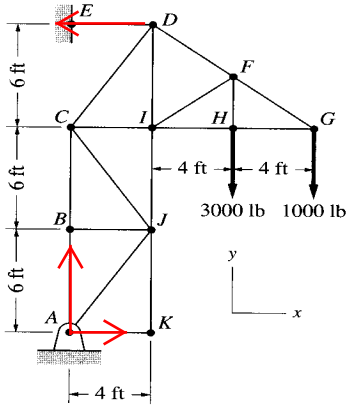
Test 4

Do all calculations on engineering paper.

Closed Book, Closed Notes, one sheet of notes allowed. Be sure to include appropriate units and signs in your answers. FBD's must be neat and readable. Do not leave out steps. Clearly place coordinate systems if different from that given in the figures.

(30 pts.) Problem 1. Determine the forces in members *FI* and *JC*.



For *FI* make a cut through *DF, FI,* and *HI*. Then do a summation of moments about *G* with the components of *FI* passing through *I*.

$$\sum M_G = 8 \cdot \frac{3}{5} FI + 4 \cdot 3000 = 0$$

$$FI = -2500 \text{ lb (C)}$$

For *JC*, first find the reactions for the FBD of the whole truss:

$$\sum M_A = 0 = 18 \cdot E - 8 \cdot 3000 - 12 \cdot 1000 \quad \Rightarrow \quad E = 2000 \text{ lb}$$

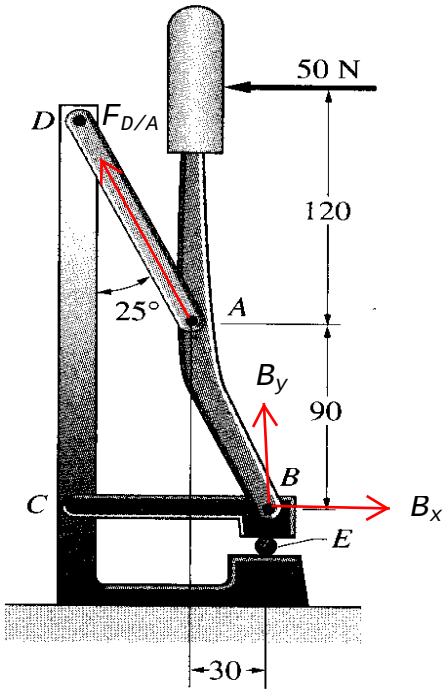
$$\sum F_x = 0 = A_x - 2000 \quad \Rightarrow \quad A_x = 2000 \text{ lb}$$

$$\sum F_y = 0 = A_y - 3000 - 1000 \quad \Rightarrow \quad A_y = 4000 \text{ lb}$$

Then cut *BC, JC,* and *JI*.

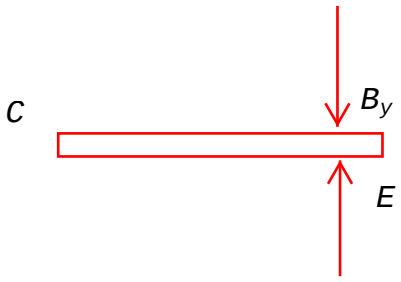
$$\sum F_x = 0 = A_x - \frac{4}{\sqrt{52}} \cdot JC \quad \Rightarrow \quad JC = 3606 \text{ lb (T)}$$

(30 pts.) Problem 2. Find the force exerted by the cutting blade *CB* on the workpiece *E*.



Dimensions in mm

From an FBD on the handle and recognizing that *AD* is a two-force member, sum moments about *B*:



$$\sum M_B = 0 = 50 \cdot 120 + 90 \cdot F_{D/A} \sin 25° - 30 \cdot F_{D/A} \cos 25° \quad \Rightarrow \quad F_{D/A} = -968 \text{ N}$$

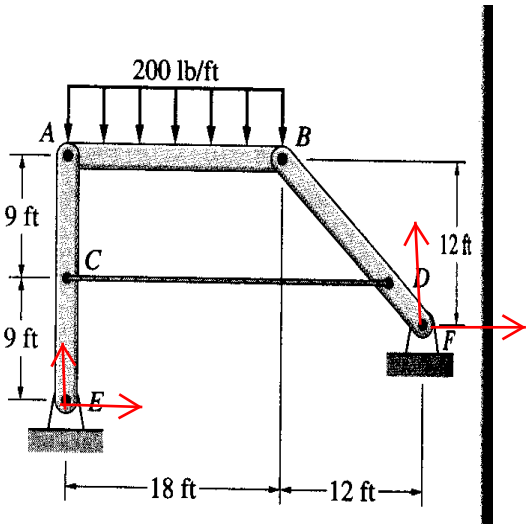
Noting that *B* and *E* are aligned, only a summation of forces in the *y*-direction is necessary:

$$\sum F_y = 0 = B_y + F_{D/A} \cos 25° \quad \Rightarrow \quad B_y = 877 \text{ lb}$$

By inspection or from an FBD of the cutting blade, sum forces in the *y*-direction:

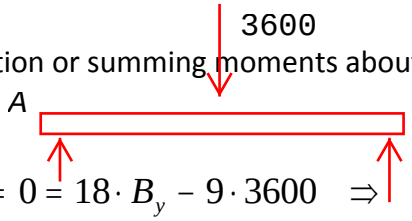
$$\sum F_y = 0 = E - B_y \Rightarrow E = 877 \text{ lb}$$

(30 pts.) Problem 3. Find the tension in cable *CD*.



From the 200 lb/ft distributed load, and equivalent load of 3600 lb acts in the middle of *AB*.

By inspection or summing moments about *A* on a FBD of *AB*:



$$\sum M_A = 0 = 18 \cdot B_y - 9 \cdot 3600 \quad \Rightarrow \quad B_y = 1800 \text{ lb}$$

$$\sum F_y = 0 = A_y + B_y - 3600 \quad \Rightarrow \quad A_y = 1800 \text{ lb}$$

From a FBD of *BD*:

$$\sum F_y = 0 = F_y - B_y \quad \Rightarrow \quad F_y = 1800 \text{ lb}$$

$$\sum M_B = 0 = 12 \cdot F_y + 12 \cdot F_x - 9 \cdot T$$

Sum moments about *E* on a FBD of the whole frame:

$$\sum M_E = 0 = 30 \cdot F_y - 6 \cdot F_x - 9 \cdot 3600 \quad \Rightarrow \quad F_x = 3600 \text{ lb}$$

From above $T = 7200$ lb

Alternately, sum moments about *F* for a FBD of whole frame, and seeing that $E_y = A_y$:

$$\sum M_F = 0 = -30 \cdot E_y + 6 \cdot E_x + 21 \cdot 3600 \quad \Rightarrow \quad E_x = -3600 \text{ lb}$$

Summing moments about *A* on the FBD of *AE*:

$$\sum M_A = 0 = 9 \cdot T + 18 \cdot E_x = \quad \Rightarrow \quad T = 7200 \text{ lb}$$