Unit Conversion

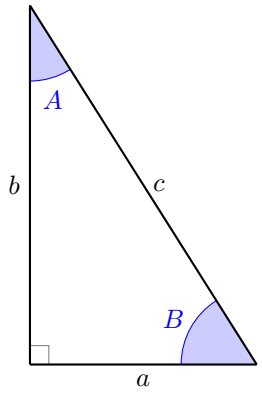
1 ft = 12 in	1 m = 3.281 ft	1 slug = 14.59 kg	$g = 9.81$ m/s^2
1 mile = 5280 ft	1 kip = 1000 lb	1 lb_f = 4.448 N	$= 32.2$ ft/s^2
1 yd = 3 ft	1 ton = 2000 lb	1 kg = 2.205 lb_m	

Right Triangles

$$\sin A = \frac{a}{c} \quad \cos A = \frac{b}{c} \quad \tan A = \frac{a}{b}$$

$$\sin B = \frac{b}{c} \quad \cos B = \frac{a}{c} \quad \tan B = \frac{b}{a}$$

$$a^2 + b^2 = c^2$$



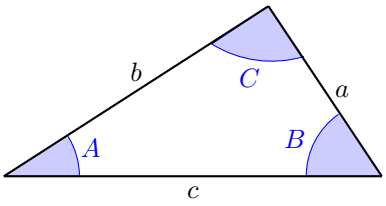
Oblique Triangles

The law of cosines:

$$a^2 = b^2 + c^2 - 2bc\,(\cos A)$$

$$b^2 = a^2 + c^2 - 2ac\,(\cos B)$$

$$c^2 = a^2 + b^2 - 2ab\,(\cos C)$$



The law of sines:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Resultants and Equilibrium

Resultant of parallel force systems:

$$R = \sum F_y = F_1 + F_2 + \cdots + F_n \qquad \overline{x} = \frac{\sum M}{R}$$

Three laws of equilibrium

$$\sum F_x = 0 \qquad \sum F_y = 0 \qquad \sum M = 0$$

Friction

Maximum available frictional force:

$$F = \mu_s N$$

For flat belts and ropes:

$$T_L = T_S e^{\mu\beta} \quad \text{or} \quad \ln \mathrm{T_L} - \ln \mathrm{T_S} = \mu\beta \qquad \text{Torque} = (\mathrm{T_L} - \mathrm{T_s})\,\mathrm{r}$$

For V-belts ($\phi \equiv {}^1\!/_2\times$ groove angle):

$$T_L = T_S e^{\mu\beta/\sin\phi} \quad \text{or} \quad \ln \mathrm{T_L} - \ln \mathrm{T_S} = \frac{\mu\beta}{\sin\phi}$$

Square-threaded screws:

$$\text{Lead angle}: \quad \theta = \tan^{-1}\frac{\mathrm{L}}{2\pi\mathrm{r}} = \tan^{-1}\frac{\mathrm{p}}{2\pi\mathrm{r}} \qquad \text{Jackscrew}: \quad \mathrm{Qa} = \mathrm{Pr}$$

Centroids and Centers of Gravity

Location of center of gravity:

$$\overline{x} = \frac{\sum wx}{W} \quad \text{or} \quad \frac{\sum \mathrm{wx}}{\sum \mathrm{w}}$$

$$\overline{y} = \frac{\sum wy}{W} \quad \text{or} \quad \frac{\sum \mathrm{wy}}{\sum \mathrm{w}}$$

Location of centroid:

$$\overline{x} = \frac{\sum ax}{A} \quad \text{or} \quad \frac{\sum \mathrm{ax}}{\sum \mathrm{a}}$$

$$\overline{y} = \frac{\sum ay}{A} \quad \text{or} \quad \frac{\sum \mathrm{ay}}{\sum \mathrm{a}}$$

Area Moments of Inertia

Moment of inertia:

$$I_x = \sum ay^2 \qquad I_y = \sum ax^2$$

Parallel axis theorem or transfer formula:

$$I = I_o + ad^2$$

Moment of inertia of composite area:

$$I = \sum \left(I_o + ad^2\right)$$

Radius of gyration:

$$r = \sqrt{\frac{I}{A}}$$

Polar moment of inertia:

$$J = I_x + I_y$$