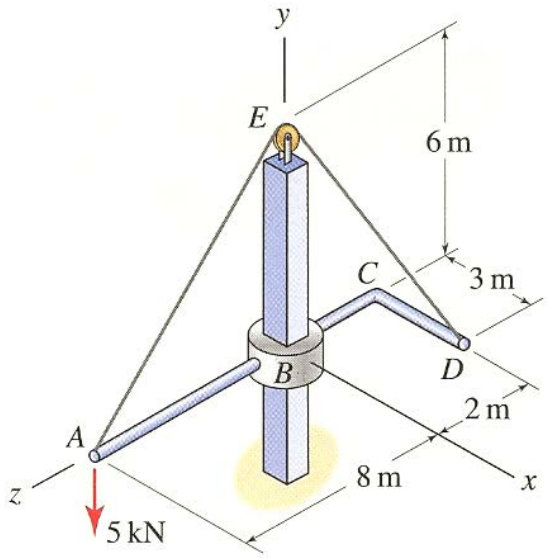
# EGM 3420C - Engineering Mechanics
# Statics Review 1 Problems

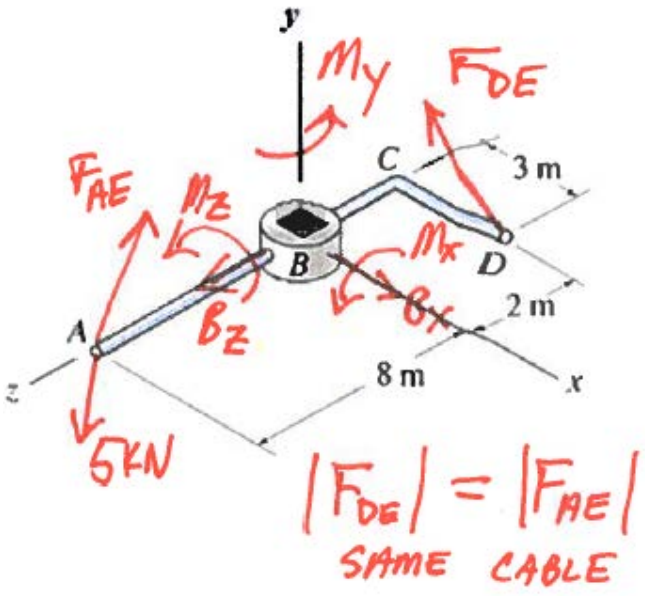
**Problem 3**

Bar *ABCD* is supported by a cable *AED*, which passes over a frictionless pulley at point *E*, and a collar *B* that slides without friction on a vertical shaft with a square cross section.

a. Draw a complete Free Body Diagram of the body *ABCD* below.




FBD




**b.** Determine the tension in cable AED and all support reactions.

Need $\vec{F}_{AE}$ & $\vec{F}_{DE}$

$\vec{AE} = [0\ \ 6\ \ -8]$ $\quad \hat{u}_{AE} = \dfrac{[0\ \ 6\ \ -8]}{\sqrt{0+6^2+8^2}} = [0\ \ 0.6\ \ -0.8]$

$\vec{F}_{AE} = F_{AE}[0\ \ 0.6\ \ -0.8]$

$\vec{DE} = [-3\ \ 6\ \ 2]$ $\quad \hat{u}_{DE} = \dfrac{[-3\ \ 6\ \ 2]}{\sqrt{9+36+4}} = [-\tfrac{3}{7}\ \ \tfrac{6}{7}\ \ \tfrac{2}{7}]$

$\vec{F}_{DE} = F_{DE}[-\tfrac{3}{7}\ \ \tfrac{6}{7}\ \ \tfrac{2}{7}]$

| FORCES MOMENTS REACTIONS | $\vec{r}_{B\to Force}$ | $\vec{F}$ | $\vec{r}\times\vec{F}$, COUPLES MOMENT RXN |
|---|---|---|---|
| FORCES @ B | $[0\ \ 0\ \ 0]$ | $[B_x\ \ 0\ \ B_z]$ | $[0\ \ 0\ \ 0]$ |
| MOMENTS @ B | | | $[M_x\ \ M_y\ \ M_z]$ |
| 5 KN | $[0\ \ 0\ \ 8]$ | $[0\ \ -5\ \ 0]$ | $[40\ \ 0\ \ 0]$ |
| $F_{AE}$ | $[0\ \ 6\ \ 0]$ OR $[0\ \ 0\ \ 8]$ | $F_{AE}[0\ \ 0.6\ \ -0.8]$ | $[-4.8\ \ 0\ \ 0]F_{AE}$ |
| $F_{DE}$ | $[0\ \ 6\ \ 0]$ OR $[3\ \ 0\ \ -2]$ | $F_{DE}[-3/7\ \ 6/7\ \ 2/7]$ | $[1.71\ \ 0\ \ 2.57]F_{DE}$ |
| | | ① ② ③ | ④ ⑤ ⑥ |

SINCE $F_{AE}=F_{DE}$ SOLVE EQN 2 FIRST

② $\Sigma F_y = 0 = 0 - 5 + 0.6\,F_{AE} + \frac{6}{7}F_{AE}$

① $\Sigma F_x = 0 = B_x + 0 + 0 - \frac{3}{7}(3.43)$

③ $\Sigma F_z = 0 = B_z + 0 - .8(3.43) + \frac{2}{7}(3.43)$

④ $\Sigma M_x = 0 = 0 + M_x + 40 - 4.8(3.43) + 1.71(3.43)$

⑤ $\Sigma M_y = 0 = 0 + M_y + 0 + 0 + 0$

⑥ $\Sigma M_z = 0 = 0 + M_z + 0 + 0 + 2.57(3.43)$

$F_{AE} = F_{DE} = 3.43\ KN$

$B_x = 1.47$

$B_z = 1.76$

$M_x = -29.4\ KN\cdot m$

$M_y = 0$

$M_z = -8.81$

**ANSWER:**

$\vec{B} = [1.47\ \ 0\ \ 1.76]\ KN \quad \vec{M}_B = [-29.4\ \ 0\ \ -8.81]\ KN\cdot m \quad F_{AE} = F_{DE} = 3.43\ KN\ (T)$