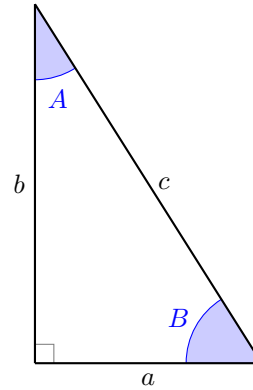


Right Triangles

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

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

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



Oblique Triangles

The law of cosines:

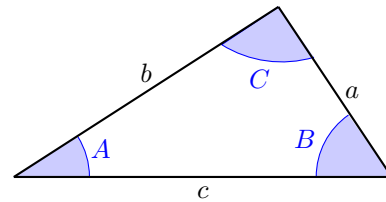
$$a^2 = b^2 + c^2 - 2bc(\cos A)$$

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

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

The law of sines:

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



Resultants and Equilibrium

Resultant of parallel force systems:

$$R = \sum F_y = F_1 + F_2 + \cdots + F_n$$

$$\bar{x} = \frac{\sum M}{R}$$

Three laws of equilibrium

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

Friction

Maximum available frictional force:

$$F = \mu_s N$$

For flat belts and ropes:

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

For V-belts:

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

Square-threaded screws:

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

Centroids and Centers of Gravity

Location of center of gravity:

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

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

Location of centroid:

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

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

Area Moments of Inertia

Moment of inertia:

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

Parallel axis theorem or transfer formula:

$$I = I_o + ad^2$$

Moment of inertia of composite area:

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

Radius of gyration:

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

Polar moment of inertia:

$$J = I_x + I_y$$