Useful and Necessary Formulas

1. **Electromagnetic Radiation**
   a) **Speed of Light** $c = \lambda * v$
   b) **Wavelength** $\lambda = c / v$
   c) **Frequency** $v = c / \lambda$
   d) **Energy in a photon** $E = h * v$

2. **Concentration and Molar Mass**
   a) **Density (D)** $D = m / V$
   b) **Moles (n)** $n = g / mm$
   c) **Moles (# of particles)** $n = \text{number of particles} / \text{Avogadro's number}$
   d) **Moles (solution)** $n = \text{concentration} \cdot \text{volume}$
   e) **Moles (gas equation)** $n = PV / RT$
   f) **Molarity (M)** $M = n / \text{volume}$
   g) **Molar mass (mm)** $mm = m / n$

3. **Gases**
   a) **Boyle's Law** $P_1 \cdot V_1 = P_2 \cdot V_2$
   b) **Charles' Law** $V_1 \cdot T_2 = V_2 \cdot T_1$
   c) **Combined Gas Law** $P_1 \cdot V_1 / T_1 = P_2 \cdot V_2 / T_2$
   d) **Ideal Gas Law** $PV = nRT$
   e) **Dalton's Law of Partial Pressures** $P_T = P_1 + P_2 + P_3 + ... + P_n$

4. **Acids and Bases**
   a) **pH** $pH = -\log[H^{+1}]$
   b) **pOH** $pOH = -\log[OH^{-1}]$
   c) **$[H_3O^{+1}]$** $[H_3O^{+1}] = 10^{-pH}$
   d) **$[OH^{-1}]$** $[OH^{-1}] = 10^{-pOH}$

5. **Heat**
   a) **Quantity of Heat (Q)** $Q = m \cdot c \cdot \Delta t$
   b) **Quantity of Heat (fusion)** $Q = m \cdot L_f$
   c) **Quantity of Heat (vaporization)** $Q = m \cdot L_v$
   d) **Celsius to Kelvin** $K = {}^{o}C + 273.15$
   e) **Kelvin to Celcius** ${}^{o}C = K - 273.15$

6. **Mathematics**
   a) **Quadratic Equation** $x = -b \pm (b^2 - 4ac)^{-2} / 2a$

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Common Physical and Chemical Constants

Avogadro's Number	**6.02217×10^{23} things/mole**
Planck's Constant	**$6.6260755 \times 10^{-34}$ Js**
1 atmosphere (atm)	**101,325 Pascals (Pa) = 101.325 kPa** **= 760 mm of Hg = 760 Torr = 1.01325 bar**
1 mole of any gas at STP	**22.4 L ($0^{o}C$, 1 atm)**
1 mole of any gas at SATP	**24.8 L ($25^{o}C$, 1 atm)**
Ideal Gas Law Constant (R)	**0.0821 L atm mol^{-1} K^{-1}** **= 8.31430 L kPa mol^{-1} K^{-1}** **= 8.31441 J mol^{-1} K^{-1}**
1 calorie (cal)	**4.184 J**
1 Cal	**1 kcal = 1000 calories**
1 atomic mass unit (amu)	**$1.6605665 \times 10^{-24}$ g**
1 tonne(t)	**1000 kg = 1 Mg**
Speed of light in a vacuum	**299792458 m s^{-1} (3.0×10^{8} m s^{-1})**
Rest mass of an electron (m_e)	**0.000548712 u = $9.1093897 \times 10^{-28}$ g**
Rest mass of a proton (m_p)	**1.00727605 u = $1.67262305 \times 10^{-24}$ g**
Rest mass of a neutron (m_n)	**1.008665 u = 1.674954×10^{-24} g**
1 kiloWattHour(kWh)	**3.6 MJ**
1 Joule (J)	**1 kg m^2 s^{-2} = 1.0×10^{7} erg**
1 Coulomb(C)	**6.24×10^{18} e^{-}**
Electronic charge on an electron	**$1.60217733 \times 10^{-19}$ C**
1 Ampere(A)	**1 Coulomb/s**
1 Volt(V)	**1 J/C = 96.5 kJ/mole**
1 electron volt (eV)	**1.60219×10^{-19} J**
Faraday's Constant	**96,486.7 C/mole e^{-}**