Common Equations Used in Chemistry

Equation for density: $d = m/v$

Converting ˚F to ˚C: ˚C = (˚F - 32) x 5/9

Converting ˚C to ˚F: ˚F = ˚C x 9/5 +32

Converting ˚C to K: K = (˚C + 273.15)

Percent composition of an element = $\frac{n \text{ x molar mass of element}}{\text{molar mass of compound}}$ x 100%

- where n = the number of moles of the element in one mole of the compound

% yield = $\frac{\text{actual yield}}{\text{theoretical yield}}$ x 100%

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

Dilution of Solution: $M_iV_i = M_fV_f$

Boyle's law - Constant T and *n*: $PV = k$

Boyle's law - For calculating changes in pressure or volume: $P_1V_1 = P_2V_2$

Charles' law - Constant P and *n*: $\frac{V}{T} = k$

Charles' law - For calculating temperature or volume changes: $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

Avogadro's law - Constant P and T: $V = k*n$

Ideal Gas equation: $PV = nRT$

Calculation of changes in pressure, temperature, or volume of gas when *n* is constant:

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

Calculation of density or molar mass of gas: $d = \frac{PM}{RT}$

Dalton's law of partial pressures - for calculating partial pressures: $P_i = X_i P_T$

Root-mean-square speed of gas molecules: $u_{rms} = \left(\frac{3RT}{M}\right)^{0.5}$

Van der waals equation; for calculating the pressure of a nonideal gas:

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

Definition of heat capacity, where s is specific heat: C = ms

Calculation of heat change in terms of specific heat : $q = ms\Delta t$

Calculation of heat change in terms of heat capacity: $q = C\Delta t$

Electrical force: $F_{el} = k \frac{q1q2}{r2}$

Potential energy: $V = k \frac{q1q2}{r}$

Calculation of standard enthalpy of reaction:

$\Delta H^\circ rxn = \sum n\Delta H^\circ f$ (products) - $\sum m\Delta H^\circ f$ (reactants) [where n and m are coefficients in equation]

Mathematical statement of the first law of thermodynamics: $\Delta E = q + w$

Work done in gas expansion or compression: $w = - P\Delta V$

Definition of enthalpy: H = E + PV

Enthalpy (or energy) change for a constant-pressure process: $\Delta H = \Delta E + P\Delta V$

Enthalpy (or energy) change for a constant-pressure process: $\Delta E = \Delta H - RT\Delta n$, where n is the change in the number of moles of gas.

Relationship of wavelength and frequency: $u = \lambda \nu$

Energy of a photon: $E = h\nu$

Energy of an electron in the n^{th} state in a hydrogen atom: $E_n = -RH(\frac{1}{n^2})$,
where R_H = Rydberg constant = 2.18×10^{-18} J

Energy of a photon emitted as the electron undergoes a transition from the n_i level to the nf level: $\Delta E = h\nu = RH(\frac{1}{ni^2} - \frac{1}{nf^2})$, where RH = Rydberg constant = 2.18×10^{-18} J

DeBroglie Relationship of wavelength of a particle to its mass m and velocity v: $\lambda = \frac{h}{mv}$

Uncertainty in the position (x) or in the momentum (p) of a particle: $\Delta x \Delta p \geq \frac{h}{4\pi}$

Formal charge on an atom in a Lewis structure = total number of valence electrons in the free atom - total number of nonbonding electrons - $\frac{1}{2}$(total number of bonding electrons)

Enthalpy change of a reaction from bond energies:

$\Delta H^\circ = \sum BE\ (reactants) - \sum BE\ (products)$

Dipole moment in terms of charge (Q) and distance of separation (r) between charges: $\mu = Q \times r$

Bragg equation for calculating the distance between planes of atoms in a crystal lattice:

$2d \sin\theta = \nu\lambda$

Clasius-Clapeyron equation for determining ΔHvap of a liquid:

$$\ln P = -\frac{\Delta H_{vap}}{RT} + C$$

Calculation of ΔH_{vap}, vapor pressure or boiling point of a liquid:

$$\ln\frac{P_1}{P_2} = \frac{\Delta H_{vap}}{R}\frac{T_1 - T_2}{(T_1 T_2)}$$