaOH	$Na^+(aq) + OH^-(aq)$
Potassium hydroxide	KOH	$K^+(aq) + OH^-(aq)$
Rubidium hydroxide	RbOH	$Rb^+(aq) + OH^-(aq)$
Cesium hydroxide	CsOH	$Cs^+(aq) + OH^-(aq)$
Calcium hydroxide	$Ca(OH)_2$	$Ca^{2+}(aq) + 2\ OH^-(aq)$
Strontium hydroxide	$Sr(OH)_2$	$Sr^{2+}(aq) + 2\ OH^-(aq)$
Barium hydroxide	$Ba(OH)_2$	$Ba^{2+}(aq) + 2\ OH^-(aq)$

Solubility Rules

Soluble Ions	Exceptions
$Li^+, Na^+, K^+, Rb^+, Cs^+, NH_4^+$	None
$C_2H_3O_2^-, NO_3^-, ClO_3^-, ClO_4^-$	None
Cl^-, Br^-, I^-	Ag^+, Pb^{2+}
SO_4^{2-}	$Ag^+, Pb^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}$

Rules for assigning oxidation numbers

1. The sum of oxidation state for all atoms in a molecule or polyatomic ion equals the charge of the molecule or ion (indicated as a superscript)
2. The oxidation state of an atom in an elemental substance is zero
3. The oxidation state of a monatomic ion is equal to the ion's charge
4. Group 1 metals and silver have $+1$ oxidation states. Group 2 atoms and zinc have $+2$ oxidation states. Aluminum has a $+3$ oxidation state.
5. Hydrogen is $+1$ when combined with nonmetals and -1 when combined with metals
6. Oxygen is -2 is most compounds but is occasionally -1 in peroxides, O_2^{2-}.
7. Other atoms follow the previously discussed common charges

$$\text{Percent Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

Chapter 5

$$1\ \text{cal} = 4.184\ \text{J}$$

$$1\ \text{kcal} = 4.184\ \text{kJ}$$

$$q = C\Delta T$$

$$q = mc\Delta T$$

$$\Delta U = q + w$$

$$\Delta H^\circ_{rxn} = \sum \Delta H^\circ_f(\text{products}) - \sum \Delta H^\circ_f(\text{reactants})$$

$$\Delta H_{rxn} = \frac{q_{rxn}}{\text{mol}_{LR}}$$

Chapter 6

$$c = \lambda\nu$$

$$E_{photon} = h\nu = \frac{hc}{\lambda}$$

$$\Delta E_{atom} = -2.179 \times 10^{-18}\text{J}\left(\frac{1}{n^2_{final}} - \frac{1}{n^2_{initial}}\right)$$

$$E_{photon} = |\Delta E_{atom}|$$

Chapter 7

$$\text{Formal charge} = \begin{pmatrix}\#\text{ of}\\ \text{valence } e^-\end{pmatrix} - \begin{pmatrix}\#\text{ of}\\ \text{nonbonding } e^-\end{pmatrix} - \begin{pmatrix}\#\text{ of bonds}\\ \text{to that atom}\end{pmatrix}$$

$$\Delta H° = \sum(\text{Energies of bonds broken}) - \sum(\text{Energies of bonds formed})$$

$$\text{Bond order of bond} = \left(\frac{\text{number of bonding lines}}{\text{number of bonding locations}}\right)$$

Chapter 9

$$1\text{ atm} = 760\text{ mmHg} = 760\text{ torr}$$

For a gas in a single set of conditions

$$PV = nRT \quad *** \text{ P is in atm, V is in liters, T is in Kelvin, and R is } 0.0821\,\frac{\text{L atm}}{\text{mol K}}$$

$$PVMM = gRT \quad *** \text{ P is in atm, V is in liters, T is in Kelvin, g is in grams, and R is } 0.0821\,\frac{\text{L atm}}{\text{mol K}}$$

$$PMM = DRT \quad *** \text{ P is in atm, MM is in } \frac{\text{g}}{\text{mol}}\text{, T is in Kelvin, D is in } \frac{\text{g}}{\text{L}}\text{, and R is } 0.0821\,\frac{\text{L atm}}{\text{mol K}}$$

For a gas transitioning from one to another set of conditions

$$\frac{P_1V_1}{n_1\,T_1} = \frac{P_2V_2}{n_2T_2} \quad *** \text{ V and P may be in any units but T must be in Kelvin and n must be in moles}$$

For a gas with multiple components

$$P_{total} = P_A + P_B + P_C + \cdots$$

$$\chi_A P_{total} = P_A$$

$$P_{total} = P_{gas} + P_{water}$$

$$\overline{KE} = \frac{3}{2}RT \quad *** \text{ T is in Kelvin and R is } 8.314\,\frac{\text{J}}{\text{mol K}}$$

$$v_{rms} = \sqrt{\frac{3RT}{MM}} \quad *** \text{ T is in Kelvin, MM is in } \frac{\text{kg}}{\text{mol}}\text{, and R is } 8.314\,\frac{\text{J}}{\text{mol K}}$$