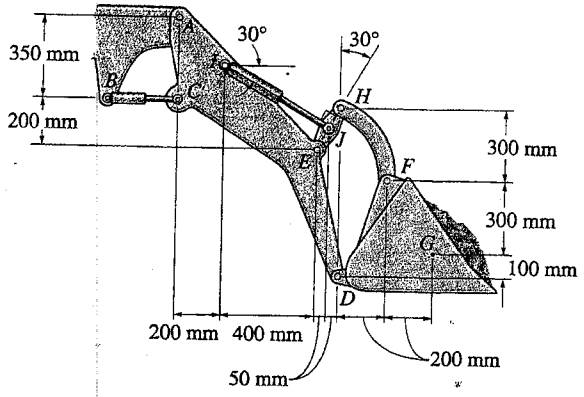
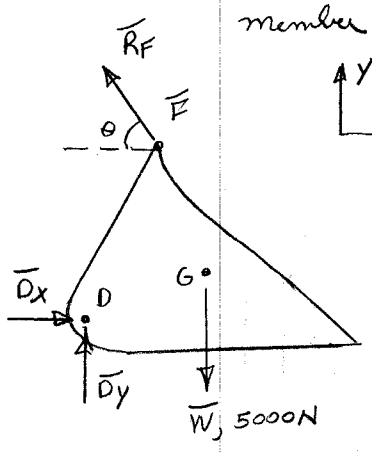
9A. The tractor shovel carries a 5000 N load of soil acting at point G. The bucket is connected to the rest of the tractor frame by pins at D and F.

a. Draw a FBD of the bucket.
b. Solve for the forces acting on the bucket at points D and F.
c. Write the forces at pins D and F as Cartesian vectors.



member HF is a 2FM



$\tan\theta = \frac{.3m}{.2m} \Rightarrow \theta = 56.3°$

$\Sigma \overline{F_x} = (D_x - R_F \cos 56.3°)\,\bar{i} = 0$

$\therefore D_x - .555 R_F = 0$

$\Sigma \overline{F_y} = (R_F \sin 56.3° + D_y - 5000N)\,\bar{j}$

$.831 R_F + D_y - 5000N = 0$

$\Sigma \overline{M_D} = 0 = (R_F \cos 56.3°(.4m) + R_F \sin 56.3°(.2m) - 5000N(.4m))\,\bar{k}$

$\therefore .222 R_F + .166 R_F - 2000 = 0$

$.388 R_F = 2000$

$R_F = 5154\,N$

$\therefore D_x = 2860\,N$

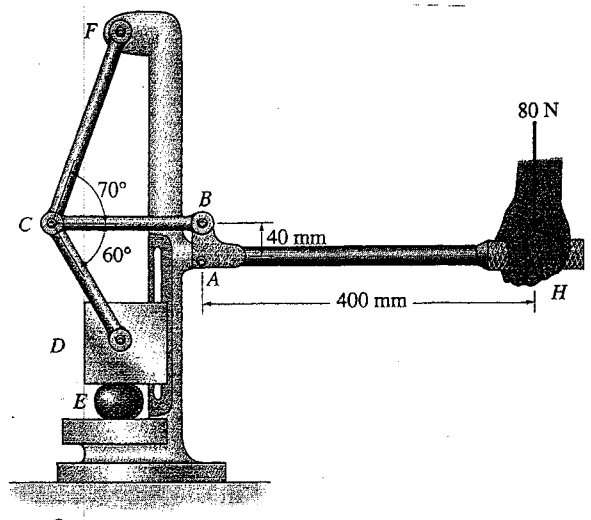
$D_y = 717\,N$

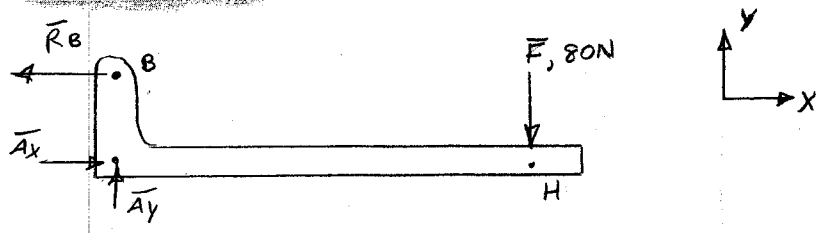
$\therefore \overline{R_F} = 2860(-\bar{i}) + 4288(\bar{j})\,N$

$\overline{D_x} = 2860\,N\,\bar{i}$

$\overline{D_y} = 717\,N\,\bar{j}$

9B. A clamp mechanism develops a large clamping force at point E when a relatively small force is applied on the handle at H. Determine the forces acting on the handle (HAB) at points A and B which are pins. Write the forces at points A and B as Cartesian vectors.





member CB is a 2FM

$\Sigma \bar{F}_x = 0 = (A_x - R_B)\bar{i} = 0$

$\therefore A_x = R_B$

$\Sigma \bar{F}_y = 0 = (A_y - F)\bar{j}$

$\therefore A_y = F = 80N$

$\Sigma \bar{M}_A = 0 = (R_B(.04m) - 80(.4m))\bar{k}$

$\therefore .04R_B = 32Nm$

$R_B = 800N$

$\therefore A_x = 800N$

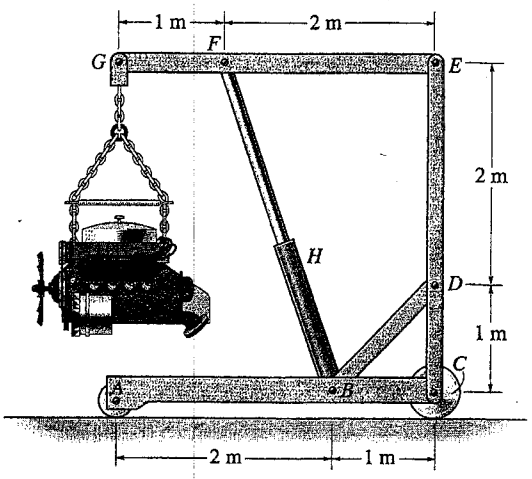
$A_y = 80N$

$\bar{R}_B = 800N(-\bar{i})$

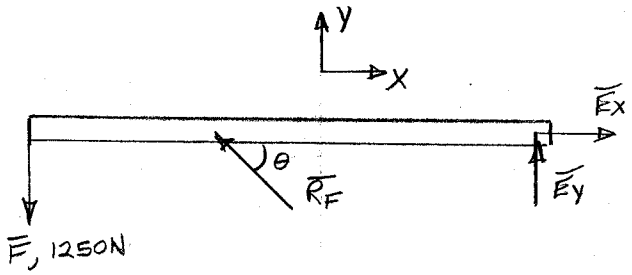
$\bar{A}_x = 800N(\bar{i})$

$\bar{A}_y = 80N(\bar{j})$

9C The hoist is supporting an engine that weighs 1250 N. Determine the forces acting on the upper horizontal member at points E and F. All labeled points on the figure are pin connections. Write the forces at points E and F as Cartesian vectors.



Member BF is a 2FM



$\tan\theta = \frac{3m}{1m} \Rightarrow \theta = 71.6^\circ$

$\Sigma \bar{F}_x = 0 = (E_x - R_F \cos 71.6^\circ)\,\bar{i}$

$E_x - .316 R_F = 0$

$\Sigma \bar{F}_y = 0 = (E_y + R_F \sin 71.6^\circ - 1250N)\,\bar{j}$

$E_y + .949 R_F - 1250N = 0$

$\Sigma \bar{M}_E = 0 = (1250N(3m) - R_F \sin 71.6(2m))\,\bar{k}$

$\therefore 3750 Nm - 1.90 R_F = 0$

$R_F = 1973 N$
$E_x = 623 N$
$E_y = -622N$ (wrong direction)

$\bar{R}_F = 622(-\bar{i}) + 1872(\bar{j})\ (N)$
$\bar{E}_x = 623N(\bar{i})$
$\bar{E}_y = 622N(-\bar{j})$