ME 35a HW #2 Solution

3.26 $\bar{F} = 2.5\,kN\,(-6\bar{i} + 2.4\bar{j} - 4\bar{k})\frac{1}{7.6}$ $\quad (L_{BG} = 7.6\,m)$

for $\bar{r}$, use A to B: $\bar{r} = 6m\,\bar{i}$

$$\bar{M}_B = \bar{r} \times \bar{F} = \det \begin{bmatrix} \bar{i} & \bar{j} & \bar{k} \\ 6m & 0 & 0 \\ -6 & 2.4 & -4 \end{bmatrix} \frac{2.5kN}{7.6}$$

$$= \frac{2.5kNm}{7.6}(24m\,\bar{j} + 14.4\,\bar{k})$$

$$= \boxed{(7.89\,\bar{j} + 4.74\,\bar{k})\ kNm} \leftarrow$$

3.59 $\bar{F} = 450N(0.375\,\bar{i} + 0.75\,\bar{j} - 0.75\,\bar{k})\frac{1}{1.125}$ $\quad (L_{BG} = 1.125m)$

Find $\bar{M}_A$ by using $\bar{r}$ from A to B: $\bar{r} = 0.5m\,\bar{i}$

$$\bar{M}_A = \bar{r} \times \bar{F} = \det \begin{bmatrix} \bar{i} & \bar{j} & \bar{k} \\ 0.5m & 0 & 0 \\ 0.375 & 0.75 & -0.75 \end{bmatrix} \frac{450N}{1.125}$$

$$= \frac{450Nm}{1.125}(+0.375\,\bar{j} + 0.375\,\bar{k})$$

$\bar{\lambda}$ along $AD = (\bar{i} - 0.75\,\bar{k})\frac{1}{1.25} = 0.8\bar{i} - 0.6\bar{k}$ $\quad (L_{AD} = 1.25m)$

$$\bar{M}_{AD} = (\bar{\lambda} \cdot \bar{M}_A)\lambda$$

$$= (0.8\bar{i} - 0.6\bar{k}) \cdot (0.375\bar{j} + 0.375\,\bar{k})\frac{450Nm}{1.125}(0.8\bar{i} - 0.6\bar{k})$$

$$= (-72\,\bar{i} + 54\,\bar{k})\,Nm$$

(magnitude 90 Nm in the direction from D to A) $\leftarrow$

3.95 The force of the equivalent force-couple system at O is the force shown:

$$\boxed{\bar{F} = 110N(-\sin 15°\,\bar{j} + \cos 15°\,\bar{k}) = (-28.47\bar{j} + 106.25\,\bar{k})\,N} \leftarrow$$

The couple of the equivalent force-couple system at O can be found by taking the moment of $\bar{F}$ about O. Use $\bar{r}$ from O to B. $\bar{r} = 0.22m \cdot \cos 35°\,\bar{i} + 0.15m\,\bar{j} - 0.22m \cdot \sin 35°\,\bar{j}$

$$= (0.18021\,\bar{i} + 0.15\,\bar{j} - 0.12619\,\bar{k})\,m$$

$$\bar{M} = \bar{r} \times \bar{F} = \det \begin{bmatrix} \bar{i} & \bar{j} & \bar{k} \\ 0.18021 & 0.15 & -0.12619 \\ 0 & -28.47 & 106.25 \end{bmatrix} Nm$$

$$= \boxed{(12.34\,\bar{i} - 19.15\,\bar{j} - 15.13\,\bar{k})\ Nm} \leftarrow$$

3.136 Resultant force $= \bar{R} = \boxed{(-20\,\bar{i} - 15\,\bar{j})\ N} \leftarrow$

Need to find point x, z so that $\bar{M}^R_{x,z}$ (resultant moment about x,z) is parallel to $\bar{R}$.

$$\bar{M}^R_{x,z} = -4Nm\,\bar{i} - 1Nm\,\bar{j} - 15N \cdot z\,\bar{i} + 15N \cdot x\,\bar{k} - 20N\,(0.1m - z)\,\bar{j}$$

$$= (-4\,\bar{i} - 3\,\bar{j})\,Nm + (-15z\,\bar{i} + 20z\,\bar{j} + 15x\,\bar{k})\,N$$

$$= p\,\bar{R}$$

Solve for x, z, p: $\boxed{x = 0,\ z = 0,\ p = 0.2m} \leftarrow$

So the axis of the wrench (LOA of $\bar{R}$) passes through pt. O.