Statics Formula Sheet

Statics of a Particle

$$\cos\alpha_x = \frac{R_x}{R}$$

$$\cos\alpha_y = \frac{R_y}{R}$$

$$\cos\alpha_z = \frac{R_z}{R}$$

$$\cos^2\alpha_x + \cos^2\alpha_y + \cos^2\alpha_z = 1$$

Statics of a Rigid Body

$$\vec{T} = \vec{r} \times \vec{F}$$

$$|T| = rF\sin\theta$$

$$T_x = r_y F_z - r_z F_y$$

$$T_y = r_z F_x - r_x F_z$$

$$T_z = r_x F_y - r_y F_x$$

$$\vec{T} = \vec{r} \times \vec{F} = \begin{vmatrix} \vec{e}_x & \vec{e}_y & \vec{e}_z \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

Compounding forces and couples

$$\sum F_x = \sum_{i=1}^{n} F_{x;i}$$

$$\sum T_x = \sum_{i=1}^{n} \left\{ \left(y_i F_{z;i} - z_i F_{y;i} \right) + T_{x;i} \right\}$$

$$\sum F_y = \sum_{i=1}^{n} F_{y;i}$$

$$\sum T_y = \sum_{i=1}^{n} \left\{ \left(z_i F_{x;i} - x_i F_{z;i} \right) + T_{y;i} \right\}$$

$$\sum F_z = \sum_{i=1}^{n} F_{z;i}$$

$$\sum T_z = \sum_{i=1}^{n} \left\{ \left(x_i F_{y;i} - y_i F_{x;i} \right) + T_{z;i} \right\}$$

Loads

$$R = \int_{x_1}^{x_2} q(x)\,dx$$

$$a = \frac{\int_{x_1}^{x_2} xq(x)dx}{\int_{x_1}^{x_2} q(x)\,dx}$$

$$R = R_1 + R_2$$

$$aR = a_1 R_1 + a_2 R_2$$

Trusses

Zero Force members:

1) If only two members meet at an unloaded joint, both are zero force members.
2) If 3 members meet at an unloaded joint of which two are in a direct line with one another, then the third is a zero-force member.
3) If two members meet at a loaded joint and the line of action of the load coincides with one of the members, the other is a zero force member.

Bending Moment, Shear Force and Normal Force Diagrams

$$V = -\int q_z dx$$

$$M = \int V dx$$

$$\frac{dV}{dx} = -q_z$$

$$\frac{dM}{dx} = V$$

$$\frac{dN}{dx} = -q_x$$

Cables

$$H = A_h = B_h$$

$$N = H\sqrt{1 + \left(\tan\alpha\right)^2}$$

$$z_k = z - \frac{x}{l}h$$

$$Hz_k = M$$

$$\frac{dV}{dx} = -q_z$$

$$H\frac{dz}{dx} = V = -qx$$

$$H\frac{d^2z}{dx^2} = -q_z$$

$$H = \frac{\frac{1}{8}ql^2}{p_k}$$

$$N = \sqrt{H^2 + V^2} = \sqrt{H^2 + (qx)^2}$$

$$V - \frac{Hh}{l} = V_{beam}$$

Virtual Work

Horizontal displacement = rotation x vertical distance

Vertical displacement= rotation x horizontal distance

$$dA = F * dr$$