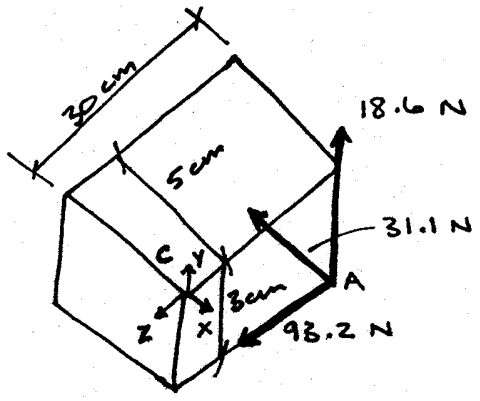
1. $\overrightarrow{AB} = -5\hat{i} + 3\hat{j} + 15\hat{k}$

$|AB| = 16.09$

$u = \frac{AB}{|AB|} = -.311\hat{i} + .186\hat{j} + .932\hat{k}$

$|F| = 100\ N$

$F = 100\,u = -31.1\hat{i} + 18.6\hat{j} + 93.2\hat{k}$

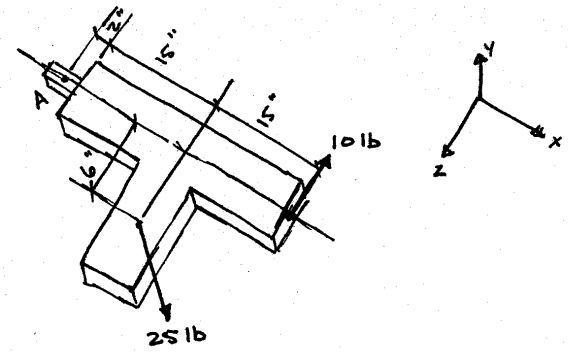


$M|_{cx} = 18.64(30) - 93.21(3) = 279.6\ N\cdot cm$

$M|_{cy} = 31.07(30) = 932.1\ N\cdot cm$

$M|_{cz} = -31.07(3) = -93.21\ N\cdot cm$

2.



$\Sigma F_x = A_x = 0$

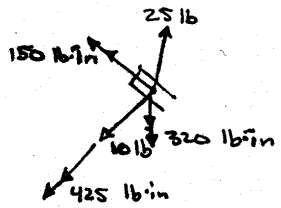
$\Sigma F_y = -25 + A_y = 0 \Rightarrow A_y = 25\,\text{lb}$

$\Sigma F_z = -10 + A_z = 0 \Rightarrow A_z = 10\,\text{lb}$

$\Sigma M|_{A_x} = 25(6) + M_{A_x} = 0 \Rightarrow M_{A_x} = -150\,\text{lb·in}$

$\Sigma M|_{A_y} = 10(32) + M_{A_y} = 0 \Rightarrow M_{A_y} = -320\,\text{lb·in}$

$\Sigma M|_{A_z} = -25(17) + M_{A_z} = 0 \Rightarrow M_{A_z} = 425\,\text{lb·in}$

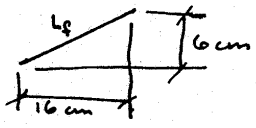


3.

Spring

$L_o = 10\text{ cm}$

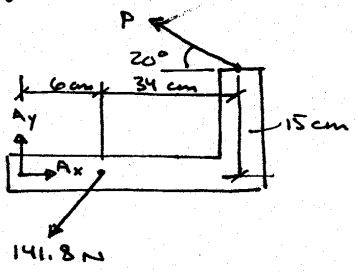
final Configuration



$L_f = \sqrt{16^2 + 6^2} = 17.09\text{ cm}$

$L_f - L_o = 17.09\text{ cm} - 10.00\text{ cm} = 7.09\text{ cm}$

$F_{spring} = k(L_f - L_o) = (20\text{ N/cm})(7.09\text{ cm}) = 141.8\text{ N}$



$$\Sigma M|_A = -141.8\left(\frac{6}{17.09}\right)(6\text{ cm}) + P\cos(20^\circ)(15\text{ cm}) + P\sin(20^\circ)(40\text{ cm}) = 0$$

$$\Rightarrow P = \frac{298.7}{15\cos 20^\circ + 40\sin 20^\circ} = 10.75\text{ N}$$

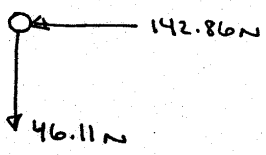
$$\Sigma F_x = A_x - 141.8\left(\frac{16}{17.09}\right) - 10.75\cos 20^\circ = 0$$

$$\Rightarrow A_x = 142.86\text{ N}$$

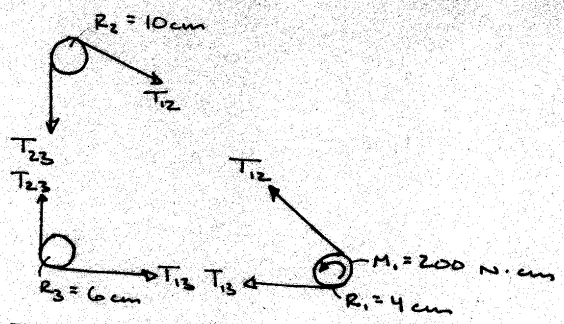
$$\Sigma F_y = A_y - 141.8\left(\frac{6}{17.09}\right) + 10.75\sin(20^\circ) = 0$$

$$\Rightarrow A_y = 46.11\text{ N}$$

Forces on Pin



4.



$T_{13} = 75\ N$

Sprocket 1

$$\Sigma M|_{center_2} = T_{12}(4) - T_{13}(4) + 200 = 0$$

$$\Rightarrow T_{12} = 25\ N$$

Sprocket 3

$$\Sigma M|_{center_3} = T_{13}(6) - T_{23}(6) = 0$$

$$\Rightarrow T_{23} = 75\ N$$

Sprocket 2

$$\Sigma M|_{center_2} = 75(10) - 25(10) - M_2 = 0$$

$$\Rightarrow M_2 = 500\ N\cdot cm \quad \text{clockwise}$$