CHEAT SHEETS HERO

ENGGEN 140

A concise cheat sheet for ENGGEN 140, covering essential concepts, formulas, and definitions from the coursebook.

Fundamentals

Units and Dimensions

Base Units (SI)

Quantity	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Current	Ampere	A
Amount of substance	mole	mol
Luminous intensity	candela	cd

Derived Units	Area: m^2 Volume: m^3 Density: kg/m^3 Velocity: m/s Acceleration: m/s^2 Force: Newton (N) = $kgcdotm/s^2$ Pressure: Pascal (Pa) = N/m^2 Energy: Joule (J) = $Ncdotm$ Power: Watt (W) = J/s
Unit Conversion	Use conversion factors to change units. **Example:** Convert 10 km to meters: $10\ \text{km}imes \frac{1000\ \text{m}}{1\ \text{km}} = 10000\ \text{m}$
Dimensional Homogeneity	Equations must be dimensionally consistent. Check that the dimensions on both sides of an equation are the same.
Significant Figures	Rules for determining significant figures in calculations. Pay attention to rounding rules.
Uncertainty	Express results with appropriate uncertainty. Report values as (value $\pm$ uncertainty) unit.

Basic Statistics

Mean (Average)	\($\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$\)
Median	$Themiddlevaluewhendataissorted.$
Standard Deviation	\($s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$\)
Variance	\($s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$\)
Probability	$\P(A) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$
Error Analysis	$Systematicvs. Randomerrors. Calculateandpropagateerrorsappropriately.$

Problem Solving

Problem-Solving Steps:

1. **Understand:** Read the problem carefully.
2. **Plan:** Devise a plan to solve the problem.
3. **Carry Out:** Execute the plan.
4. **Look Back:** Review the solution and method.

Modeling Assumptions:
Identify and state any assumptions made in the problem.

Example:
Neglecting air resistance in projectile motion problems.

Estimation:
Develop reasonable estimates for unknown quantities.

Example:
Estimating the height of a building.

Approximations:
Using approximations to simplify the problem.

Example:
Small angle approximation: $\sin(\theta) \approx \theta$ for small θ.

Verification and Validation:
Ensure the solution is correct and makes sense.

Iterative Methods:
Use iterative methods to find solutions when closed-form solutions are unavailable.

Engineering Applications

Mechanics

Force Equilibrium	$\sum F_x = 0$ $\sum F_y = 0$
Stress	$\sigma = \frac{F}{A}$
Strain	$\epsilon = \frac{\Delta L}{L}$
Young's Modulus	$\E = \frac{\sigma}{\epsilon}$
Hooke's Law	$F = kx$
Kinematics	$v = v_0 + at$ $\Delta x = v_0 t + \frac{1}{2}at^2$ $v^2 = v_0^2 + 2a\Delta x$

Thermodynamics

First Law of Thermodynamics	$\Delta U = Q - W$
Heat Transfer	$Q = mc\Delta T$
Conduction	$\frac{Q}{t} = kA\frac{\Delta T}{L}$
Convection	$\frac{Q}{t} = hA\Delta T$
Radiation	$\frac{Q}{t} = \epsilon\sigma AT^4$
Ideal Gas Law	$PV = nRT$

Circuits

Ohm's Law	$V = IR$
Power	$P = VI = I^2R = \frac{V^2}{R}$
Series Resistance	$R_{eq} = R_1 + R_2 + \ldots + R_n$
Parallel Resistance	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n}$
Kirchhoff's Current Law (KCL)	$\sum I_{in} = \sum I_{out}$
Kirchhoff's Voltage Law (KVL)	$\sum V_{loop} = 0$