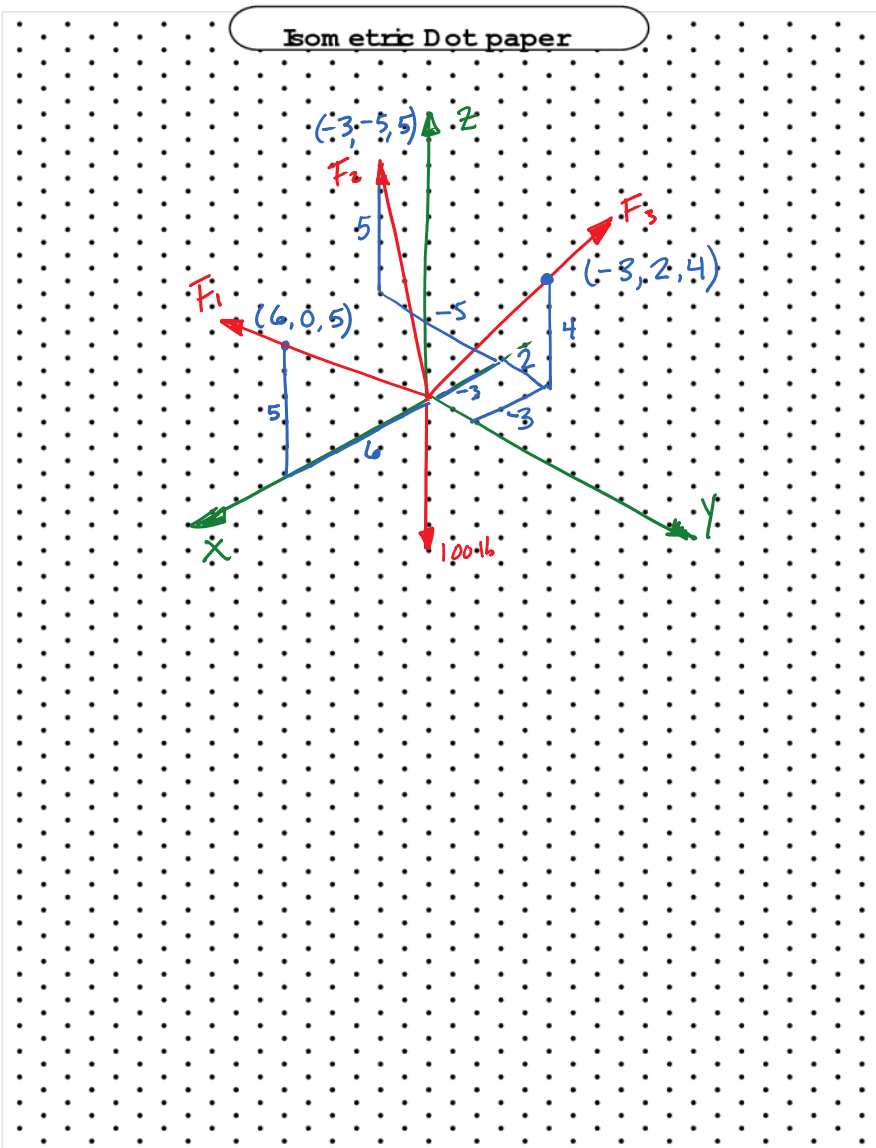
Summer Class 2 3D Concurrent Force Systems

Monday, June 3, 2013 2:17 PM

$\Sigma F_x = 0 \qquad \Sigma F_y = 0 \qquad \Sigma F_z = 0$



$L_1 = \sqrt{6^2 + 0^2 + 5^2}$

$= 7.81$

$L_2 = \sqrt{-3^2 + -5^2 + 5^2}$

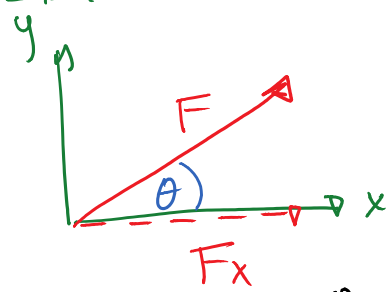
$= 7.68$

$L_3 = \sqrt{-3^2 + 2^2 + 4^2}$

$= 5.39$

$\cos\theta = \frac{adj}{hyp}$

2D:



$F_x = F \cdot \cos\theta$

$\theta_{x1} = \cos^{-1}\frac{6}{7.81}$ $\qquad \theta_{x2} = \cos^{-1}\frac{-3}{7.68}$ $\qquad \theta_{x3} = \cos^{-1}\frac{-3}{5.39}$

$\theta_{y1} = \cos^{-1}\frac{0}{7.81}$ $\qquad \theta_{y2} = \cos^{-1}\frac{-5}{7.68}$ $\qquad \theta_{y3} = \cos^{-1}\frac{2}{5.39}$

$\theta_{z1} = \cos^{-1}\frac{5}{7.81}$ $\qquad \theta_{z2} = \cos^{-1}\frac{5}{7.68}$ $\qquad \theta_{z3} = \cos^{-1}\frac{4}{5.39}$

$\Sigma F_x = 0$

$F_1 \cdot \cos(\theta_{x1}) + F_2 \cdot \cos(\theta_{x2}) + F_3 \cdot \cos(\theta_{x3}) = 0$

$$F_1 \cdot \cos\left(\cos^{-1}\frac{6}{7.81}\right) + F_2 \cdot \cos\left(\cos^{-1}\frac{-3}{7.68}\right) + F_3 \cdot \cos\left(\cos^{-1}\frac{-3}{5.39}\right) = 0$$

$$F_1 \cdot 0.768 + F_2 \cdot {}^{-}0.391 + F_3 \cdot {}^{-}0.557 = 0$$

$$\Sigma F_y = 0$$

$$F_1 \cdot 0 + F_2 \cdot {}^{-}0.651 + F_3 \cdot 0.371 = 0$$

$$\Sigma F_z = 0$$

$$F_1 \cdot 0.640 + F_2 \cdot 0.651 + F_3 \cdot 0.742 = 100\,\text{lb}$$

$$A = \begin{bmatrix} 0.768 & {}^{-}0.391 & {}^{-}0.557 \\ 0 & {}^{-}0.651 & 0.371 \\ 0.640 & 0.651 & 0.742 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 100 \end{bmatrix} \text{lb}$$

$$A^{-1} \cdot B = \begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix} = \begin{bmatrix} 57.6 \\ 32.3 \\ 56.7 \end{bmatrix} \text{lb}$$