

Common vector methods in statics		
Vector Type	Coordinates	Plane Angles
Force (Chap. 2)	1. Find coordinates of tip & tail of the vector: $\mathbf{A}(x_A, y_A, z_A), \mathbf{B}(x_B, y_B, z_B),$ etc. 2. Find direction vector of force: $\bar{d}_{tip/tail} = (x_{tip} - x_{tail})\hat{i} + (y_{tip} - y_{tail})\hat{j} + (z_{tip} - z_{tail})\hat{k}$ 3. Find unit vector of direction vectors: $\bar{\lambda}_{tip/tail} = \bar{d}_{tip/tail} / \bar{d}_{tip/tail} $ 4. Find force vector: $\bar{F} = \bar{F} \cdot \bar{\lambda}_{tip/tail}$ 5. Repeat for all forces	1. Find: θ_y, ϕ (usually in diagram) 2. Find force vector: $\bar{F} = (F \sin \theta_y \cos \phi)\hat{i} + (F \cos \theta_y)\hat{j} + (F \sin \theta_y \sin \phi)\hat{k}$ $\bar{F} = F\bar{\lambda}_{\theta_y, \phi}$ $\bar{\lambda}_{\theta_y, \phi} = (\sin \theta_y \cos \phi)\hat{i} + (\cos \theta_y)\hat{j} + (\sin \theta_y \sin \phi)\hat{k}$ If $\theta_y = 90^\circ$, the vector 2-D. 3. Repeat for all forces
Position Vector (3.1-3.8)	1. Find coordinates of tip & tail of the vector as in 1. above. 2. Find the position vector: $\bar{r}_{tip/tail} = (x_{tip} - x_{tail})\hat{i} + (y_{tip} - y_{tail})\hat{j} + (z_{tip} - z_{tail})\hat{k}$ For moments, tail is the point about which moment will be taken.	$\bar{r} = \bar{r} \left[(\sin \theta_y \cos \phi)\hat{i} + (\cos \theta_y)\hat{j} + (\sin \theta_y \sin \phi)\hat{k} \right]$ <p>Not a likely scenario ...</p>
Moment Vectors (3.1-3.8)	Using procedures from above for \bar{r} and \bar{F} , $\bar{M}_{point} = \bar{r} \times \bar{F}$	
Moment Vector Projection on to an Axis (3.11)	Find unit vector of axis: $\bar{\lambda}_{axis} = \frac{\bar{d}_{axis}}{ \bar{d}_{axis} }$ or $\bar{\lambda}_{axis} = \bar{\lambda}_{\theta_y, \phi}$, then dot with moment: $ \bar{M}_{axis} = \bar{\lambda}_{axis} \bullet \bar{M}_{point}$	
Couples	$\bar{M}_{couple} = \bar{r}_{F/-F} \times \bar{F}$ or $\bar{M}_{couple} = \bar{r}_{-F/F} \times -\bar{F}$	

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Resolution of a force into a force and couple at a point away from original application of just a force (3.16)	<p>Move force to point O away from original application of force and add a couple at O.</p> $\bar{F}_O = \bar{F} \quad M_O = \bar{r}_{F/O} \times \bar{F}$
Reducing a force system to a force and moment at a point (3.17)	$\bar{R} = \sum F \quad \bar{M}_{point}^R = \sum (\bar{r} \times \bar{F})$
Further reduction of a system of forces to a single force (3.20)	$\bar{r}_{new} \times \bar{R} = \bar{M}_{point}^R$ <p>When all forces are in a plane, $(xR_y - yR_x)\hat{k} = \bar{M}_{point}^R \hat{k}$ & $x = M_{point}^R / R_y$, $y = -M_{point}^R / R_x$</p> <p>When all forces are parallel, equate the corresponding i, j, k coefficients on each side of the equation.</p>

Notes:

1. Direction, unit, and force vectors can all be defined with direction cosines but no problems in the textbook use this method. However, textbook problem may ask you to find the direction cosines from vectors.