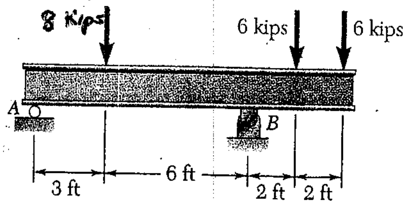
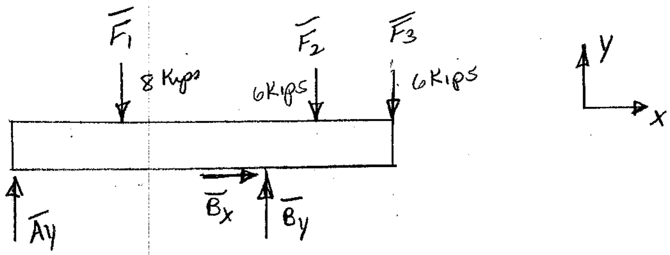
7A

The beam below is supported by a roller at point A and a pin connection at point B.

a. Draw a Free-Body Diagram (FBD) of the beam.
b. Use the equations from Newton's first law to solve for the reaction forces at points A and B.





$$\Sigma \bar{F} = 0 = \bar{F}_1 + \bar{F}_2 + \bar{F}_3 + \bar{A}_y + \bar{B}_x + \bar{B}_y$$

$$= 8(-\bar{j}) + 6(-\bar{j}) + 6(-\bar{j}) + A_y(\bar{j}) + B_x(\bar{i}) + B_y(\bar{j})$$

$$0 = B_x(\bar{i}) + (8 - 6 - 6 + A_y + B_y)(\bar{j}) = 0$$

$\therefore B_x = 0$

and $-4 + A_y + B_y = 0$

$$\Sigma \bar{M}_B = 0 = \bar{M}_B^{F_1} + \bar{M}_B^{F_2} + \bar{M}_B^{F_3} + \bar{M}_B^{A_y} = 0$$

$$= 8(6ft)(\bar{k}) + 6(2ft)(-\bar{k}) + 6(4ft)(-\bar{k}) + A_y(9ft)(-\bar{k})$$

$$= (48 - 12 - 24 - 9A_y)\bar{k} = 0$$

$$\therefore (12 - 9A_y)\bar{k} = 0$$

$\therefore A_y = 1.33 \text{ Kips}$ ← $\bar{A}_y$ in correct direction

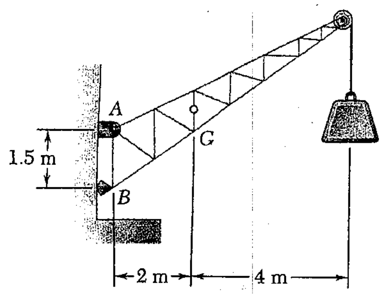
but $-20 + A_y + B_y = 0$

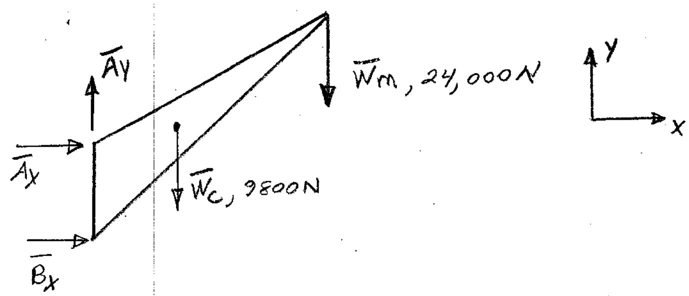
so $-20 + 1.33 + B_y = 0$

$\therefore B_y = 18.67 \text{ Kips}$ ← $\bar{B}_y$ in the correct direction

7B The fixed crane shown below weighs 9800 N and is holding up a 24,000 N load. The crane is supported by a pin at point A and a rocker at point B. The center of gravity of the crane (9800 N) is at point G.

a. Draw a Free-Body Diagram (FBD) of the crane and its load.
b. Use the equations from Newton's first law to solve for the reaction forces at points A and B.





$\Sigma \overline{F_x} = (A_x + B_x)\overline{i} = 0$

$\Sigma \overline{F_y} = (A_y - 9800 - 24{,}000)\overline{j} = 0 \Rightarrow A_y = 33{,}800N$

$\Sigma \overline{M_A} = 0 = (B_x(1.5m) - 9800(2m) - 24000(6m))\overline{k} = 0$

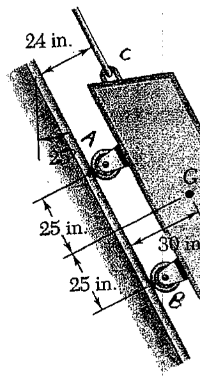
$\therefore 1.5 B_x = 163{,}600$

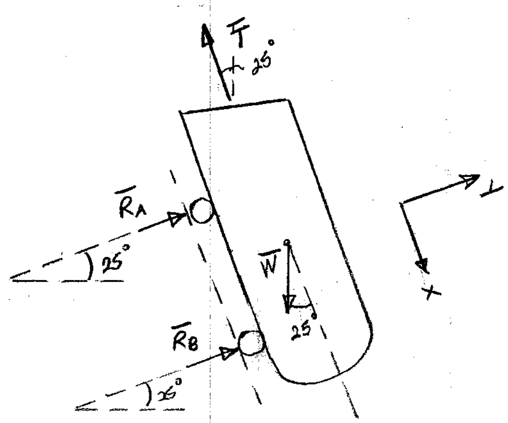
$B_x = 109{,}000 N$

$\therefore A_x = -109{,}000 N$ (guessed wrong direction)

7C A loading car is at rest on a track forming an angle of 25° with the vertical. The gross weight of the car and its load is 5500 lb, and it is applied at point G. The wheels of the car contact the rail at points A and B. The car is also attached to a cable at point C.

a. Draw an FBD of the car.
b. Solve for the rail forces acting on the wheels and for the force within the cable.





$$\Sigma \bar{F}_x = (W\cos 25^\circ - T)\,\bar{i} = 0 \Rightarrow T = W\cos 25^\circ = 5500\cos 25^\circ$$

$$T = 4985\,\text{lb}$$

$$\Sigma \bar{F}_y = (R_A + R_B - W\sin 25^\circ)\,\bar{j} \Rightarrow R_A + R_B = W\sin 25^\circ = 2324\,\text{lb}$$

$$\Sigma \bar{M}_A = (T(24\,\text{in}) - W\cos 25^\circ(30\,\text{in}) - W\sin 25^\circ(25\,\text{in}) + R_B(50\,\text{in}))\,\bar{k}$$

$$= 4985(24) - 4985(30) - 2324(25) + 50R_B = 0$$

$$-29{,}910 - 58{,}100 + 50R_B = 0$$

$$50R_B = 88010$$

$$R_B = 1760\,\text{lb}$$

$$\therefore R_A = 2324 - R_B$$

$$R_A = 564\,\text{lb}$$