140

A comprehensive cheat sheet covering key concepts in engineering, including scientific literacy, introductory chemistry, and engineering biology. Useful for students and professionals alike.

Scientific Literacy & Physical Quantities

Uncertainty and Conservation Laws

Managing Uncertainty

Types of Uncertainty:

- **Random Uncertainty:** Statistical fluctuations.
- **Systematic Uncertainty:** Consistent errors in measurement.

Representing Uncertainty:
Use standard deviation, confidence intervals, or error bars to quantify uncertainty in measurements.

Propagating Uncertainty:
Use appropriate statistical methods to determine how uncertainty in input variables affects the uncertainty in calculated results.

Conservation Laws

Systems: Defined region of space or quantity of matter under study.	**Conservation Laws:** Fundamental principles stating that certain physical quantities remain constant over time.
Types: Open, closed, and isolated systems.	Examples: Conservation of mass, energy, and momentum.
Mass conservation states that mass cannot be created or destroyed in a closed system. Expressed mathematically as: \sum m_{in} = \sum m_{out} + \Delta m_{system}.	Energy conservation states that energy cannot be created or destroyed, only transformed. Expressed mathematically as: \Delta E = Q - W where Q is heat added and W is work done by the system.

Introductory Chemistry

Composition of Matter

States of Matter: Solid, liquid, gas, and plasma.

Mixtures: Combinations of substances that are physically combined (homogeneous and heterogeneous).

Atoms: Basic building blocks of matter.

Periodic Table: Arrangement of elements based on their atomic number and chemical properties.

Chemical Reactions

Moles: Unit of amount of substance (6.022 x 10^23 particles).	**Chemical Equations:** Symbolic representation of a chemical reaction.
Molar Mass: Mass of one mole of a substance.	**Chemical Bonds:** Attractive forces holding atoms together (ionic, covalent, metallic).
Balancing chemical equations ensures mass conservation.	Examples: Single, double, and triple bonds.

Ideal Gases

Ideal Gas Law: PV = nRT, where P is pressure, V is volume, n is the number of moles, R is the ideal gas constant, and T is temperature.

Partial Pressure: Pressure exerted by a single gas in a mixture of gases.

Dalton's Law of Partial Pressures states that the total pressure of a gas mixture is the sum of the partial pressures of each individual gas: P_{total} = P_1 + P_2 + ... + P_n

Energy & Engineering Biology

Energy Concepts

Energy: Capacity to do work.

Power: Rate at which energy is transferred or converted.

Energy, Heat, and Work: Heat is energy transferred due to temperature difference. Work is energy transferred when a force causes displacement.

Energy Conservation: Energy cannot be created or destroyed, only converted from one form to another.

Enthalpy and Applications

Enthalpy (H): Thermodynamic property that is the sum of the internal energy and the product of pressure and volume: H = U + PV	**Reaction Enthalpy (ΔH):** Change in enthalpy during a chemical reaction.
Exothermic reactions release heat (ΔH < 0). Endothermic reactions absorb heat (ΔH > 0).	Energy use contributes to global warming through the emission of greenhouse gases.
Consideration for sustainable energy practices is crucial.	Global warming is caused by increasing concentration of greenhouse gases.

Living Systems & Human Physiology

Living Systems: Complex systems exhibiting properties like metabolism, growth, and reproduction.

Cellular Respiration and Metabolism: Processes by which cells convert nutrients into energy.

Anatomy and Physiology: Study of the structure and function of living organisms.