(Engineering Mechanics – Physics)

# STATICS

the study of

# FORCES

at

# EQUILIBRIUM

using Vector Math

+

*EVERY OTHER* kind of Math you have ever learned in your life

# Some Useful Equations for Quiz 1

Cartesian Form of a Vector: $\overline{F} = F_x\overline{i} + F_y\overline{j} + F_z\overline{k}$

Magnitude: $F = \left|\overline{F}\right| = \sqrt{F_x^2 + F_y^2 + F_z^2}$

Direction Cosines For $\overline{F}$ : $\cos\alpha = \frac{F_x}{F}$ $\cos\beta = \frac{F_y}{F}$ $\cos\gamma = \frac{F_z}{F}$

Unit Vector: $\overline{u} = \left(\frac{F_x}{F}\right)\overline{i} + \left(\frac{F_y}{F}\right)\overline{j} + \left(\frac{F_z}{F}\right)\overline{k} = (\cos\alpha)\overline{i} + (\cos\beta)\overline{j} + (\cos\gamma)\overline{k}$

Directed Force Vector: $\overline{F} = F\overline{u}$

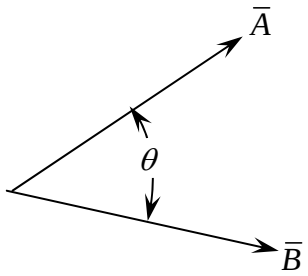
Absolute Position Vector: $\overline{r}_A = x_A\overline{i} + y_A\overline{j} + z_A\overline{k}$

Relative Position Vector: $\overline{r}_{B/A} = \left(x_B - x_A\right)\overline{i} + \left(y_B - y_A\right)\overline{j} + \left(z_B - z_A\right)\overline{k}$

Dot Product: $\overline{A}\cdot\overline{B} = AB\cos\theta = A_xB_x + A_yB_y + A_zB_z$

Projection of Vector along Line a-a: $A_{Proj} = \overline{A}\cdot\overline{u}$

Angle between Two Vectors, $\overline{A}$ & $\overline{B}$ : $\theta = \cos^{-1}\left(\frac{\overline{A}\cdot\overline{B}}{AB}\right)$




Particle Equilibrium, Vector Formulation: $\sum\overline{F} = 0$

Particle Equilibrium, Scalar Formulation, 2D: $\sum F_x = 0$ $\sum F_y = 0$

Particle Equilibrium, Scalar Formulation, 3D: $\sum F_x = 0$ $\sum F_y = 0$ $\sum F_z = 0$

$\overline{A}$

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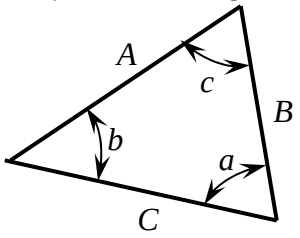
Geometric Relationships for A Triangle:




**Law of Cosines:**

$$A^2 = B^2 + C^2 - 2BC\cos a$$
$$B^2 = A^2 + C^2 - 2AC\cos b$$
$$C^2 = A^2 + B^2 - 2AB\cos c$$

**Law of Sines:**

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