Solutions to Quiz #1 B, 24-261, Fall 2001

1B

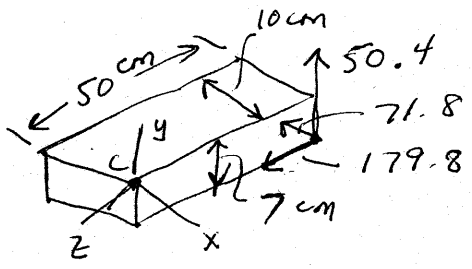
$$\underset{\sim}{AB} = -10\underset{\sim}{i} + 7\underset{\sim}{j} + 25\underset{\sim}{k}$$

$$|\underset{\sim}{AB}| = 27.821$$

unit vector $\underset{\sim}{u} = \dfrac{\underset{\sim}{AB}}{|\underset{\sim}{AB}|} = -0.359\underset{\sim}{i} + 0.252\underset{\sim}{j} + 0.899\underset{\sim}{k}$

$$|\underset{\sim}{F}| = 200\ N$$

$$\underset{\sim}{F} = 200\underset{\sim}{u} = -71.8\underset{\sim}{i} + 50.4\underset{\sim}{j} + 179.8\underset{\sim}{j}$$

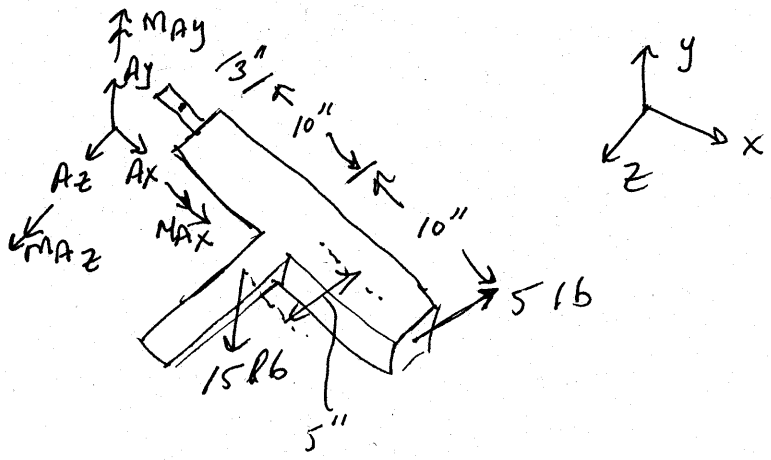


$$M|_{C_x} = 50.4(50) - 179.8(7) = 1261\ N\text{-cm}$$

$$M|_{C_y} = 71.8(50) = 3590\ N\text{-cm}$$

$$M|_{C_z} = -71.8(7) = -502.6\ N\text{-cm}$$

2B



$\Sigma F_x = A_x = 0$

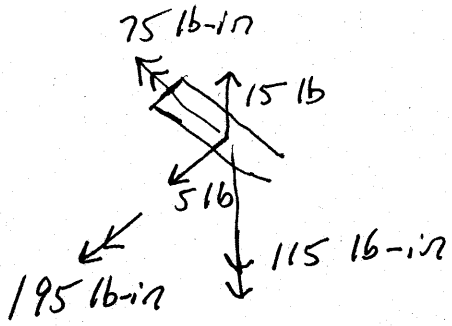
$\Sigma F_y = -15 + A_y = 0 \Rightarrow A_y = 15 \text{ lb}$

$\Sigma F_z = -5 + A_z = 0 \Rightarrow A_z = 5 \text{ lb}$

$\Sigma M|_{A_x} = 15(5) + M_{A_x} = 0 \Rightarrow M_{A_x} = -75 \text{ lb-in}$

$\Sigma M|_{A_y} = 5(23) + M_{A_y} = 0 \Rightarrow M_{A_y} = -115 \text{ lb-in}$

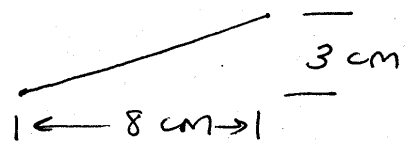
$\Sigma M|_{A_z} = -15(13) + M_{A_z} = 0 \Rightarrow M_{A_z} = 195 \text{ lb-in}$



3B

Spring Initial length $L_0 = 5$ cm

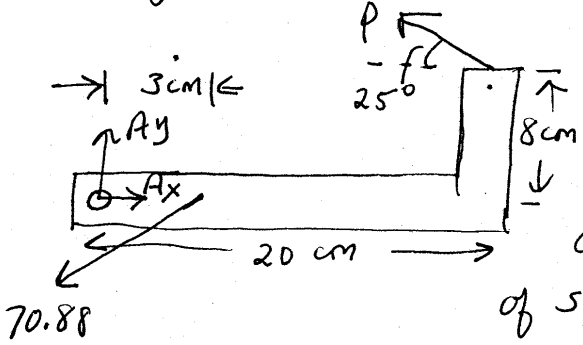
Final configuation



$L_f = \sqrt{8^2+3^2}$
$= 8.544$

$L_f - L_0 = 3.544$

Spring force is $R_{AX} = \left(20 \frac{N}{cm}\right)(3.544\,cm)$
$= 70.88\ N$



Take moments about A.
Only vertical component of spring force contributes
or $70.88\left[\frac{3}{8.544}\right] = 24.89$

$\Sigma m|_A = -24.89(3) + P\cos 25°(8)$
$+ P\sin 25°(20) = 0$

$\Rightarrow P = \dfrac{24.89(3)}{8\cos 25° + 20\sin 25°} = 4.75\ N$

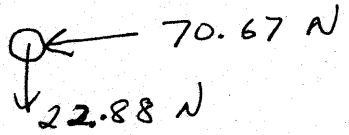
$$\Sigma F_x = A_x - 70.88\left[\frac{8}{8.544}\right] - 4.75\cos 25^\circ = 0$$

$$A_x = 70.67\ N$$

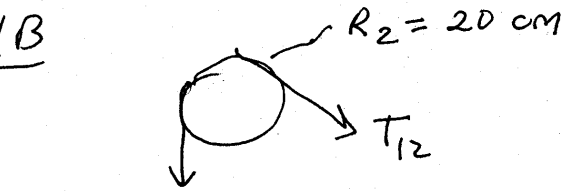
$$\Sigma F_y = A_y - 70.88\ \frac{3}{8.544} + 4.75\sin 25^\circ = 0$$

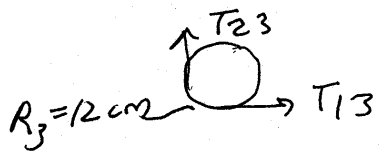
$$A_y = 22.88\ N$$

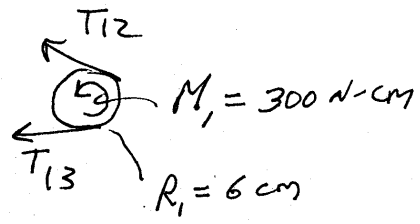
Force on pin



4B







$T_{13} = 75$ N

Sprocket 1: $\Sigma M|_{center_1} = T_{12}(6) - T_{13}(6) + 300 = 0$

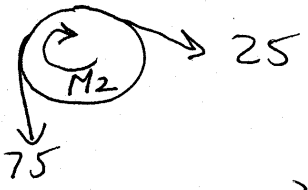
$T_{12} = \frac{-300 + 75(6)}{6}$

$\boxed{T_{12} = 25 \text{ N}}$

Sprocket 3: $\Sigma M|_{center_3} = T_{13}(12) - T_{23}(12) = 0$

$T_{23} = T_{13} = 75 \Rightarrow \boxed{T_{23} = 75 \text{ N}}$

Sprocket 2:



$\Sigma M|_{center_2}$

$= 75(20) - 25(20)$

$- M_2 = 0$

$\Rightarrow M_2 = 1000$ N-cm

moment of shaft on sprocket 2 is 1000 N-cm clockwise