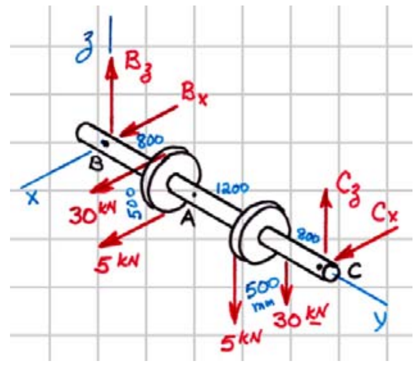
1-64*

First draw an overall free-body diagram of the shaft and sum moments about the bearing *B*



$$\Sigma \mathbf{M}_C = \mathbf{0}:$$

$$(-800\mathbf{j}+250\mathbf{i})\times(-5\mathbf{k})+(-800\mathbf{j}-250\mathbf{i})\times(-30\mathbf{k})$$
$$+(-2000\mathbf{j}+250\mathbf{k})\times(30\mathbf{i})+(-2000\mathbf{j}-250\mathbf{k})\times(5\mathbf{i})$$
$$+(-2800\mathbf{j})\times(B_x\mathbf{i}+B_z\mathbf{k})=\mathbf{0}$$

The *x*-, *y*-, and *z*-components of this equation give

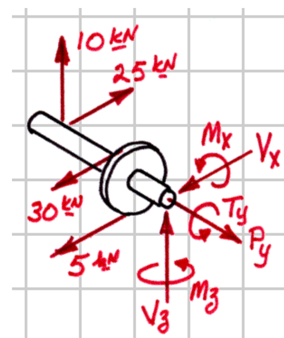
$x:\quad 4000+24{,}000-2800B_z=0$

$y:\quad 1250-7500+7500-1250=0$

$z:\quad 60{,}000+10{,}000+2800B_x=0$

$B_x=-25.00\text{ kN} \qquad B_z=10.00\text{ kN}$

Next draw a free-body diagram of the portion of the shaft between the bearing *B* and the section at *A* and write the equations of equilibrium



$\Sigma F_x=0:\quad V_x+30+5-25=0$

$\Sigma F_y=0:\quad P_y=0$

$\Sigma F_z=0:\quad V_z+10=0$

$V_x=-10\text{ kN}$ .... **Ans.**

$P_y=0\text{ kN}$ .... **Ans.**

$V_z=-10\text{ kN}$ .... **Ans.**

$$\Sigma \mathbf{M}_{cut} = \mathbf{0}:$$

$$(M_x\mathbf{i}+T_y\mathbf{j}+M_z\mathbf{k})+(-0.4\mathbf{j}+0.25\mathbf{k})\times(30\mathbf{i})$$
$$+(-0.4\mathbf{j}-0.25\mathbf{k})\times(5\mathbf{i})+(-1.2\mathbf{j})\times(-25\mathbf{i}+10\mathbf{k})=\mathbf{0}$$

The *x*-, *y*-, and *z*-components of this equation give

$x:\quad M_x-12=0$ $\qquad M_x=12\text{ kN}\cdot\text{m}$ .... **Ans.**

$y:\quad T_y+7.5-1.25=0$ $\qquad T_y=-6.25\text{ kN}\cdot\text{m}$ .... **Ans.**

$z:\quad M_z-30+12+2=0$ $\qquad M_z=16\text{ kN}\cdot\text{m}$ .... **Ans.**