Coplanar: $\vec{F} = F_x\hat{\imath} + F_y\hat{\jmath}$, $\left|\vec{F}\right| = \sqrt{{F_x}^2 + {F_y}^2}$, $\tan\theta = \frac{F_y}{F_x}$

Spatial: Force passes through A and B. $\overrightarrow{r_{AB}} = (x_B - x_A)\hat{\imath} + (y_B - y_A)\hat{\jmath} + (z_B - z_A)\hat{k}$

Unit vector: $\hat{u}_F = \frac{\overrightarrow{r_{AB}}}{|\overrightarrow{r_{AB}}|}$, $\vec{F} = \left|\vec{F}\right|\hat{u}_F$ $\vec{F} = F_x\hat{\imath} + F_y\hat{\jmath} + F_z\hat{k}$

Moments Coplanar of a force: $M_O = Fd$ (d is perpendicular distance) or $M_O = F_y x - F_x y$

Moment of a force: $\overrightarrow{M_O} = \overrightarrow{r_{OA}} \times \overrightarrow{F_A}$ (vector), $\left|\overrightarrow{M_O}\right| = \sqrt{{M_{O_x}}^2 + {M_{O_y}}^2 + {M_{O_z}}^2}$

Moment about axis: $M_a = \hat{u}_a(\vec{r} \times \vec{F})$ (scalar). Moment of a couple : $\overrightarrow{M_c} = \vec{r} \times \vec{F}$

Moment of a system of forces/couples about a point: $\overrightarrow{M_O} = \sum\overrightarrow{M_c} + \sum\overrightarrow{r_{OA}} \times \overrightarrow{F_A}$

A wrench is the combination of a colinear force and a couple moment.

Equations of Equilibrium

Particle: $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$

Coplanar: $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M_o = 0$

Spatial: $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$

$\Sigma M_x = 0$, $\Sigma M_y = 0$, $\Sigma M_z = 0$

Friction Dry Friction: $F_s \leq \mu_s N$

Limiting Static Friction $F_s = \mu_s N$

Kinetic Friction: $F_k = \mu_k N$

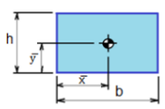
Centroids

$$\bar{x} = \frac{\int_A \tilde{x}dA}{\int_A dA} \text{ and } \bar{y} = \frac{\int_A \tilde{y}dA}{\int_A dA}$$

Composite Bodies: $\bar{x} = \frac{\sum \bar{x}A}{\Sigma A}$ and $\bar{y} = \frac{\sum \bar{y}A}{\Sigma A}$

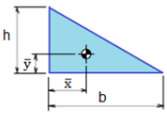
Rectangle Centroid

$\bar{x} = \frac{b}{2}$ and $\bar{y} = \frac{h}{2}$



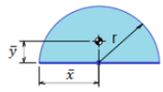
Right Triangle Centroid

$\bar{x} = \frac{b}{3}$ and $\bar{y} = \frac{h}{3}$



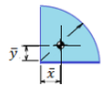
Semi-circle Centroid

$\bar{x} = r$ and $\bar{y} = \frac{4r}{3\pi}$

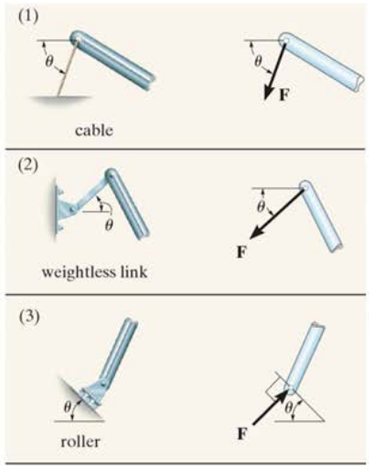


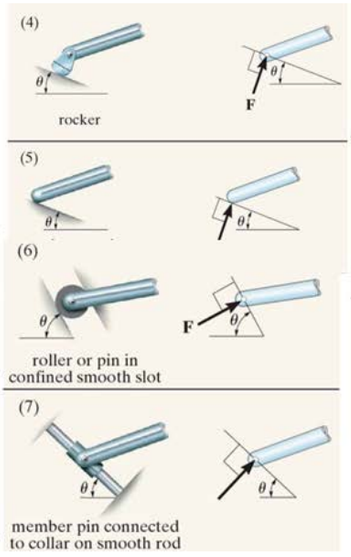
Quarter-circle Centroid

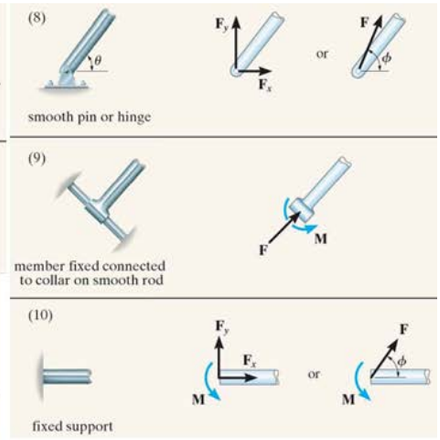
$\bar{x} = \frac{4r}{3\pi}$ and $\bar{y} = \frac{4r}{3\pi}$



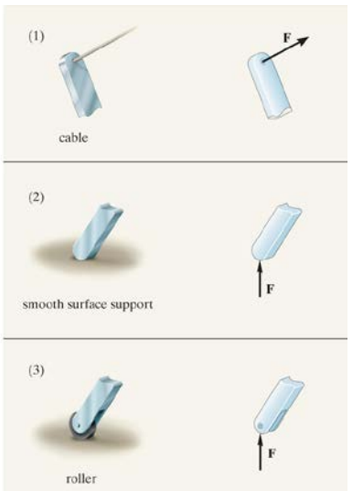
Coplanar Supports

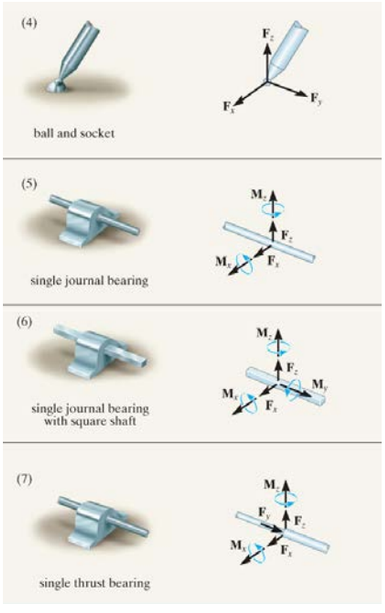


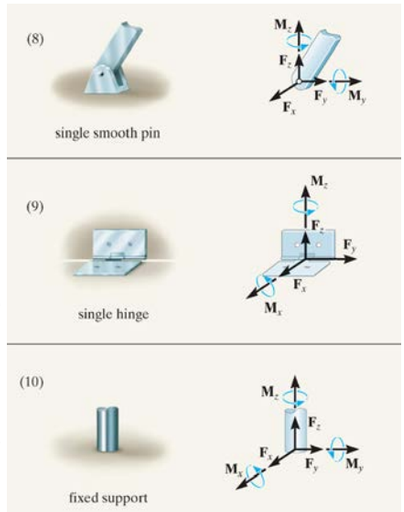




Spatial Supports







DO NOT REMOVE FORMULA SHEET FROM EXAMINATION