Announcements

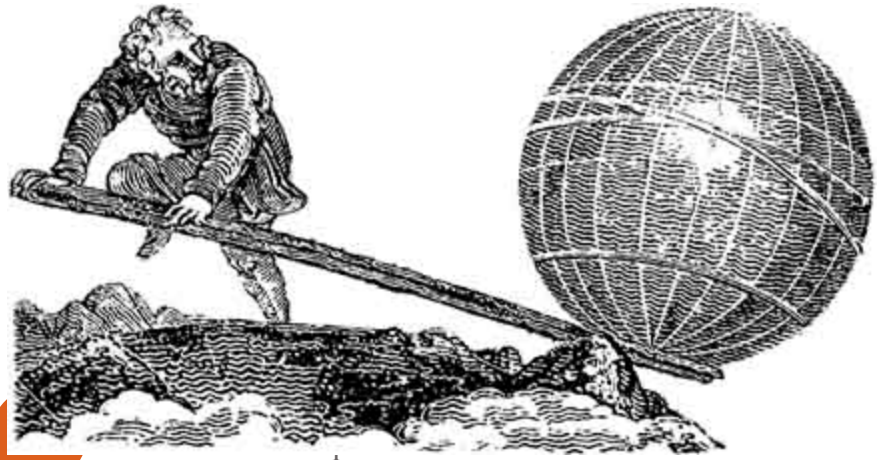
- Go through course website (schedule & lectures)
- Register i>clicker (Compass)
- MATLAB Clinics
- Special ME Office Hours (Grainger Library room 429):

  Wednesday (8/30) and Thursday (8/31), 4-6 pm
- Upcoming deadlines:
  - Friday (9/1)
    - Prairie Learn HW0
  - Sunday (9/3)
    - Mastering Engineering HW1
  - Tuesday (9/5)
    - Prairie Learn HW1

Chapter 1: General Principles

What is “statics”?

- Science
  - Life
  - Physical
    - Astronomy
    - Physics
      - Relativity
      - Mechanics
      - Thermo
      - More!
    - Chemistry
    - More!
  - Social
  - More!



Mechanics

Mechanics is a branch of the physical sciences that is concerned with the **state of rest or motion of bodies that are subjected to the action of forces**

Rigid Bodies

Statics

Dynamics

Deformable Bodies

Solid Mechanics

Fluids

Compressible and incompressible

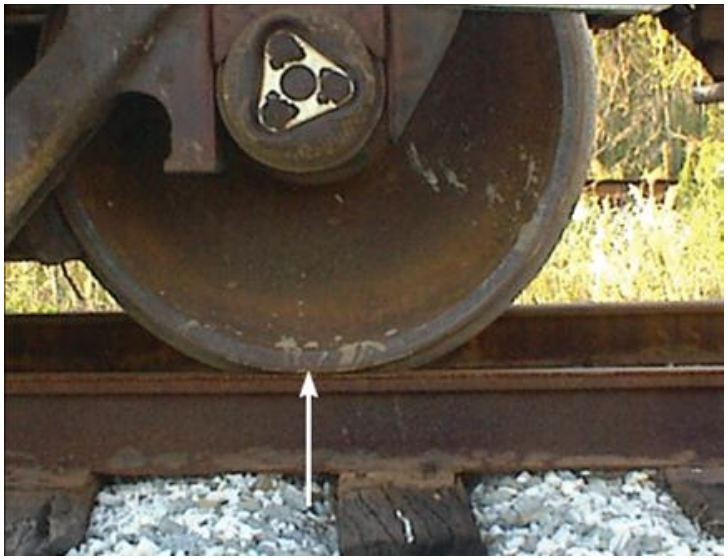
victorstuff.com

state of rest or motion of bodies that are subjected to the action of forces

www.ashvegas.com

Which forces?

Fundamental concepts



Basic quantities:

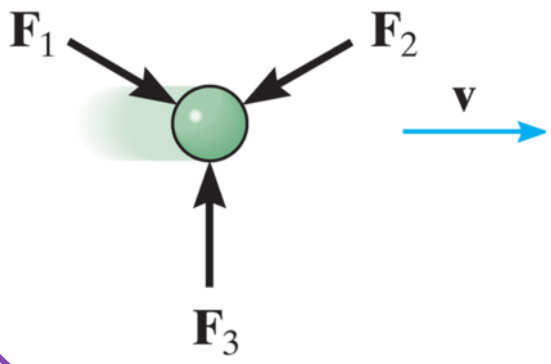
Idealizations:

- Particle:
- Rigid Body:
- Concentrated Force:

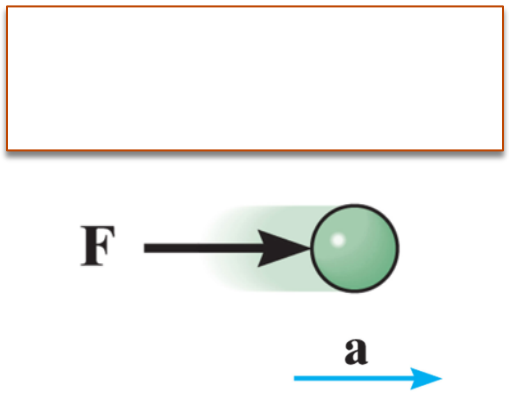
Understanding and applying these things allows for amazing achievements in engineering!

Newton's laws of motion

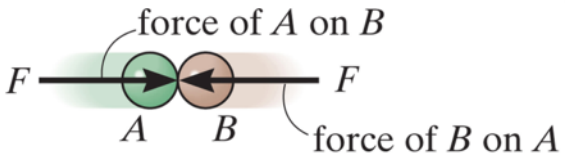
First law:



Second law: a particle acted upon by an unbalanced force **F** experiences an acceleration **a** that is proportional to the particle mass *m*:



Third law: the mutual forces of action and reaction between two particles are _____, _____ and _____.



Newton's law of gravitational attraction

The mutual **force F of gravitation** between two particles of mass m_1 and m_2 is given by:

G is the universal constant of gravitation (small number)
r is the distance between the two particles

Weight is the force exerted by the earth on a particle at the earth's surface:

Figure: 01_PH003
The astronaut's weight is diminished, since she is far removed from the gravitational field of the earth.

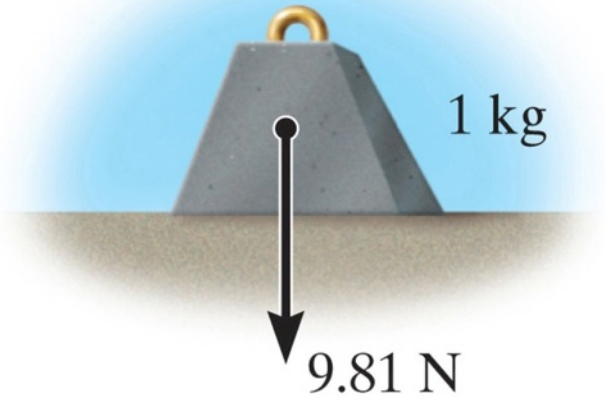
M_e is the mass of the earth
r_e is the distance between the earth's center and the particle near the surface
g is the acceleration due to the gravity

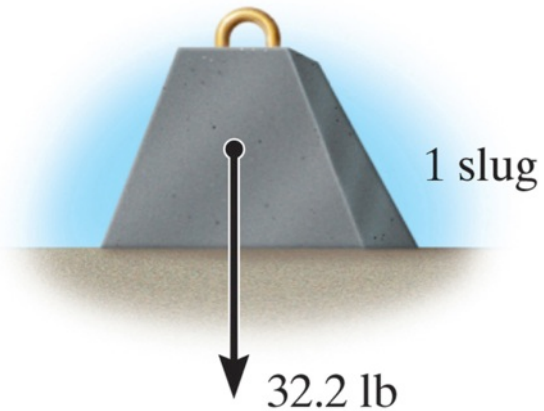
Units

TABLE 1–1 Systems of Units

Name	Length	Time	Mass	Force
International System of Units SI	meter m	second s	kilogram kg	newton* $\left(\frac{\text{kg}\cdot\text{m}}{\text{s}^2}\right)$
U.S. Customary FPS	foot ft	second s	slug* $\left(\frac{\text{lb}\cdot\text{s}^2}{\text{ft}}\right)$	pound lb

*Derived unit.





$$G = 66.73 \times 10^{-12} \frac{m^3}{kg \cdot s^2}$$

$$g = 9.81 \frac{m}{s^2}$$

$$g = 32.2 \frac{ft}{s^2}$$

Numerical Calculations

Dimensional Homogeneity

Equations ***must*** be dimensionally homogeneous, i.e., each term must be expressed in the same units.

Work problems in the units given unless otherwise instructed!

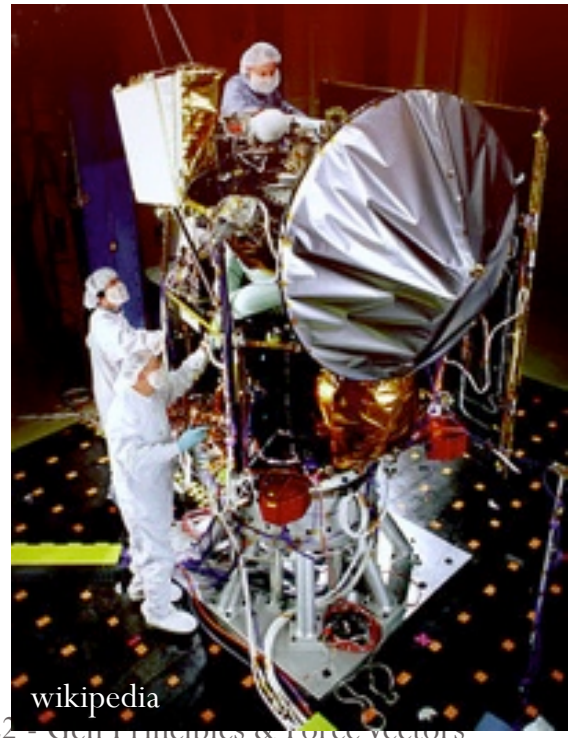
Numerical Calculations

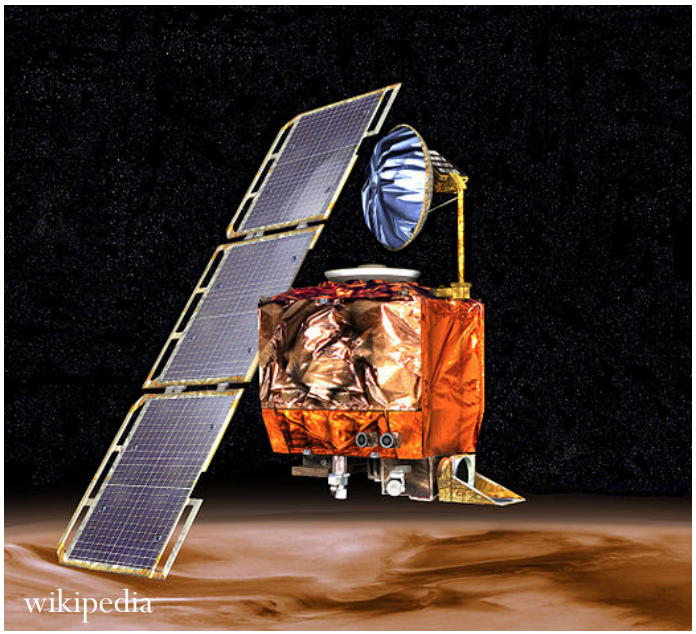
Significant figures

The number of significant figures contained in any number determines the accuracy of the number. Use 3 or > significant figures for final answers. For intermediate steps, use symbolic notation, store numbers in calculators or use more significant figures, in order to maintain precision.

Why so picky? Units matter…

- A national power company mixed up prices quoted in kilo-Watt-hour (kWh) and therms.
  - Actual price = $50,000
  - Paid while trading on the market: $800,000
- In Canada, a plane ran out of fuel because the pilot mistook liters for gallons!. He landed the plane safely without power on an emergency airstrip.





http://www.planetseed.com/sciencearticle/importance-units

General procedure for analysis

1. Read the problem carefully; write it down carefully.

2. MODEL THE PROBLEM: Draw given diagrams neatly and construct additional figures as necessary.

3. Apply principles needed.

4. Solve problem symbolically. Make sure equations are dimensionally homogeneous

5. Substitute numbers. Provide proper units *throughout*. Check significant figures. Box the final answer(s).

6. See if answer is reasonable.

Chapter 2: Force Vectors

Scalars and vectors

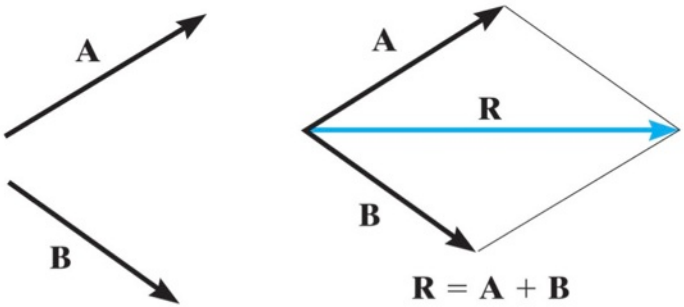
	Scalar	**Vector**
Examples	Mass, Volume, Time	Force, Velocity
Characteristics	It has a magnitude	It has a magnitude and direction
Special notation used in TAM 210/211	None	Bold font or symbols ("~" or "→") Ex:

Multiplication or division of a vector by a scalar

$$\boldsymbol{B} = \alpha \boldsymbol{A}$$

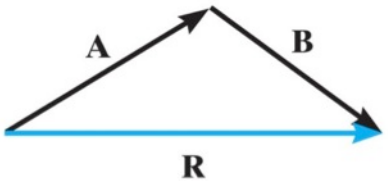
Vector addition

$$\boldsymbol{R} = \boldsymbol{A} + \boldsymbol{B}$$



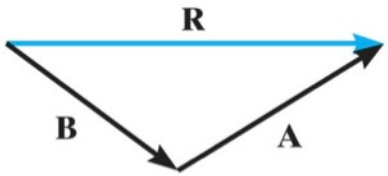
R = A + B

Parallelogram law



R = A + B

Triangle rule



R = B + A

Triangle rule

Vector subtraction:

$$\boldsymbol{R} = \boldsymbol{A} - \boldsymbol{B} = \boldsymbol{A} + (-\boldsymbol{B})$$

Commutative law:

$$\boldsymbol{R} = \boldsymbol{A} + \boldsymbol{B} = \boldsymbol{B} + \boldsymbol{A}$$

Associative law:

$$\boldsymbol{A} + (\boldsymbol{B} + \boldsymbol{C}) = (\boldsymbol{A} + \boldsymbol{B}) + \boldsymbol{C}$$

Scalar / Vector multiplication:

$$\alpha(\boldsymbol{A} + \boldsymbol{B}) \qquad (\alpha + \beta)\boldsymbol{A}$$