Chem 109 Constants & Equations you should know how to use: Exam II

$R = 0.08206\ ^{L\cdot atm}/_{mol\cdot K} = 8.315\ ^{J}/_{mol\cdot K}$ | $1\ J = 1\ ^{kg\cdot m^2}/_{s^2}$ s_{H2O} = 4.18 J/(°C g) = 1 cal/(°C g)

proton/electron charge $= \pm 1.602 \times 10^{-19} C$ | $1 atm = 760 mmHg = 760\, torr = 101.325 kPa$

electron mass $= 9.109 \times 10^{-31} kg$ | proton/neutron mass $\approx 1.67 \times 10^{-27} kg$

$1 amu = 1.661 \times 10^{-24}\ grams$ | Avogadro's Number $= N_A = 6.022 \times 10^{23}\ ^{things}/_{mole}$

$h = 6.626076 \times 10^{-34} J \cdot s$ **or** $kg\ m^2\ s^{-1}$ | $c = 2.99792458 \times 10^{8}\ ^{m}/_{s}$

$$T_C = \frac{T_F - 32}{1.8} \qquad T_K = T_C + 273.15 \qquad M_1V_1 = M_2V_2 \qquad M = \frac{mol\ solute}{L\ solution} \qquad PV = nRT$$

$$d_{mass} = \frac{mass}{V} \quad or \quad d_{molar} = \frac{n}{V} \qquad P_1 = \chi_1 \cdot P_{total} \qquad \chi_1 = \frac{n_1}{n_1 + n_2 + n_3 + \cdots} \qquad P = \tfrac{1}{3} m v^2 (\frac{N}{V})$$

$$P_{total} = P_1 + P_2 + P_3 + \cdots \qquad u_{rms} = \sqrt{3RT/M} = \sqrt{3000RT/MM} \qquad \frac{rate_1}{rate_2} = \frac{\sqrt{MM_2}}{\sqrt{MM_1}}$$

$$MM = \frac{dRT}{P} \qquad (KE)_{avg} = \frac{3}{2}RT \qquad Mass\%\ i = \frac{Mass_i}{Mass_{total}} \times 100\%$$

$$\%\ Yield = \frac{Actual\ Yield}{Theoretical\ Yield} \times 100\% \qquad \Delta E = q + w \qquad w = -P_{ext} \cdot \Delta V \qquad q = n \cdot c_p \cdot \Delta T$$

$$q = mass \cdot c_s \cdot \Delta T \qquad \Delta H = \Delta E + P\Delta V \qquad q_p = \Delta H \qquad q_v = \Delta E$$

$$\Delta H^o_{rxn} = \Sigma n_p \Delta H^o_f(\text{products}) - \Sigma n_r \Delta H^o_f(\text{reactants}) \qquad \Delta E_{universe} = \Delta E_{surroundings} + \Delta E_{system} = 0$$

$$c = \lambda \nu \qquad E = h\nu \qquad E = \frac{hc}{\lambda} \qquad \Delta E = nh\nu \qquad E = mc^2 \qquad \lambda = \frac{h}{mv} \qquad \Delta x \Delta p \geq \frac{h}{4\pi}$$

$$E_{electron} = -2.178 \times 10^{-18} J\left(\frac{Z^2}{n^2}\right) \qquad \Delta E_{electron} = -2.178 \times 10^{-18} J\left(\frac{1}{n^2_{final}} - \frac{1}{n^2_{initial}}\right) \qquad n\lambda = 2d \sin\theta$$

$$E_{coulomb} = 2.31 \times 10^{-19} J \cdot nm \frac{Q_1Q_2}{r} \qquad \Delta H_{rxn} \approx \Sigma D(\text{bonds broken}) - \Sigma D(\text{bonds formed})$$

Quantum Number	**Symbol**	**Characteristic specified**	**Information provided**	**Possible values**
Principle quantum number	*n*	Shell	Average distance from nucleus (r)	1, 2, 3, 4, ...
Angular momentum (Azimuthal) quantum number	*l*	Subshell	Shape of orbital	0 (*s*), 1 (*p*), 2 (*d*), 3 (*f*), ...*n* - 1
Magnetic quantum number	m_l	Orbital	Orientation of orbital	- *l* ... 0 ... +*l*
Spin quantum number	m_s	Electron spin	Spin direction	± 1/2

Standard Enthalpies of Formation, ΔH_f°

$CH_{4(g)}$	-75 kJ/mol	$H_2O_{(l)}$	-286 kJ/mol	$NO_{(g)}$	90 kJ/mol
$ClF_{3(g)}$	-163 kJ/mol	$H_2O_{(g)}$	-242 kJ/mol	$NO_{2(g)}$	34 kJ/mol
$HCN_{(g)}$	135.1 kJ/mol	$NH_{3(g)}$	-46 kJ/mol		
HF(g)	-271 kJ/mol	$NH_{3(aq)}$	-80 kJ/mol		