

Coplanar: $\vec{F} = F_x\hat{i} + F_y\hat{j}$, $|\vec{F}| = \sqrt{F_x^2 + F_y^2}$, $\tan \theta = \frac{F_y}{F_x}$

Spatial: Force passes through A and B. $\vec{r}_{AB} = (x_B - x_A)\hat{i} + (y_B - y_A)\hat{j} + (z_B - z_A)\hat{k}$

Unit vector: $\hat{u}_F = \frac{\vec{r}_{AB}}{|\vec{r}_{AB}|}$, $\vec{F} = |\vec{F}|\hat{u}_F$ $\vec{F} = F_x\hat{i} + F_y\hat{j} + F_z\hat{k}$

Moments Coplanar of a force: $M_O = Fd$ (d is perpendicular distance) or $M_O = F_yx - F_xy$

Moment of a force: $\vec{M}_O = \vec{r}_{OA} \times \vec{F}_A$ (vector), $|\vec{M}_O| = \sqrt{M_{O_x}^2 + M_{O_y}^2 + M_{O_z}^2}$

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

Moment of a system of forces/couples about a point: $\vec{M}_O = \sum \vec{M}_c + \sum \vec{r}_{OA} \times \vec{F}_A$

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: $\bar{X} = \frac{\Sigma \bar{x}A}{\Sigma A}$ and $\bar{Y} = \frac{\Sigma \bar{y}A}{\Sigma A}$

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

(1) cable

(2) weightless link

(3) roller

(4) rocker

(5) smooth pin or hinge

(6) roller or pin in confined smooth slot

(7) member pin connected to collar on smooth rod

(8) smooth pin or hinge

(9) member fixed connected to collar on smooth rod

(10) fixed support

Spatial Supports

(1) cable

(2) smooth surface support

(3) roller

(4) ball and socket

(5) single journal bearing

(6) single journal bearing with square shaft

(7) single thrust bearing

(8) single smooth pin

(9) single hinge

(10) fixed support

DO NOT REMOVE
FORMULA SHEET FROM
EXAMINATION