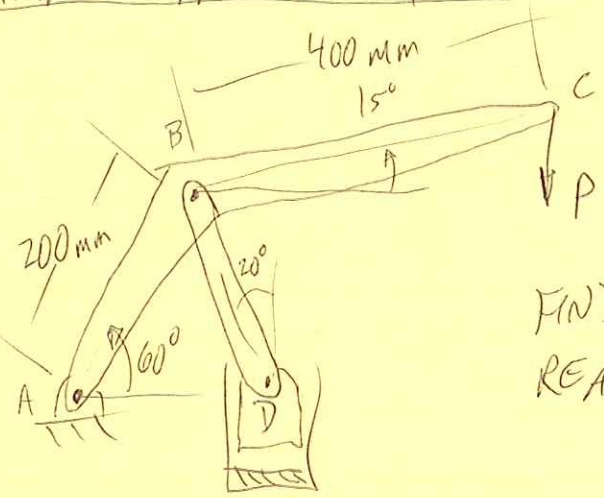
MACHINES TRANSMIT AND MODIFY FORCES.

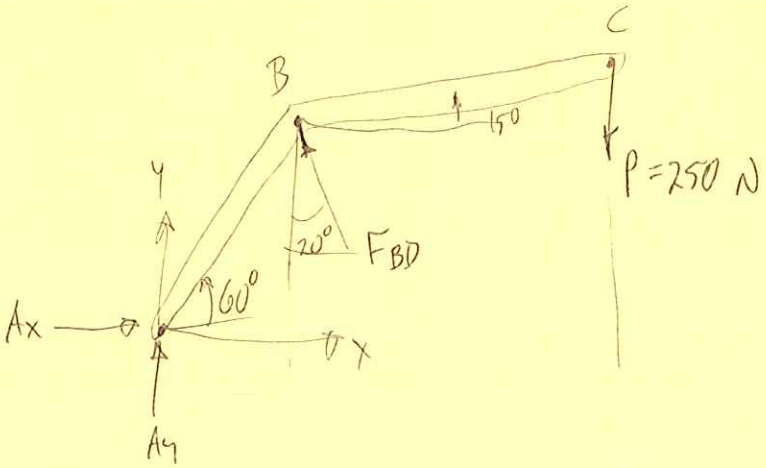
MACHINES ARE ANALYZED BY DISASSEMBLING INTO COMPONENTS.

EXAMPLE PROB. 6.125



FIND VERTICAL FORCE AT D
REACTION AT A.

a) FBD OF ABC:



$$\vec{F}_{BD} = (-\cos 70^\circ F_{BD})\hat{i} + (\sin 70^\circ F_{BD})\hat{j} \text{ N}$$

PROB. 6.125

$\vec{F}_{BD} = (-0.342\,F_{BD})\,\hat{i} + (0.940\,F_{BD})\,\hat{j}$

need F_{BD} : $\Sigma \vec{M}_A = 0$

FIND POSITION VECTORS FROM POINT A:

POINT B: $X_B = 200\cos 60^\circ = 100\ mm$

$Y_B = 200\sin 60^\circ = 173\ mm$

POINT C: $X_C = 100 + 400\cos 15^\circ = 486\ mm$

$Y_C = 173 + 400\sin 15^\circ = 276\ mm$

$\vec{r}_{AB} = (100)\,\hat{i} + (173)\,\hat{j}\ mm$

$\vec{r}_{AC} = (486)\,\hat{i} + (276)\,\hat{j}\ mm$

$\Sigma \vec{M}_A = 0$: $\vec{M}_1 + \vec{M}_2 = 0$

$$\vec{M}_1 = \vec{r}_{AB} \times \vec{F}_{BD} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 100 & 173 & 0 \\ -0.342F_{BD} & 0.94F_{BD} & 0 \end{vmatrix}$$

$\vec{M}_1 = [(100)(0.94\,F_{BD}) - (173)(-0.342\,F_{BD})]\,\hat{k}$ N-mm

$\vec{M}_1 = (153\,F_{BD})\,\hat{k}$ N-mm

PROB. 6.125

$$\vec{M}_2 = \vec{r}_{AC} \times \vec{P} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 486 & 276 & 0 \\ 0 & -250 & 0 \end{vmatrix}$$

$$\vec{M}_2 = [(486)(-250)]\,\hat{k} \quad N\text{-}mm$$

$$\vec{M}_2 = (-1.21 \times 10^5)\,\hat{k} \quad N\text{-}mm$$

$$.153\,F_{BD} - 1.21 \times 10^5 = 0$$

$$\boxed{F_{BD} = 794\ N}$$

THE VERTICAL FORCE AT D IS

$$\boxed{F_D = 794 \cos 20^\circ = 746\ N}$$

b) FIND REACTION AT A:

$$\Sigma F_x = 0:$$

$$A_x - 0.342\,F_{BD} = 0$$

$$\boxed{A_x = 0.342(794) = 271\ N}$$

$$\Sigma F_y = 0: \quad A_y + 0.94\,F_{BD} - 250 = 0$$

$$\boxed{A_y = 250 - 0.94(794) = -496\ N}$$