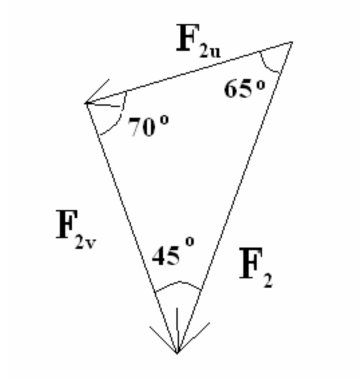
PHY211 Statics/F05 **HW#1 Solution** **NAME: <u>Dr. Camille A. Issa</u>**

<u>PROB-2.6-</u>

Drawing the triangle of forces:



Applying the law of sine:

$$\frac{F_{2u}}{\sin 45} = \frac{F_{2v}}{\sin 65} = \frac{F_2}{\sin 70}$$

Then

$$F_{2u} = F_2 \frac{\sin 45}{\sin 70} = 376.2N$$

$$\& \; F_{2v} = F_2 \frac{\sin 65}{\sin 70} = 482.2N$$

<u>PROB-2.8-</u>

$\vec{R} = \vec{F}_A + \vec{F}_B = R\vec{i}$

Resolving each force into its x and y components:

$\vec{F}_A = 8\sin\theta\vec{i} + 8\cos\theta\vec{j}$

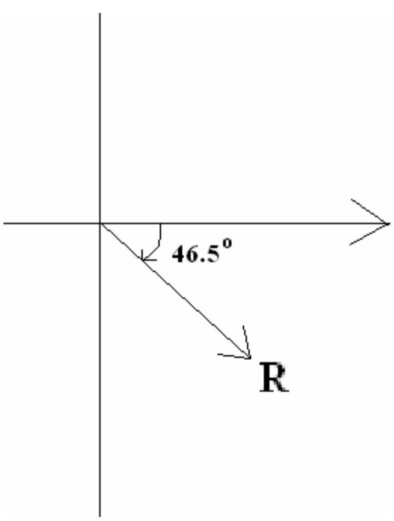
$\vec{F}_B = 6\sin 40\vec{i} - 6\cos 40\vec{j}$

$\vec{F}_A + \vec{F}_B = (8\sin\theta + 6\sin 40)\vec{i} + (8\cos\theta - 6\cos 40)\vec{j} = R_X\vec{i} + R_Y\vec{j}$

$R_Y = 0 \Rightarrow 8\cos\theta - 6\cos 40 = 0 \Rightarrow \cos\theta = 6\cos 40/8 \Rightarrow \theta = \cos^{-1}(6\cos 40/8) = 54.93^\circ$

$R_X = 8\sin\theta + 6\sin 40 = 10.4kN$

<u>PROB-2.32-</u>



$F_1 = 50N$

$F_2 = 65N$

$F_3 = 70N$

In vector form:

$\vec{F}_1 = 50\cos 30\vec{i} - 5\sin 30\vec{j}$

$\vec{F}_2 = -65\cos 45\vec{i} - 65\sin 45\vec{j}$

$\vec{F}_3 = 70\vec{i}$

$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

$\vec{R} = (50\cos 30 - 65\cos 45 + 70)\vec{i} + (-50\sin 30 - 65\sin 45)\vec{j} = R_X\vec{i} + R_Y\vec{j}$

$\vec{R} = 67.34\vec{i} - 70.96\vec{j}$

The magnitude of the resultant: $R = \sqrt{R_X^2 + R_Y^2} = \sqrt{67.34^2 + 70.96^2} = 97.83N$

And $\theta = \tan^{-1}(R_Y / R_x) = \tan^{-1}(-70.96/67.34) = -46.5^\circ$ **from positive axis**

PROB-2.38-

$F_1 = 500N$
$F_2 = 400N$
$F_3 = 600N$

In vector form:

$\vec{F}_2 = 400\cos 30\vec{i} + 400\sin 30\vec{j}$
$\vec{F}_1 = 500\sin 20\vec{i} + 500\cos 20\vec{j}$
$\vec{F}_3 = 600(-\frac{4}{5}\vec{i} + \frac{3}{5}\vec{j}$

$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

$\vec{R} = (400\cos 30 + 500\sin 20 - 600\times 4/5)\vec{i} + (400\sin 30 + 500\cos 20 + 600\times 3/5)\vec{j} = R_X\vec{i} + R_Y\vec{j}$
$\vec{R} = 37.42\vec{i} + 1029.85\vec{j}$

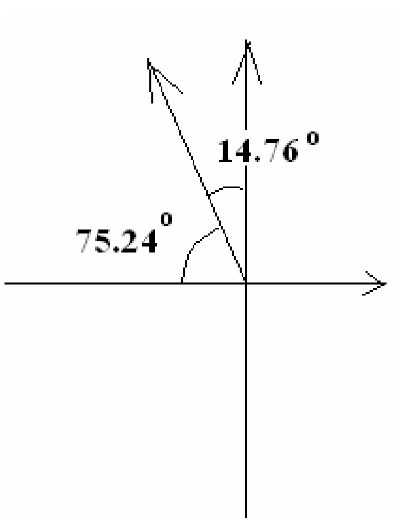
The magnitude of the resultant: $R = \sqrt{R_X^2 + R_Y^2} = \sqrt{37.42^2 + 1029.85^2} = 1030.53N$
And $\theta = \tan^{-1}(R_Y / R_x) = 87.92°$

PROB-2.44-

$F_A = 700N$
$F_B = 600N$

In vector form:

$\vec{F}_A = 700\sin 30\vec{i} + 700\cos 30\vec{j}$



$\vec{F}_B = -600\cos 20\vec{i} + 600\sin 20\vec{j}$

$\vec{R} = \vec{F}_A + \vec{F}_B$

$\vec{R} = (700\sin 30 - 600\cos 20)\vec{i} + (700\cos 30 + 600\sin 20)\vec{j} = R_X\vec{i} + R_Y\vec{j}$
$\vec{R} = -213.82\vec{i} + 811.43\vec{j}$

The magnitude of the resultant:
$R = \sqrt{R_X^2 + R_Y^2} = \sqrt{(-213.82)^2 + 811.43^2} = 839.13N$
And $\theta = \tan^{-1}(R_Y / R_x) = 75.24°$
Then the angle from the positive y axis is $\alpha = 90 - \theta = 14.76°$

PHY211 Statics/F05 **HW#2 Solution** **NAME: Dr. Camille A. Issa**

PROB-2.58-

$\vec{R} = \vec{F}_A + \vec{F}_B = R\vec{i}$

Resolving each force into its x and y components:

$\vec{F} = -F\cos 45\vec{i} - F\sin 45\vec{j}$

$\vec{F}_1 = 8\vec{i}$

$\vec{F}_2 = -14\cos 30\vec{i} + 14\sin 30\vec{j}$

$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F} = (8\sin\theta - 14\cos 30 - F\cos 45)\vec{i} + (14\sin 30 - F\sin 45)\vec{j} = R_X\vec{i} + R_Y\vec{j}$

$R = \sqrt{(-4.124 - F\sqrt{2}/2)^2 + (7 - F\sqrt{2}/2)^2}$

$R^2 = 17.0074 + 5.832F + \frac{F^2}{2} + 49 - 9.8995F + \frac{F^2}{2} = F^2 - 4.0675F + 66.0074$

R^2 **is minimum for** $\frac{dR^2}{dF} = 0 = 2F - 4.0675 \Rightarrow F = 2.03375kN$

Then $R = 7.866kN$

PROB-2.68-

$\vec{F}_1 = 350\sin 40\vec{j} + 350\cos 40\vec{k}$

$\vec{F}_2 = 100(\cos 45\vec{i} + \cos 60\vec{j} + \cos 120\vec{k})$

$\vec{F}_3 = 250(\cos 60\vec{i} - \cos 45\vec{j} + \cos 60\vec{k}$

$\vec{R} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

$\vec{R} = (100\cos 45 + 250\cos 60)\vec{i} + (350\sin 40 + 100\cos 60 - 250\cos 45)\vec{j}$
$+ (350\cos 40 + 100\cos 120 + 250\cos 60)\vec{k}$

$\vec{R} = 195.71\vec{i} + 98.199\vec{j} + 343.116\vec{k}$

The magnitude of the resultant: $R = \sqrt{R_X^2 + R_Y^2 + R_Z^2} = \sqrt{195.71^2 + 98.199^2 + 343.116^2} = 407.03N$

And $\alpha = \cos^{-1}(R_x / R) = 61.26°$

$\beta = \cos^{-1}(R_Y / R) = 76.039°$

$\gamma = \cos^{-1}(R_Z / R) = 32.544°$

PROB-2.78-

$\vec{F}_1 = 80(\frac{4}{5}\vec{i} + \frac{3}{5}\vec{k}) = 64\vec{i} + 48\vec{k}$

$\alpha = \cos^{-1}(F_{1x} / F_1) = 36.87°$

$\beta = \cos^{-1}(F_{1y} / F_1) = 90°$

$\gamma = \cos^{-1}(F_{1z} / F_1) = 53.13°$

$$\vec{F}_R = 120\cos 45(\sin 30\vec{i} + \cos 30\vec{j}) + 120\sin 45\vec{k} = 42.426\vec{i} + 73.485\vec{j} + 84.853\vec{k}$$

$\alpha = \cos^{-1}(F_{Rx} / F_R) = 69.295°$

$\beta = \cos^{-1}(F_{Ry} / F_R) = 52.239°$

$\gamma = \cos^{-1}(F_{Rz} / F_R) = 45°$

PROB-2.86-

$A(0,-2\sin 60, 2\cos 60)$

$B(4,1,0)$

$$\vec{F} = F\frac{\overrightarrow{AB}}{AB} = 500\frac{(4-0)\vec{i} + (1+2\sin 60)\vec{j} + (0-2\cos 60)\vec{k}}{\sqrt{4^2 + (1+2\sin 60)^2 + (0-2\cos 60)^2}}$$

$$\vec{F} = 404.357\vec{i} + 276.181\vec{j} - 101.089\vec{k}$$

$\alpha = \cos^{-1}(F_x / F) = 36.0295°$

$\beta = \cos^{-1}(F_y / F) = 56.471°$

$\gamma = \cos^{-1}(F_z / F) = 101.664°$

PROB-2.98-

$A(0,0,4)$

$B(0,0,5.5)$

$C(-1,4,0)$

$D(2,-3,0)$

$$\vec{F}_A = F_A\frac{\overrightarrow{AC}}{AC} = 250\frac{(-1)\vec{i} + (4)\vec{j} + (-4)\vec{k}}{\sqrt{1^2 + (4)^2 + (-4)^2}}$$

$$\vec{F}_A = -43.519\vec{i} + 174.078\vec{j} - 174.078\vec{k}$$

$$\vec{F}_B = F_B\frac{\overrightarrow{BD}}{BD} = 175\frac{(2)\vec{i} + (-3)\vec{j} + (-5.5)\vec{k}}{\sqrt{2^2 + (-3)^2 + (-5.5)^2}}$$

$$\vec{F}_A = 53.22\vec{i} - 79.83\vec{j} - 146.355\vec{k}$$

PHY211 Statics/F05 **HW#3 Solution** **NAME: Dr. Camille A. Issa**

PROB-2.88-

$A(-5\cos 60\cos 35, -5\cos 60\sin 35, 5\sin 60)$

$B(2\cos 25\sin 40, 2\cos 25\cos 40, -2\sin 25)$

$\overrightarrow{BA} = (-5\cos 60\cos 35 - 2\cos 25\sin 40)\vec{i} + (-5\cos 60\sin 35 - 2\cos 25\cos 40)\vec{j} + (5\sin 60 + 2\sin 25)\vec{k}$

$\overrightarrow{BA} = -3.213\vec{i} - 2.8225\vec{j} + 5.17536\vec{k}$

Then

$d = \sqrt{(-3.213)^2 + (-2.8225)^2 + (5.17536)^2} = 6.714km$

PROB-2.100-

$A(0,0,35)$

$B(50\sin 20, 50\cos 20, 0)$

$$\vec{F} = F\frac{\overrightarrow{AB}}{AB} = 350\frac{(50\sin 20)\vec{i} + (50\cos 20)\vec{j} + (-35)\vec{k}}{\sqrt{(50\sin 20)^2 + (50\cos 20)^2 + (-35)^2}}$$

$$\vec{F} = 98.068\vec{i} + 269.439\vec{j} - 200.712\vec{k}$$

PROB-2.106-

$A(20,15,0)$

$B(-6,4,0)$

$C(16,-18,0)$

$D(0,0,24)$

$$\vec{F}_{DB} = F_{DB}\frac{\overrightarrow{DB}}{DB} = 800\frac{(-6)\vec{i} + (4)\vec{j} + (-24)\vec{k}}{\sqrt{(-6)^2 + (4)^2 + (-24)^2}}$$

$$\vec{F}_{DB} = -191.54\vec{i} + 127.69\vec{j} - 766.16\vec{k}$$

$$\vec{F}_{DA} = F_{DA}\frac{\overrightarrow{DA}}{DA} = 400\frac{(20)\vec{i} + (15)\vec{j} + (-24)\vec{k}}{\sqrt{20^2 + (15)^2 + (-24)^2}}$$

$$\vec{F}_{DA} = 230.84\vec{i} + 173.13\vec{j} - 277.01\vec{k}$$

$$\vec{F}_{DC} = F_{DC}\frac{\overrightarrow{DC}}{DC} = 600\frac{(16)\vec{i} + (-18)\vec{j} + (-24)\vec{k}}{\sqrt{16^2 + (-18)^2 + (-24)^2}}$$

$$\vec{F}_{DA} = 282.35\vec{i} - 317.65\vec{j} - 423.53\vec{k}$$

$$\vec{R} = \vec{F}_{DB} + \vec{F}_{DA} + \vec{F}_{DC} = (-191.54 + 230.84 + 282.35)\vec{i} + (127.69 + 173.13 - 317.65)\vec{j}$$

$$+ (-766.16 - 277.01 - 423.53)\vec{k}$$

$$\vec{R} = 321.65\vec{i} - 16.83\vec{j} - 1466.7\vec{k}$$

$$R = \sqrt{321.65^2 + 16.83^2 + 1466.7^2} = 1501.65N$$

$$\alpha = \cos^{-1}(R_X / R) = 77.63°$$

$$\beta = \cos^{-1}(R_Y / R) = 90.64°$$

$$\gamma = \cos^{-1}(R_Z / R) = 167.61°$$

PROB-2.112-

$$\vec{r}_1 = 9\sin 40\cos 30\vec{i} - 9\sin 40\sin 30\vec{j} + 9\cos 40\vec{k} = 5.01\vec{i} - 2.89\vec{j} + 6.89\vec{k}$$

$$\vec{r}_2 = 6(\cos 60\vec{i} + \cos 45\vec{j} + \cos 120\vec{k}) = 3\vec{i} + 4.24\vec{j} - 3\vec{k}$$

The projection of r_1 along r_2

$$r_{1/2} = \vec{r}_1 \cdot \frac{\vec{r}_2}{r_2} = \frac{1}{6}(5.01\vec{i} - 2.89\vec{j} + 6.89\vec{k}) \cdot (3\vec{i} + 4.24\vec{j} - 3\vec{k}) = -2.982m$$

The projection of r_2 along r_1

$$r_{2/1} = \vec{r}_2 \cdot \frac{\vec{r}_1}{r_1} = \frac{1}{9}(3\vec{i} + 4.24\vec{j} - 3\vec{k}) \cdot (5.01\vec{i} - 2.89\vec{j} + 6.89\vec{k}) = -1.988m$$

PROB-2.136-

$A(3,-2,0)$

$B(0,0,6)$

$C(1.5,-1,3)$

$$\vec{F}_{CO} = F_{CO}\frac{\overrightarrow{CO}}{CO} = 80\frac{(-1.5)\vec{i} + (1)\vec{j} + (-3)\vec{k}}{\sqrt{(-1.5)^2 + (1)^2 + (-3)^2}}$$

$$\vec{F}_{CO} = -34.28\vec{i} + 22.86\vec{j} - 68.57\vec{k}$$

PHY211 Statics/F05 **HW#4 Solution** **NAME: Dr. Camille A. Issa**

PROB-3.4-

$$\vec{F} = F\cos\theta\ \vec{i} + F\sin\theta\ \vec{j}$$
$$\vec{F}_1 = 2.25\cos 60\vec{i} - 2.25\sin 60\vec{j}$$
$$\vec{F}_2 = -7.5\sin 30\vec{i} - 7.5\cos 30\vec{j}$$
$$\vec{F}_3 = -4.5\vec{i}$$

At equilibrium: $\sum \vec{F} = 0 \Rightarrow \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F} = 0$

$$\sum F_x = 0 = F\cos\theta + 2.25\cos 60 - 7.5\sin 30 - 4.5 = 0 \Rightarrow F\cos\theta = 7.125 \quad (1)$$
$$\sum F_y = 0 = F\sin\theta - 2.25\sin 60 - 7.5\cos 30 = 0 \Rightarrow F\sin\theta = 8.444 \quad (2)$$

(2) / (1) gives: $\tan\theta = 1.185 \Rightarrow \theta = 49.84°$

$$\& \ F = \frac{8.444}{\sin 49.84} = 11.05kN$$

PROB-3.8-

$$\sum F \uparrow = 0 = -W + T_{AB}\sin 12 + T_{AC}\left(\frac{7}{25}\right)$$
$$\Rightarrow T_{AB}\sin 12 + T_{AC}\left(\frac{7}{25}\right) = W = 12(9.81) \quad (1)$$
$$\sum F \downarrow = 0 = +T_{AB}\cos 12 - T_{AC}\left(\frac{24}{25}\right) \quad (2)$$

Solving (1) & (2) simultaneously : $T_{AB} = 238.68N$, $T_{AC} = 243.20N$

PROB-3.40-

At point A:

Equilibrium: $\sum F \uparrow = 0 = -W + T_{AB}\sin 60 \ \Rightarrow T_{AB} = \frac{W}{\sin 60} = \frac{(30)(9.81)}{\sin 60} = 339.83N$

$$\sum F \downarrow = 0 = T_{AE} - T_{AB}\cos 60 \ \Rightarrow T_{AE} = T_{AB}\cos 60 = 169.91N$$

At point A:

Equilibrium: $\sum F \uparrow = 0 = -T_{AB}\sin 60 \ + T_{BD}\left(\frac{3}{5}\right) \Rightarrow T_{BD} = \frac{5}{3}T_{AB}\sin 60 = 490.50N$

$$\sum F \downarrow = 0 = -T_{BC} + T_{BD}\left(\frac{4}{5}\right) + T_{BA}\cos 60 \ \Rightarrow T_{BC} = T_{BD}\left(\frac{4}{5}\right) + T_{BA}\cos 60 = 562.32N$$

PROB-3.46-

$A(0,0,6)$

$B(2,3,0)$

$C(1.5,2,0)$

$D(-3,-6,0)$

$$\vec{T}_{AD} = T_{AD}\frac{\overrightarrow{AD}}{AD} = T_{AD}\frac{(-3)\vec{i}+(-6)\vec{j}+(-6)\vec{k}}{\sqrt{(-3)^2+(6)^2+(6)^2}} = T_{AD}\left(-\frac{1}{3}\vec{i}-\frac{2}{3}\vec{j}-\frac{2}{3}\vec{k}\right)$$

$$\vec{T}_{AC} = T_{AC}\frac{\overrightarrow{AC}}{AC} = T_{AC}\frac{(-1.5)\vec{i}+(2)\vec{j}+(-6)\vec{k}}{\sqrt{(-1.5)^2+(2)^2+(-6)^2}} = T_{AC}\left(-\frac{3}{13}\vec{i}+\frac{4}{13}\vec{j}-\frac{12}{13}\vec{k}\right)$$

$$\vec{T}_{AB} = T_{AB}\frac{\overrightarrow{AB}}{AB} = 700\frac{(2)\vec{i}+(3)\vec{j}+(-6)\vec{k}}{\sqrt{(2)^2+(3)^2+(6)^2}} = \left(200\vec{i}+300\vec{j}-600\vec{k}\right)$$

$$\vec{F} = F\vec{k}$$

$$\sum F_x = 0 = -\frac{T_{AD}}{3}-\frac{3T_{AC}}{13}+200 = 0$$

$$\sum F_y = 0 = -\frac{2T_{AD}}{3}+\frac{4T_{AC}}{13}+300 = 0$$

$$\sum F_z = 0 = -\frac{2T_{AD}}{3}-\frac{12T_{AC}}{13}-600+F = 0$$

Solving the 3 equations in 3 unknowns,

$$T_{AD} = 510N$$
$$T_{AC} = 130N$$
$$F = 1060N$$

PROB-3.52-

$A(12,0,0)$

$B(18,0,0)$

$C(0,9,8)$

$D(0,-4,6)$

$$\vec{T}_{AD} = T_{AD}\frac{\overrightarrow{AD}}{AD} = T_{AD}\frac{(-12)\vec{i}+(-4)\vec{j}+(6)\vec{k}}{\sqrt{(-12)^2+(-4)^2+(6)^2}} = T_{AD}\left(-\frac{6}{7}\vec{i}-\frac{2}{7}\vec{j}+\frac{3}{7}\vec{k}\right)$$

$$\vec{T}_{AC} = T_{AC}\frac{\overrightarrow{AC}}{AC} = T_{AC}\frac{(-12)\vec{i}+(9)\vec{j}+(8)\vec{k}}{\sqrt{(-12)^2+(9)^2+(8)^2}} = T_{AC}\left(-\frac{12}{17}\vec{i}+\frac{9}{17}\vec{j}+\frac{8}{17}\vec{k}\right)$$

$$\vec{T}_{AB} = T_{AB}\vec{i}$$

$$\vec{W} = -60\vec{k}$$

$$\sum F_x = 0 = -\frac{6T_{AD}}{7} - \frac{12T_{AC}}{17} + T_{AB} = 0$$

$$\sum F_y = 0 = -\frac{2T_{AD}}{7} + \frac{9T_{AC}}{17} = 0$$

$$\sum F_z = 0 = \frac{3T_{AD}}{7} + \frac{8T_{AC}}{17} - 60 = 0$$

Solving the 3 equations in 3 unknowns,

$$T_{AD} = 87.91lb$$
$$T_{AC} = 47.44lb$$
$$F = 108.84lb$$

PROB-3.70-

$$\vec{F} = -9\ \vec{i} - 8\ \vec{j} - 5\vec{k}$$

$$\vec{F}_1 = F_1(\cos 60 \cos 30\vec{i} - \cos 60 \sin 30\vec{j} + \sin 60\vec{k}) = F_1\left(\frac{\sqrt{3}}{4}\vec{i} - \frac{1}{4}\vec{j} + \frac{\sqrt{3}}{2}\vec{k}\right)$$

$$\vec{F}_2 = F_2(\cos 135\vec{i} + \cos 60\vec{j} + \cos 60\vec{k}) = F_2\left(-\frac{\sqrt{2}}{2}\vec{i} + \frac{1}{2}\vec{j} + \frac{1}{2}\vec{k}\right)$$

$$\vec{F}_3 = F_3\left(\frac{4\vec{i} + 4\vec{j} - 2\vec{k}}{\sqrt{4^2 + 4^2 + 2^2}}\right) = F_3\left(\frac{2}{3}\vec{i} + \frac{2}{3}\vec{j} - \frac{1}{3}\vec{k}\right)$$

At equilibrium: $\sum \vec{F} = 0 \Rightarrow \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F} = 0$

$$\sum F_x = 0 = \frac{2F_3}{3} - \frac{\sqrt{2}F_2}{2} + \frac{\sqrt{3}F_1}{4} - 9 = 0 \quad (1)$$

$$\sum F_y = 0 = \frac{2F_3}{3} + \frac{F_2}{2} - \frac{F_1}{4} - 8 = 0 \quad (2)$$

$$\sum F_z = 0 = -\frac{F_3}{3} + \frac{F_2}{2} + \frac{\sqrt{3}F_1}{2} - 5 = 0 \quad (3)$$

Solving three equations in three unknowns: $F_1 = 8.26kN$, $F_2 = 3.84kN$, $F_3 = 12.21kN$

PROB-3.74-

$A(2,0,0)$
$B(-2,0,0)$
$C(0,6,0)$
$D(0,12,8)$
$\vec{W} = -500\vec{k}$

$$\vec{T}_{AC} = T_{AC}\frac{\overrightarrow{AC}}{AC} = T_{AC}\frac{(2)\vec{i} + (-6)\vec{j}}{\sqrt{(2)^2 + (6)^2}} = T_{AC}\left(\frac{1}{\sqrt{10}}\vec{i} - \frac{3}{\sqrt{10}}\vec{j}\right)$$

$$\vec{T}_{CB} = T_{CB}\frac{\overrightarrow{CB}}{CB} = T_{CB}\frac{(-2)\vec{i} + (-6)\vec{j}}{\sqrt{(-2)^2 + (-6)^2}} = T_{CB}\left(-\frac{1}{\sqrt{10}}\vec{i} - \frac{3}{\sqrt{10}}\vec{j}\right)$$

$$\vec{T}_{CD} = T_{CD}\frac{\overrightarrow{CD}}{CD} = T_{CD}\frac{(6)\vec{j} + (8)\vec{k}}{\sqrt{(6)^2 + (8)^2}} = T_{CD}\left(0.6\vec{j} + 0.8\vec{k}\right)$$

$$\sum F_x = 0 = \frac{T_{AC}}{\sqrt{10}} - \frac{T_{CB}}{\sqrt{10}} = 0$$

$$\sum F_y = 0 = -\frac{3T_{AC}}{\sqrt{10}} - \frac{3T_{CB}}{\sqrt{10}} + 0.6T_{CD} = 0$$

$$\sum F_z = 0 = 0.8T_{CD} - 500 = 0$$

Solving three equations in three unknowns, $T_{AC} = T_{CB} = 197.64lb$, $T_{CD} = 625lb$

PROB-4.22-

First method:

$$M_A^{F_1} = F_{1y} \times r_1 = 250\cos 30(2) = 433.01N - mCW$$

$$M_A^{F_2} = F_{2y} \times r_2 = 300\sin 60(5) = 1299.04N - mCW$$

$$M_A^{F_3} = F_3\left(\frac{4}{5}\right)\times 5 - F_3\left(\frac{3}{5}\right)\times 4 = 500\left(\frac{4}{5}\right)\times 5 - 500\left(\frac{3}{5}\right)\times 4 = 800N - mCW$$

Second method:

$$\vec{r}_1 = 2\vec{i}, \& \vec{F}_1 = F_1(\sin 30\vec{i} - \cos 30\vec{j})$$

$$\vec{M}_A^{F_1} = \vec{r}_1 \times \vec{F}_1 = F_1\begin{vmatrix} i & j & k \\ 2 & 0 & 0 \\ \sin 30 & -\cos 30 & 0 \end{vmatrix} = F_1(-2\cos 30\vec{k}) = -433.01\vec{k}(N - m)$$

$$\vec{r}_1 = 5\vec{i}, \& \vec{F}_2 = -F_2(\cos 60\vec{i} + \sin 60\vec{j})$$

$$\vec{M}_A^{F_2} = \vec{r}_2 \times \vec{F}_2 = -F_2\begin{vmatrix} i & j & k \\ 5 & 0 & 0 \\ \cos 60 & \sin 60 & 0 \end{vmatrix} = -F_2(5\sin 60\vec{k}) = -1299.04\vec{k}(N - m)$$

$$\vec{r}_1 = 5\vec{i} - 4\vec{j}, \& \vec{F}_3 = F_3(\frac{3}{5}\vec{i} - \frac{4}{5}\vec{j})$$

$$\vec{M}_A^{F_3} = \vec{r}_3 \times \vec{F}_3 = F_3\begin{vmatrix} i & j & k \\ 5 & -4 & 0 \\ \frac{3}{5} & -\frac{4}{5} & 0 \end{vmatrix} = F_3(5\left(\frac{-4}{5}\right) - (-4)\frac{3}{5})\vec{k} = -800\vec{k}(N - m)$$

PROB-4.40-

$A(0,0,0.4)$
$B(0.2,1.2,0.4)$
$\vec{r}_{AB} = 0.2\vec{i} + 1.2\vec{j}$,
$\vec{F}_B = 600\vec{i} + 300\vec{j} - 600\vec{k})$

$$\vec{M}_A^F = \vec{r}_{AB} \times \vec{F}_B = \begin{vmatrix} i & j & k \\ 0.2 & 1.2 & 0 \\ 600 & 300 & -600 \end{vmatrix} = (-600\times 1.2)\vec{i} - (-600)(0.2)\vec{j} + (0.2\times 300 - 1.2\times 600)\vec{k}$$

$= (-720\vec{i} + 120\vec{j} - 660\vec{k}(N-m)$

PROB-4.40-

F = 30N

a) $\vec{F} = 30(\cos 60\vec{i} + \cos 60\vec{j} + \cos 45\vec{k}) = 15\vec{i} + 15\vec{j} + 15\sqrt{2}\vec{k}$

Taking a point A(100,0,-150) on aa, $\vec{r}_{OA} = 100\vec{i} - 150\vec{k}$ & $\vec{\lambda}_{aa} = \vec{j}$

$$\vec{M}_{aa}^F = \vec{\lambda}_{aa}\cdot(\vec{r}_{OA}\times\vec{F}) = \begin{vmatrix} 0 & 1 & 0 \\ 100 & 0 & -150 \\ 15 & 15 & 15\sqrt{2} \end{vmatrix} = (-150\times 15) + (-15\sqrt{2}\times 100) = -4371.32(N-mm)$$

b)

$$\vec{M}_{aa}^F = \vec{\lambda}_{aa}\cdot(\vec{r}_{OA}\times\vec{F}) = 30\begin{vmatrix} 0 & 1 & 0 \\ 100 & 0 & -150 \\ \cos\alpha & \cos\beta & \cos\gamma \end{vmatrix} = (-150\times 30\cos\alpha) - (-100\times 30\cos\gamma)$$

M_{aa}^F is maximum for $\alpha = \gamma = 45°, \gamma = 90°$

And $M_{aa}^F = -150\times 30\cos 45 - 100\times 30\cos 45 = -5303.3N-mm$

PHY211 Statics/F05 **HW#6 Solution** **NAME: Dr. Camille A. Issa**

PROB-4.70-

$$M_{couple} = F_x(4) - F_y(9) = \frac{4}{5}F(4) - \frac{3}{5}F(9) = -250CW$$

$$F\left(\frac{16}{5} - \frac{27}{5}\right) = -250 \Rightarrow F = 113.64N$$

PROB-4.82-

$$M_1 = 200(1.5) = 300lb - ftCW$$

$$M_2 = -F\left(\frac{3}{5}\right)(4) - F\left(\frac{4}{5}\right)(1.5)CW$$

$$\sum M = M_1 + M_2 = 300 - F\left(\frac{12}{5} + \frac{6}{5}\right) = -300$$

$$F = 600\left(\frac{5}{18}\right) = 166.67lb$$

PROB-4.114-

$$R_y = -300 - 200 - 400 = -900lb$$

$$R_x = -200lb$$

$$R = \sqrt{900^2 + 200^2} = 921.95lb \;\&\; \theta = \tan^{-1}\left(\frac{900}{200}\right) = 77.47°$$

Summing moments about point A:

$$\sum M_A = -600 + (200)(3) + (400)(7) + (200)(2) = 900(d) \Rightarrow d = 3.56ft$$

PROB-4.126-

F = 30N

a) $\vec{F} = 30(\cos 60\vec{i} + \cos 60\vec{j} + \cos 45\vec{k}) = 15\vec{i} + 15\vec{j} + 15\sqrt{2}\vec{k}$

Taking a point A(100,0,-150) on aa, $\vec{r}_{OA} = 100\vec{i} - 150\vec{k}$ & $\vec{\lambda}_{aa} = \vec{j}$

$$\vec{M}^F_{aa} = \vec{\lambda}_{aa} \cdot (\vec{r}_{OA} \times \vec{F}) = \begin{vmatrix} 0 & 1 & 0 \\ 100 & 0 & -150 \\ 15 & 15 & 15\sqrt{2} \end{vmatrix} = (-150 \times 15) + (-15\sqrt{2} \times 100) = -4371.32(N - mm)$$

b) $$\vec{M}^F_{aa} = \vec{\lambda}_{aa} \cdot (\vec{r}_{OA} \times \vec{F}) = 30\begin{vmatrix} 0 & 1 & 0 \\ 100 & 0 & -150 \\ \cos\alpha & \cos\beta & \cos\gamma \end{vmatrix} = (-150 \times 30\cos\alpha) - (-100 \times 30\cos\gamma)$$

M^F_{aa} is maximum for $\alpha = \gamma = 45°, \gamma = 90°$

And $M^F_{aa} = -150 \times 30\cos 45 - 100 \times 30\cos 45 = -5303.3N - mm$

PROB-4.166-

$A(0,500,0)$
$B(300\sqrt{2},0,-300\sqrt{2})$
$C(300\sqrt{2},-400,-300\sqrt{2})$
$\vec{M}_1 = \vec{r}_{OA} \times \vec{F}_A + \vec{r}_{OB} \times \vec{F}_B$

$But\ \vec{F}_B = -\vec{F}_A$

$$\vec{M}_1 = (\vec{r}_{OA} - \vec{r}_{OB}) \times \vec{F}_A = \begin{vmatrix} i & j & k \\ -300\sqrt{2} & 500 & 300\sqrt{2} \\ -400 & 0 & 0 \end{vmatrix}$$

$= (-400 \times 300\sqrt{2})\vec{j} + (400 \times 500)\vec{k}$
$\vec{M}_P = (-169705.6\vec{j} + 200000\vec{k})$

$\vec{M}_2 = \vec{r}_{OO} \times \vec{F}_O + \vec{r}_{OC} \times \vec{F}_C$

$But\ \vec{F}_C = -\vec{F}_O$

$$\vec{M}_1 = (\vec{r}_{OO} - \vec{r}_{OC}) \times \vec{F}_O = \begin{vmatrix} i & j & k \\ -300\sqrt{2} & 400 & 300\sqrt{2} \\ 0 & -150 & 0 \end{vmatrix}$$

$= (150 \times 300\sqrt{2})\vec{i} + (300\sqrt{2} \times 150)\vec{k}$
$\vec{M}_P = (63639.6\vec{i} + 63639.6\vec{k})$

$\vec{M}_{TOT} = 63639.6\vec{i} - 169705.6\vec{j} + 2632639.6\vec{k}(N - mm)$
$\vec{M}_{TOT} = 63.64\vec{i} - 170\vec{j} + 264\vec{k}(N - m)$

PHY211 Statics/F05 **HW#7 Solution** **NAME: Dr. Camille A. Issa**

PROB-5.20-

From the figure, $B_x = 0.5kip \rightarrow$

Summing moments about point A counter-clockwise:

$$\sum M_A = B_y(14) - 0.5(8) - 2(20) + B_x(14) - 10(14) - 7(8) = 0 \Rightarrow B_y = \frac{233}{14} = 16.64kip$$

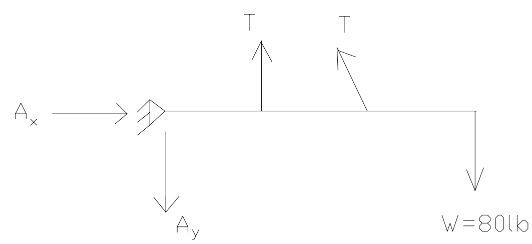
Summing moments about point B clockwise:

$$\sum M_B = R_A(14) - 5(14) + 2(6) - 0.5(6) - 7(6) = 0 \Rightarrow R_A = \frac{103}{14} = 7.36kip$$

Check: $\sum F \uparrow = \frac{103}{14} - 5 - 7 - 10 - 2 + \frac{233}{14} = 0$

PROB-5.28-

Summing moments about point A counter-clockwise:



$$\sum M_A = 5T + T\left(\frac{2}{\sqrt{5}}\right)(10) - W(13) = 0 \Rightarrow T = 74.58lb$$

$$\sum F \rightarrow = A_x - T\left(\frac{1}{\sqrt{5}}\right) = 0 \Rightarrow A_x = 33.35lb$$

$$\sum F \uparrow = -A_y + T + T\left(\frac{2}{\sqrt{5}}\right) - W = 0 \Rightarrow A_y = 61.29lb$$

PROB-5.70-

$$\vec{F} = -1500\vec{k}$$

$$\sum \vec{M}_A = \vec{r}_F \times \vec{F} + \vec{r}_B \times \vec{T} = (5\vec{j}) \times (-1500\vec{k}) + (10\vec{j})\left[\left(-\frac{2}{\sqrt{5}}T\right)\vec{j} + \left(\frac{1}{\sqrt{5}}T\right)\vec{k}\right] = \vec{0}$$

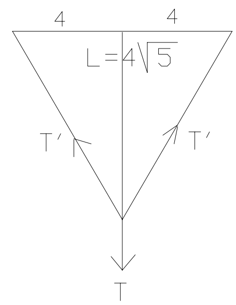
$$-1500(5)\vec{i} + \left(\frac{10}{\sqrt{5}}T\right)\vec{i} = \vec{0} \Rightarrow T = 750\sqrt{5}lb$$

$$\sum F_x = 0 = A_x$$

$$\sum F_y = 0 = A_y - T\left(\frac{2}{\sqrt{5}}\right) \Rightarrow A_y = 1500lb$$

$$\sum F_z = 0 = -1500 + \frac{1}{\sqrt{5}}T + A_z \Rightarrow A_z = 750lb$$

$$T = 2T'\frac{4\sqrt{5}}{\sqrt{4^2 + (4\sqrt{5})^2}} \Rightarrow T' = 918.6lb$$



PROB-5.64-

$$T = 8kN$$
$$\vec{T} = 8\vec{i}$$
$$\vec{L} = 45\vec{k}$$
$$\vec{W} = -(2.1)(9.81)\vec{k}$$

$$\sum F_x = 0 = T + R_x \Rightarrow R_x = -8kN$$
$$\sum F_y = 0 = R_y$$
$$\sum F_z = 0 = 45 - (2.1)(9.81) + R_z \Rightarrow R_z = -24.399kN$$

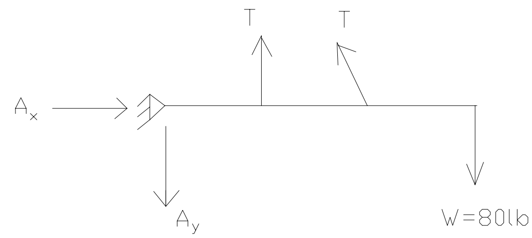
$$\sum \vec{M} = \vec{M}_R + \vec{r}_L \times \vec{L} + \vec{r}_T \times \vec{T} + \vec{r}_G \times \vec{W} = \vec{M}_R + (15\vec{j}) \times (45\vec{k}) + (8\vec{j} - 2.5\vec{k}) \times 8\vec{i} + (5\vec{j}) \times (-2.1(9.81)\vec{k}) = \vec{0}$$
$$\vec{M}_R + 15(45)\vec{i} + \left(-8(8)\vec{k} - 2.5(8)\vec{j}\right) - 5(2.1)(9.81)\vec{i} = \vec{0} \Rightarrow \vec{M}_R = -571.995\vec{i} + 20\vec{j} + 64\vec{k}$$

PHY211 Statics/F05 **HW#8 Solution** **NAME: <u>Dr. Camille A. Issa</u>**

<u>PROB-5.28-</u>

Summing moments about point A counter-clockwise:

$$\sum M_A = 5T + T\left(\frac{2}{\sqrt{5}}\right)(10) - W(13) = 0 \Rightarrow T = 74.58lb$$



$$\sum F \rightarrow = A_x - T\left(\frac{1}{\sqrt{5}}\right) = 0 \Rightarrow A_x = 33.35lb$$

$$\sum F \uparrow = -A_y + T + T\left(\frac{2}{\sqrt{5}}\right) - W = 0 \Rightarrow A_y = 61.29lb$$

<u>PROB-5.64-</u>

$$T = 8kN$$
$$\vec{T} = 8\vec{i}$$
$$\vec{L} = 45\vec{k}$$
$$\vec{W} = -(2.1)(9.81)\vec{k}$$

$$\sum F_x = 0 = T + R_x \Rightarrow R_x = -8kN$$
$$\sum F_y = 0 = R_y$$
$$\sum F_z = 0 = 45 - (2.1)(9.81) + R_z \Rightarrow R_z = -24.399kN$$

$$\sum \vec{M} = \vec{M}_R + \vec{r}_L \times \vec{L} + \vec{r}_T \times \vec{T} + \vec{r}_G \times \vec{W} = \vec{M}_R + (15\vec{j}) \times (45\vec{k}) + (8\vec{j} - 2.5\vec{k}) \times 8\vec{i} + (5\vec{j}) \times (-2.1(9.81)\vec{k}) = \vec{0}$$
$$\vec{M}_R + 15(45)\vec{i} + \left(-8(8)\vec{k} - 2.5(8)\vec{j}\right) - 5(2.1)(9.81)\vec{i} = \vec{0} \Rightarrow \vec{M}_R = -571.995\vec{i} + 20\vec{j} + 64\vec{k}$$

PROB-5.84-

$C(0,12,0)$
$A(0,0,0)$
$D(-3,04)$
$E(3,0,6)$
$B(0,4,0)$

$$\vec{T}_{CD} = T_{CD}\frac{-3\vec{i} - 12\vec{j} + 4\vec{k}}{\sqrt{3^2 + 12^2 + 4^2}} = T_{CD}\left(\frac{-3}{13}\vec{i} - \frac{12}{13}\vec{j} + \frac{4}{13}\vec{k}\right)$$

$T_{CD} = T_{BD}$

$$\vec{T}_{BD} = T_{BD}\frac{-3\vec{i} - 4\vec{j} + 4\vec{k}}{\sqrt{3^2 + 4^2 + 4^2}} = \frac{T_{CD}}{\sqrt{41}}\left(-3\vec{i} - 4\vec{j} + 4\vec{k}\right)$$

$$\vec{T}_{CE} = T_{CE}\frac{3\vec{i} - 12\vec{j} + 6\vec{k}}{\sqrt{3^2 + 12^2 + 6^2}} = \frac{T_{CE}}{\sqrt{189}}\left(3\vec{i} - 12\vec{j} + 6\vec{k}\right)$$

$$\sum \vec{M}_A = \vec{0} = \vec{r}_{AC} \times \vec{T}_{CE} + \vec{r}_{AB} \times \vec{T}_{BD} + \vec{r}_{AC} \times \vec{T}_{CD} + \vec{r}_{AC} \times \vec{W}$$

$$\vec{0} = \frac{T_{CE}}{\sqrt{189}}\begin{vmatrix} i & j & k \\ 0 & 12 & 0 \\ 3 & -12 & 6 \end{vmatrix} + \frac{T_{CD}}{\sqrt{41}}\begin{vmatrix} i & j & k \\ 0 & 4 & 0 \\ -3 & -4 & 4 \end{vmatrix} + \frac{T_{CD}}{13}\begin{vmatrix} i & j & k \\ 0 & 12 & 0 \\ -3 & -12 & 4 \end{vmatrix} + \begin{vmatrix} i & j & k \\ 0 & 12 & 0 \\ 0 & 0 & -80 \end{vmatrix}$$

$$\Rightarrow \begin{cases} \dfrac{72}{\sqrt{189}}T_{CE} + T_{CD}\left(\dfrac{16}{\sqrt{41}} + \dfrac{48}{13}\right) = 960 \\ \dfrac{-36}{\sqrt{189}}T_{CE} + T_{CD}\left(\dfrac{12}{\sqrt{41}} + \dfrac{36}{13}\right) = 0 \end{cases} \Rightarrow \begin{cases} T_{CE} = 109.98 lb \\ T_{CD} = 62.02 lb \end{cases}$$

$$\sum F_X = 0 = R_x - \frac{3}{13}T_{CD} - \frac{3}{\sqrt{41}}T_{CD} + \frac{3}{\sqrt{189}}T_{CE} \Rightarrow R_x = 19.37 lb$$

$$\sum F_Y = 0 = R_y - \frac{12}{13}T_{CD} - \frac{4}{\sqrt{41}}T_{CD} - \frac{12}{\sqrt{189}}T_{CE} \Rightarrow R_y = 191.99 lb$$

$$\sum F_Z = 0 = R_z + \frac{4}{13}T_{CD} + \frac{4}{\sqrt{41}}T_{CD} + \frac{6}{\sqrt{189}}T_{CE} - 80 \Rightarrow R_z = -25.83 lb$$

PROB-5.92-

$$(CCW)\sum M_A 6F + 4F + 2F - R_B \cos 45(2) \Rightarrow R_B = 5091.17N$$
$$A_x = R_{Bx} = R_B \cos 45 = 3600N$$
$$(CCW)\sum M_0 = 6A_y + R_B \cos 45(6) - 2F - 4F - 2A_x \Rightarrow A_y = 1800N$$

Check :

$$\sum F \uparrow = -A_y - 600 - 600 - 600 + R_B \cos 45 = -1800 - 600 - 600 - 600 + 3600 = 0$$

PROB-5.96-

$C(2,3,4)$

$A(0,0,0)$

$D(2,9,4)$

$B(2,6,0)$

$$\vec{T}_{BC} = T_{BC}\frac{-3\vec{j} + 4\vec{k}}{\sqrt{3^2 + 4^2}} = T_{BD}\left(-\frac{3}{5}\vec{j} + \frac{4}{5}\vec{k}\right)$$

$$\vec{T}_{BD} = T_{BD}\frac{3\vec{j} + 4\vec{k}}{\sqrt{3^2 + 4^2}} = T_{BD}\left(\frac{3}{5}\vec{j} + \frac{4}{5}\vec{k}\right)$$

$$\sum \vec{M}_A = \vec{0} = \vec{r}_B \times (\vec{T}_{BC} + \vec{T}_{BD} + \vec{F}_1) + \vec{r}_2 \times \vec{F}_2 + M_x\vec{i} + M_z\vec{k}$$

$$\vec{0} = \frac{6}{5}(T_{BD} - T_{BC})\vec{k} - (\frac{8}{5}T_{BC} + \frac{8}{5}T_{BD} - 1600)\vec{j} + (\frac{24}{5}T_{BC} + \frac{24}{5}T_{BD} - 4800) + M_x\vec{i} + M_z\vec{k}$$

$$\Rightarrow \begin{cases} \frac{6}{5}T_{BD} - \frac{6}{5}T_{BC} + M_z = 0(1) \\ \frac{24}{5}T_{BD} + \frac{24}{5}T_{BC} + M_x - 4800 = 0(2) \\ \frac{8}{5}T_{BD} + \frac{8}{5}T_{BC} - 1600 = 0(3) \end{cases}$$

$$\sum F_X = 0 = A_x (4)$$

$$\sum F_Y = 0 = 350 - \frac{3}{5}T_{BC} + \frac{3}{5}T_{BD} (5)$$

$$\sum F_Z = 0 = A_z - 800 + \frac{4}{5}T_{BC} + \frac{4}{5}T_{BD} (6)$$

Solving six equations in six unknowns:

$T_{BD} = 208.33N$

$T_{BC} = 791.66N$

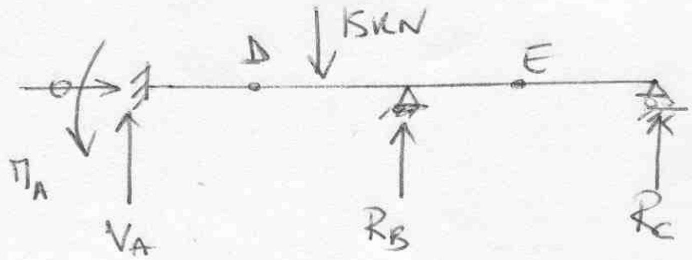
$A_x = 0$

$A_z = 0$

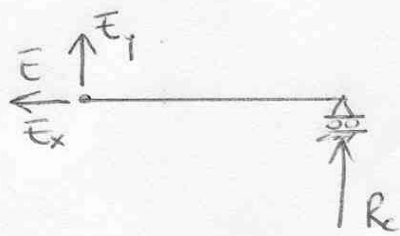
$M_x = 0$

$M_z = 700N - m$

6.72)



↳ Member EC:

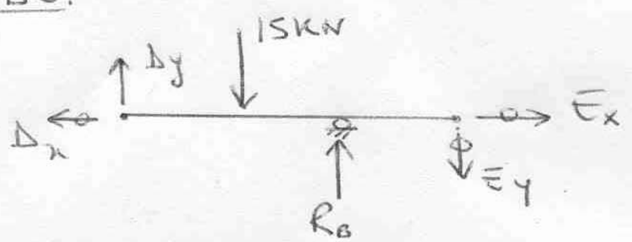


$\Sigma M_E \circlearrowleft = 0 = 6R_c$

$\Rightarrow$ $\boxed{R_c = 0}$

& $E_y = 0$
$E_x = 0$

↳ Member DE:



$\Sigma M_D \circlearrowleft = 4R_B - 2(15) = 0$

$\boxed{R_B = 7.5\text{ kN}}$

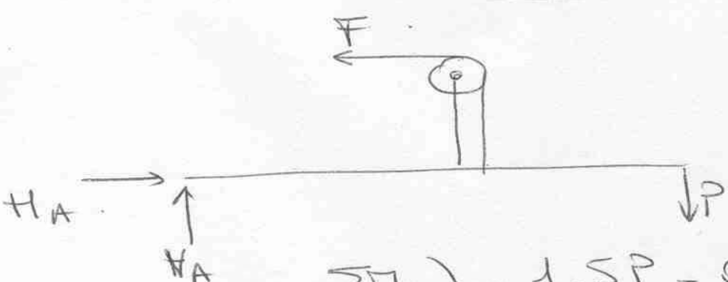
↳ Taking whole structure

$\Sigma M_A \circlearrowleft = M_A + R_B(10) - 15(8) = 0$

$\boxed{M_A = 15(8) - (10)(7.5) = 45\text{ kN-m CCW}}$

& $\boxed{V_A = 15 - 7.5 = 7.5\text{ kN}}$

6.74)



$H_A = F$. (Summation in the horizontal direction)

$P = V_A$ (vertical direction)

$\Sigma M_A \circlearrowright = 1.5P - 0.6F = 0.$

$\Rightarrow 1.5P = 0.6F$

$1.5V_A = 0.6H_A$

$\Rightarrow H_A = \frac{1.5}{0.6}V_A = \frac{5}{2}V_A$

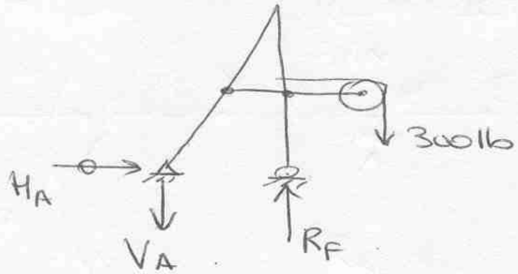
But $F_A = \sqrt{H_A^2 + V_A^2}$

$F_A = V_A\sqrt{1 + \left(\frac{5}{2}\right)^2} = \frac{\sqrt{29}}{2}V_A$

then $V_A = \frac{2F_A}{\sqrt{29}} = \frac{2(2)}{\sqrt{29}} = 0.743\text{ kN}$

$\Rightarrow \boxed{P = V_A = 743\text{ N}}$

6.78



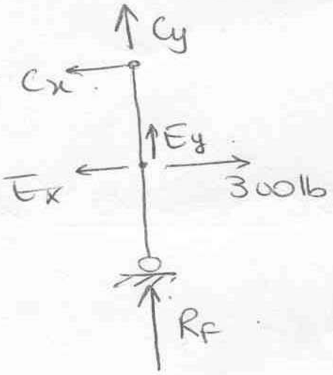
↳ whole structure: $\sum M_A = 0 = 6R_F - 300 \times 10$

$\Rightarrow$ $\boxed{R_F = 500\,lb}$

Then $\sum F\uparrow = 0 = R_F - 300 - V_A$

$\Rightarrow$ $\boxed{V_A = 200\,lb}$

↳



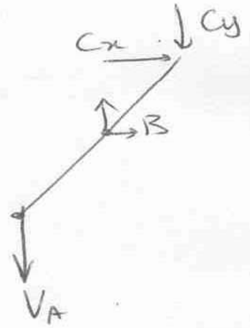
$\sum M_C = -4E_x + 300 \times 3$

Then $\boxed{E_x = 225\,lb}$

Then $\sum F\rightarrow = 0 = 300 - C_x - E_x$

$\boxed{C_x = 75\,lb}$

↳

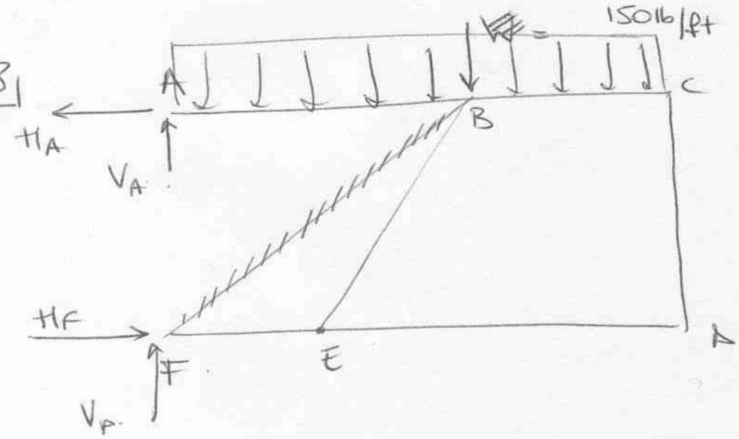


$\sum M_B = 3C_y + 4C_x - V_A(3)$

$\Rightarrow$ $C_y = \frac{200(3) - 4(75)}{3}$

$\boxed{C_y = 100\,lb}$

6.128



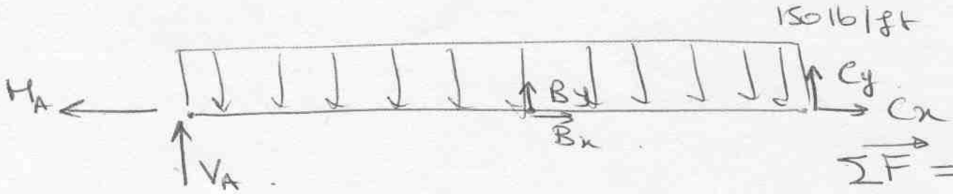
↳ Whole structure: $\sum M_F = 0 = -4H_A + 150 \times 7\left(\frac{7}{2}\right)$

$\boxed{H_A = 918.75\,lb}$

$\Rightarrow$ $H_F = H_A = 918.75\,lb$

& $V_A + V_F = 150 \times 7 = 1050\,lb$

↳ Member AC:

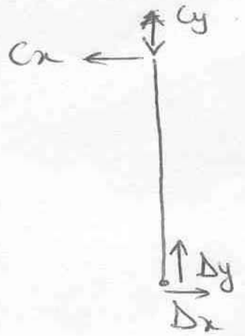


$$\overrightarrow{\Sigma F} \Rightarrow \boxed{C_x + B_x = H_A}$$

$$\Sigma M_A \curvearrowleft = 0 = 5B_y + 7C_y - (150 \times 7)\left(\frac{7}{2}\right)$$

$$\Rightarrow \boxed{5B_y + 7C_y = 3675} \quad (1)$$

↳ Member CD:

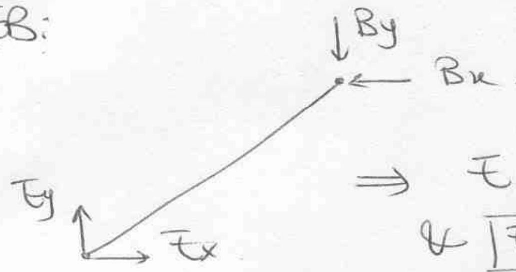


$$\Sigma M_C \curvearrowleft = 4D_x = 0 \Rightarrow D_x = 0$$

$$\Rightarrow \boxed{D_x = C_x = 0}$$

$$\& \quad \boxed{C_y = D_y} \quad (2)$$

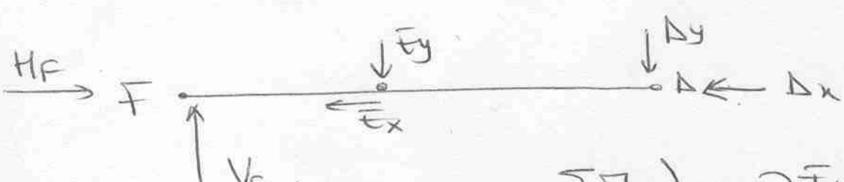
↳ Member EB:



$$\Rightarrow E_x = B_x$$

$$\& \quad \boxed{E_y = B_y} \quad (3)$$

↳ Member FD:



$$\Sigma M_F \curvearrowleft = 2E_y + 7D_y = 0$$

$$\Rightarrow \boxed{2E_y + 7D_y = 0} \quad (4)$$

But $E_y = B_y$ & $D_y = C_y$

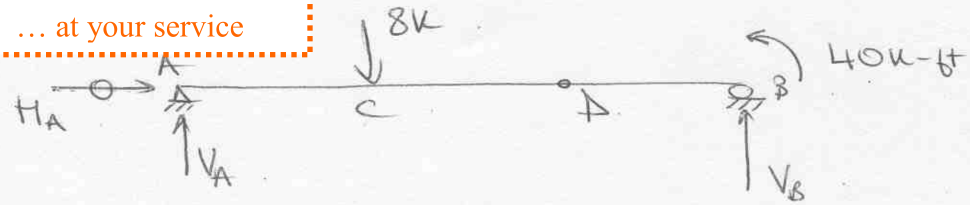
$$\Rightarrow \quad (4) \Rightarrow 2B_y + 7C_y = 0 \qquad (1) \Rightarrow 5B_y + 7C_y = 3675 \quad \Bigg\} \Rightarrow B_y = 1225\text{lb} \Rightarrow C_y = -350\text{lb}$$

$$\Rightarrow \left.\begin{array}{l} C_y = -350\text{lb} \\ C_x = 0\text{lb} \end{array}\right\} \boxed{R_C = 350\text{lb}}$$

$$\& \quad C_x = 0 \Rightarrow C_x + B_x = H_A \Rightarrow \left.\begin{array}{l} B_x = H_A = 918.75\text{lb} \\ B_y = 1225\text{lb} \end{array}\right\} \boxed{R_B = 1531.25\text{lb}}$$

Statics PHY211 Correction of HW Dr Issa

7.61



↳ Whole structure:

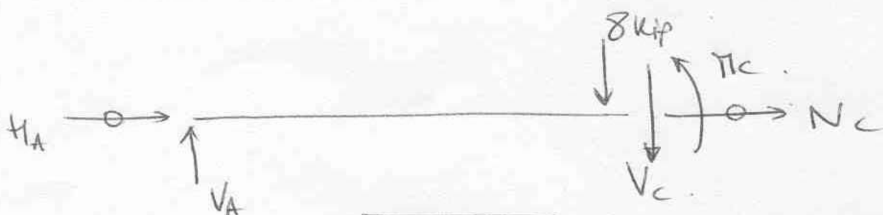
$$\Sigma M_A \circlearrowleft = 0 = 24 V_B + 40 - 8(8) = 0$$

$$\Rightarrow \boxed{V_B = 1.00K}$$

$$\Sigma F \uparrow = 0 = V_B - 8 + V_A$$

$$\Rightarrow \boxed{V_A = 7.00 kip}$$

↳ Cut at C:



$$\boxed{N_C = 0}$$

$$\Sigma F \uparrow = -V_C - 8 kip + 7 kip = 0 \Rightarrow \boxed{V_C = -1.00K}$$

$$\Sigma M_A \circlearrowleft = M_C - 8(8) - 8 V_C \Rightarrow \boxed{M_C = 56K\text{-}ft}$$

↳ Cut at point D:

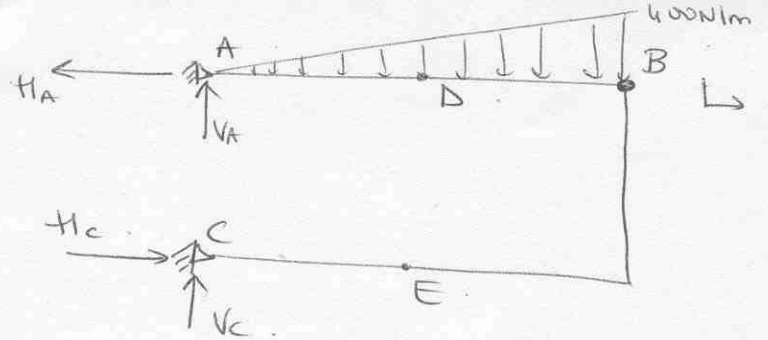
$$\boxed{N_D = 0}$$

$$\& \quad \boxed{V_D = -V_B = -1.00K}$$

$$\Sigma M_B \circlearrowright = M_D + 8 V_D - 40$$

$$\Rightarrow \boxed{M_D = 48K\text{-}ft}$$

7.141



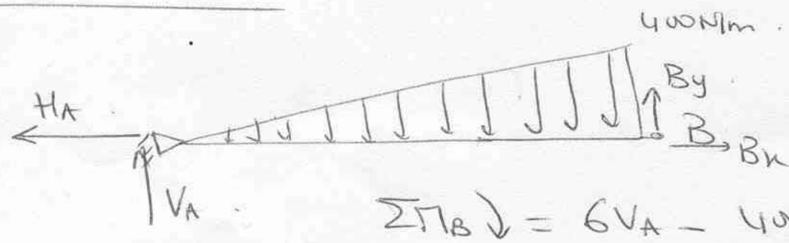
↳ Whole structure:

$\Sigma M_A \circlearrowleft = 2.5H_C - (400)(\frac{6}{2})(\frac{2}{3}6)$

$\Rightarrow \boxed{H_C = 1920N}$

& $H_C = \boxed{H_A = 1920N}$

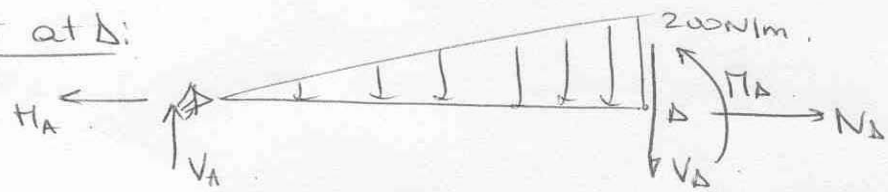
↳ Member AB:



$\Sigma M_B \circlearrowright = 6V_A - 400(\frac{6}{2})(\frac{1}{3}6)$

$\Rightarrow \boxed{V_A = 400N}$

↳ Cut at D:



$\Rightarrow \overrightarrow{\Sigma F} = 0 \Rightarrow \boxed{N_D = 1920N}$

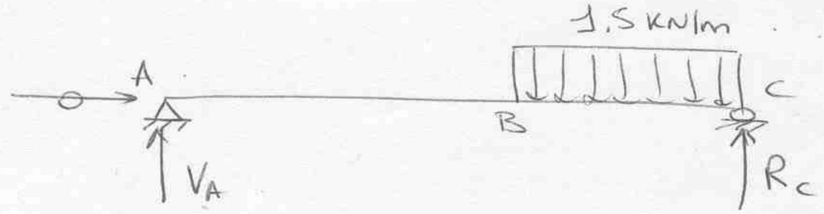
$\Rightarrow \Sigma F\uparrow = 0 = 400 - V_D - 200\times\frac{3}{2} \Rightarrow$

$\Rightarrow \boxed{V_D = 100N}$

$\Rightarrow \Sigma M_D \circlearrowleft = M_D - 400\times 3 + 200\times(\frac{3}{2})(\frac{1}{3}3)$

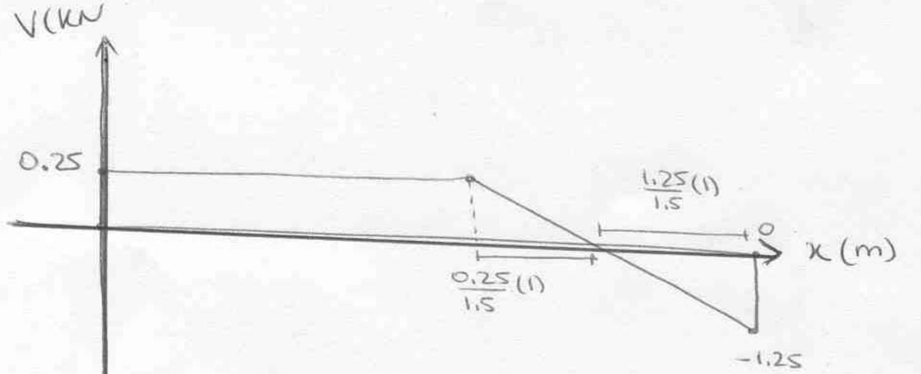
$\Rightarrow \boxed{M_D = 900\ N\text{-}m}$

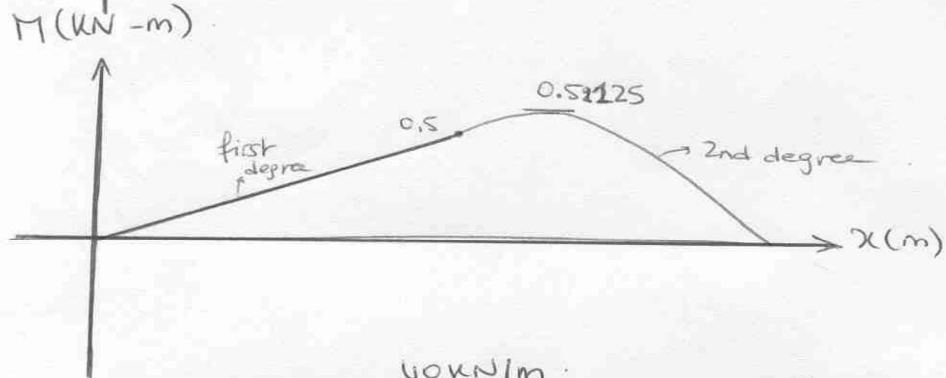
7.48



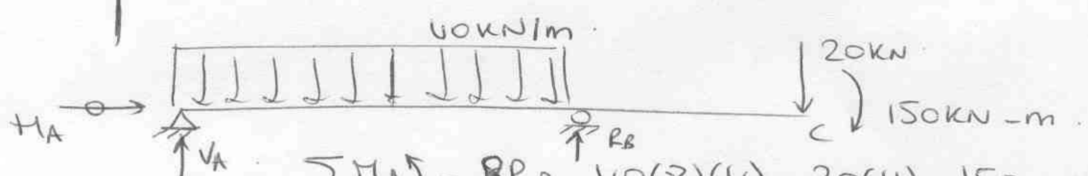
$$\sum M_A \circlearrowleft = 3R_C - 1.5(1)(2.5) \Rightarrow R_C = 1.25\,\text{kN}$$

$$\sum M_C \circlearrowright = 3V_A - 1.5(1)(0.5) \Rightarrow V_A = 0.25\,\text{kN}$$





7.52

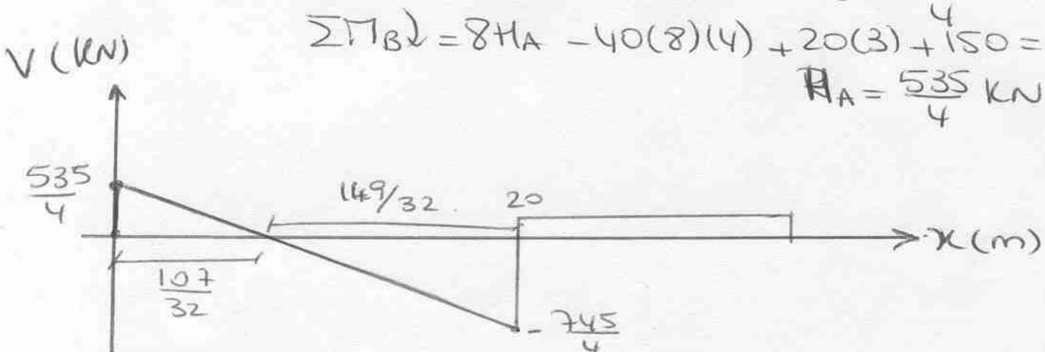


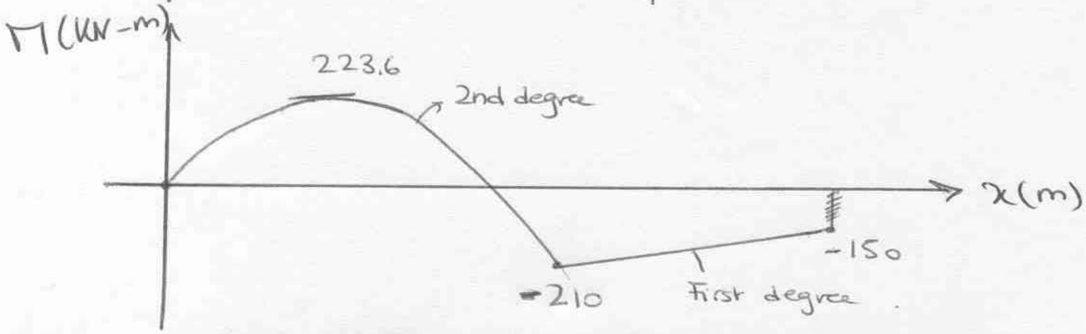
$$\sum M_A \circlearrowleft = 8R_B - 40(8)(4) - 20(11) - 150 = 0$$

$$\Rightarrow R_B = \frac{825}{4}\,\text{kN}$$

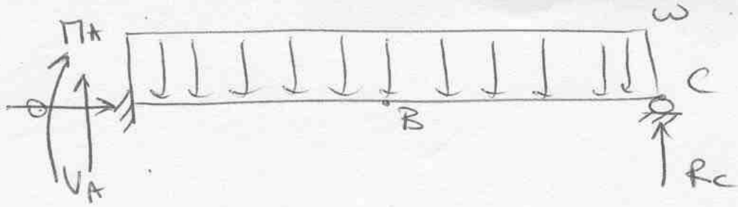
$$\sum M_B \circlearrowright = 8H_A - 40(8)(4) + 20(3) + 150 = 0$$

$$H_A = \frac{535}{4}\,\text{kN}$$

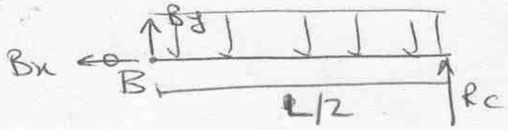




7.54



↳ Cut at B



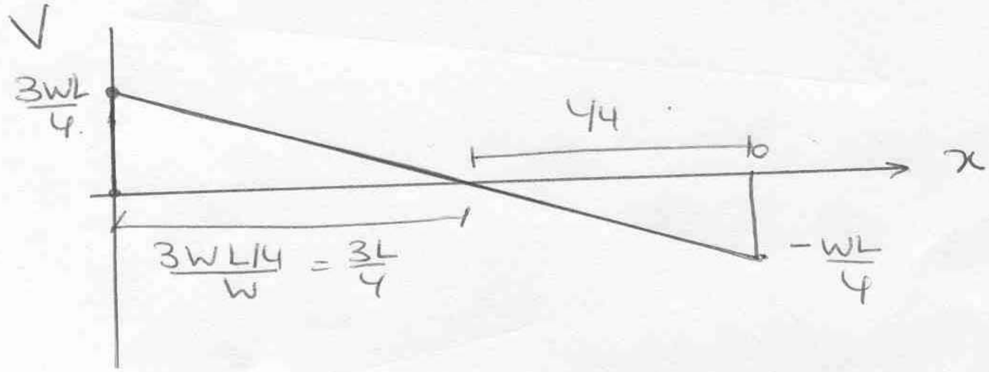
$$\Sigma M_B \circlearrowleft = 0 = R_C\left(\frac{L}{2}\right) - \omega\left(\frac{L}{2}\right)\left(\frac{L}{4}\right)$$

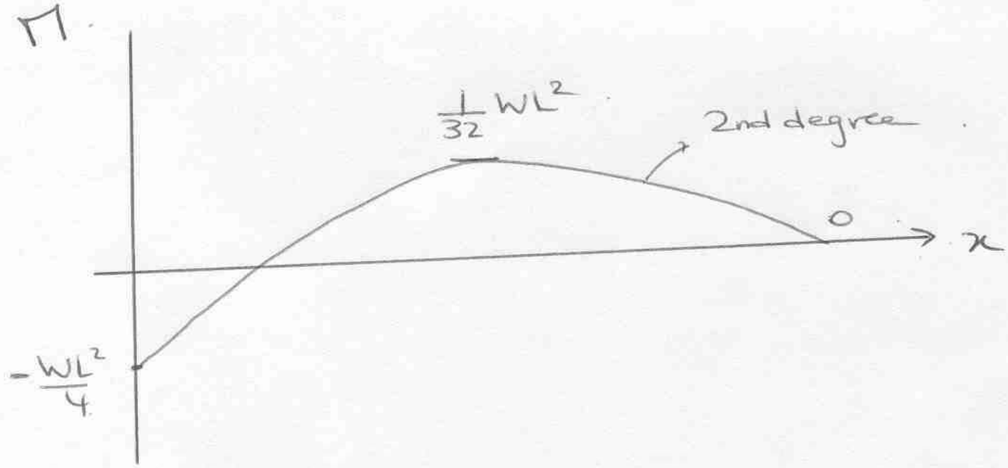
$$\Rightarrow \boxed{R_C = \frac{WL}{4}}$$

↳ Whole structure:

$$\Sigma F \uparrow = 0 = V_A + R_C - WL \Rightarrow \boxed{V_A = \frac{3WL}{4}}$$

$$\Sigma M_A \circlearrowleft = M_A + R_C(L) - WL\left(\frac{L}{2}\right) = 0 \Rightarrow \boxed{M_A = -\frac{WL^2}{4}}$$

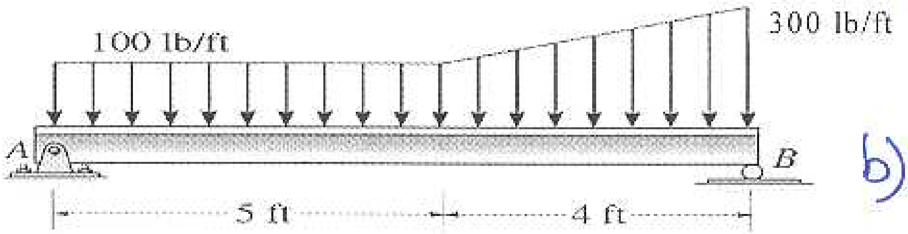




PHY211 Statics/F02 Test #2 NAME________________

PROB-1-(30)

a) Replace the loading by an equivalent resultant force and specify its location on the beam, measured from point A. b) Determine the reactions at the supports.



a) $R = 1{,}300$ lb

$d_A = 5.47$ FT

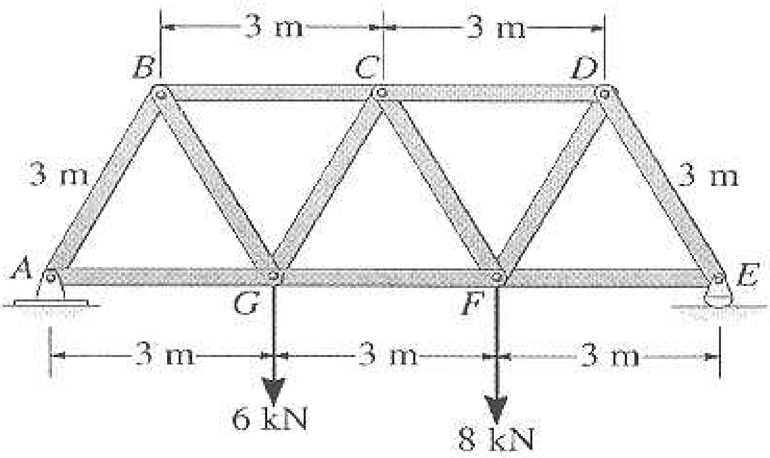
b) $V_A = 509.26$ lb.

$R_B = 790.74$ lb

$H_A = 0$

PROB-2-(35)

Determine the force in members CD, CF, and FG of the Warren truss. Indicate if the members are in tension or compression.



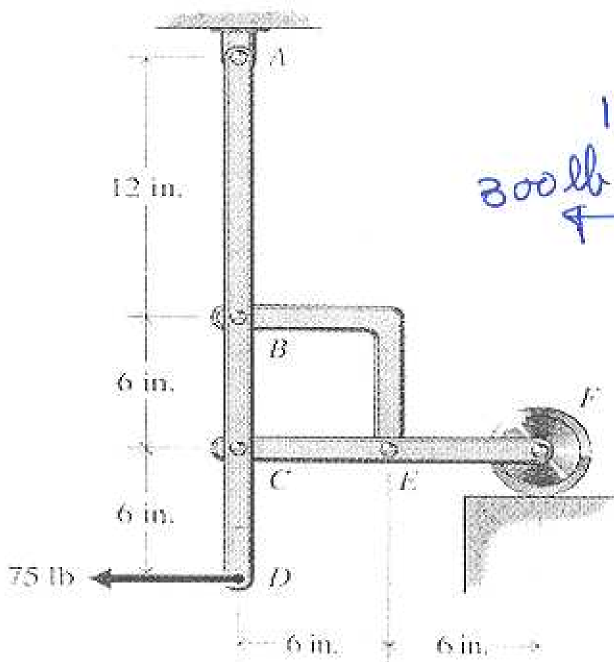
$F_{DC} = -8.48$ KN

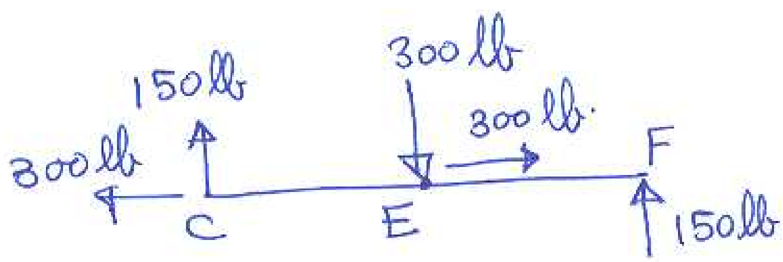
$F_{GF} = 8.08$ KN

$F_{CF} = 0.77$ KN

PROB-3-(35)

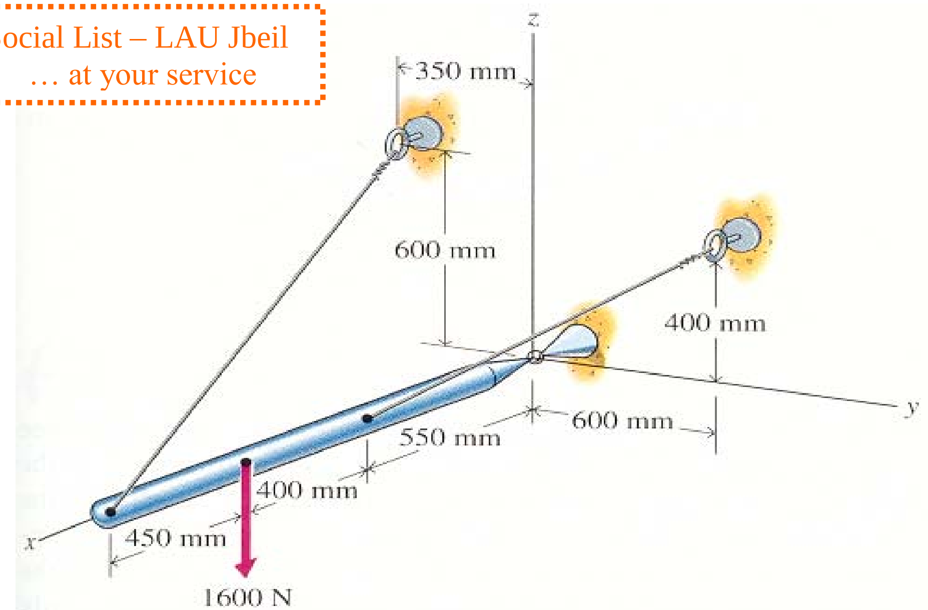
Determine the forces acting on member CEF of the frame shown below.





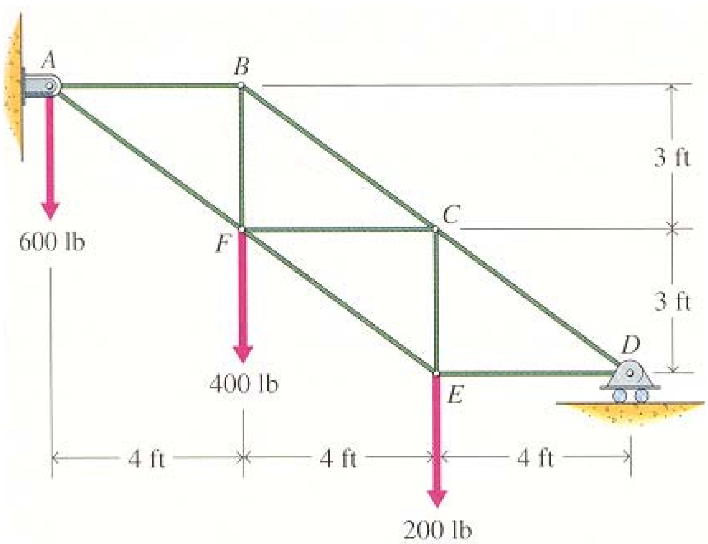
PHY211 Statics/F03 **Test #2** **NAME______________________**

PROB-1-(35)



A bar is supported by a ball-and-socket joint and two cables as shown Determine the reaction at support *A* (the ball-and-socket joint) and the tensions in the two cables.

PROB-2-(30)



Find the forces in members BC, CE, and FE of the stairs truss shown.

PROB-3-(35)

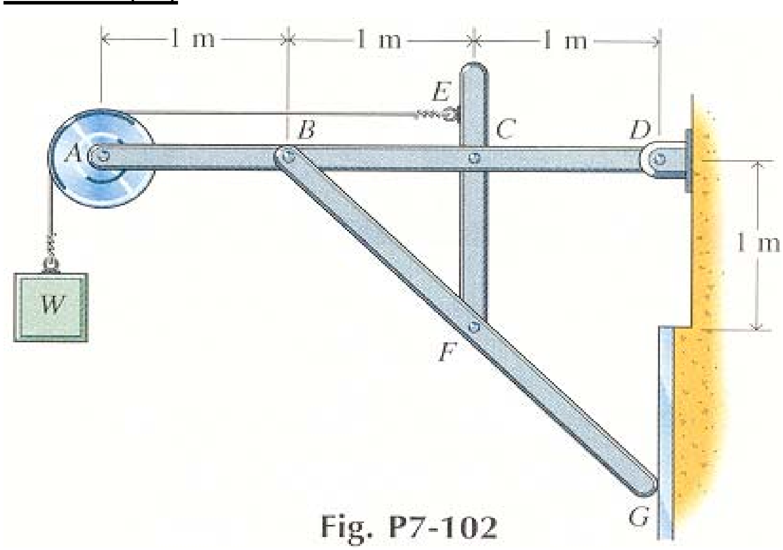
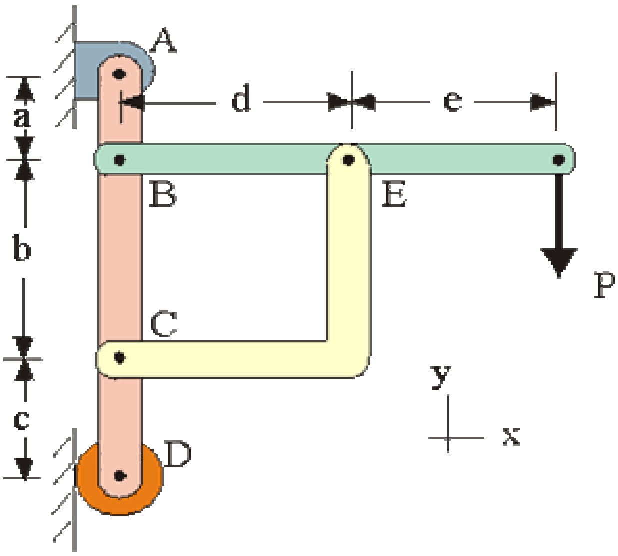


Fig. P7-102

A cable is attached to the structure at E, passes around the 0.8 m diameter, frictionless pulley at *A,* and then is attached to a 1000 N weight W. Determine all forces acting on member *ABCD.*

PHY211 Statics/F04 **Test #2** **NAME______________________**

PROB-1-(35)

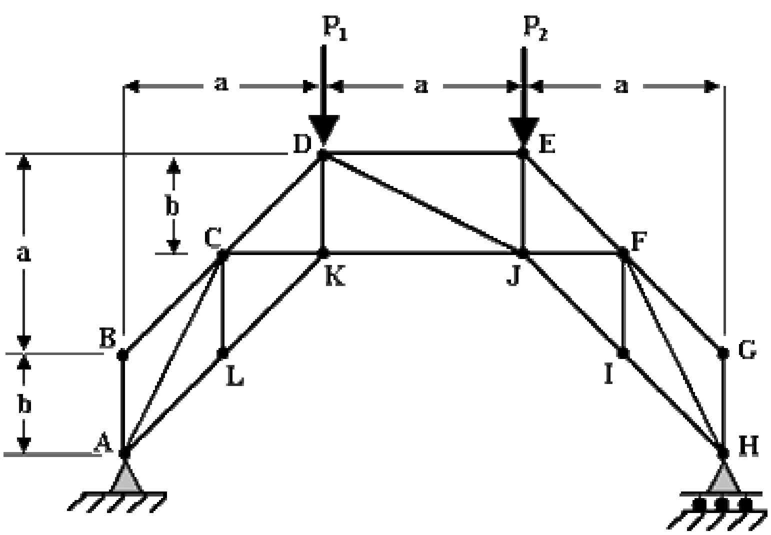


Determine the horizontal and vertical components of pin forces at A, B, C and D on member ABCD.

Given:

a = 3 m
b = 3 m
c = 2 m
d = 4 m
e = 2 m
P = 1000 N

PROB-2-(30)

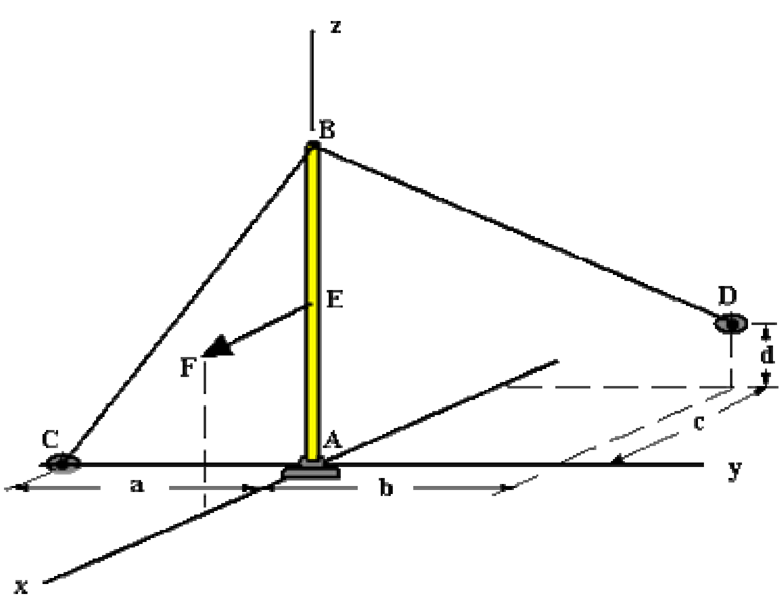


Solve for the forces acting in members DE, DJ, and KJ of the truss and indicate whether they are in tension, (T) or compression, (C).

Given:

a = 5 ft
b = 2 ft
P_1 = 900 lb
P_2 = 1800 lb

PROB-3-(35)



The boom AB of length L is supported by a ball-&-socket at A and two cables BC and BD. Calculate the cable tensions and the reaction at A due to the force F applied at the midpoint E of the boom.

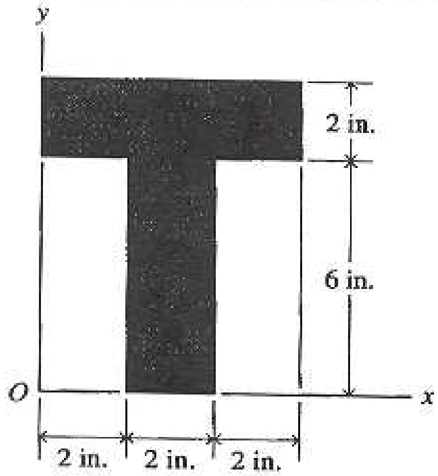
Given:

a = 8 m
b = 6 m
c = 7 m
d = 4 m
L = 10 m
F = 20 KN

PHY211 Statics/F02 TEST#3 NAME_______________

PROB-1-(35)

For the composite cross-section, determine the location of the centroidal axes and the moment of inertia about the x and y centroidal axes.



$\bar{X} = 3''$

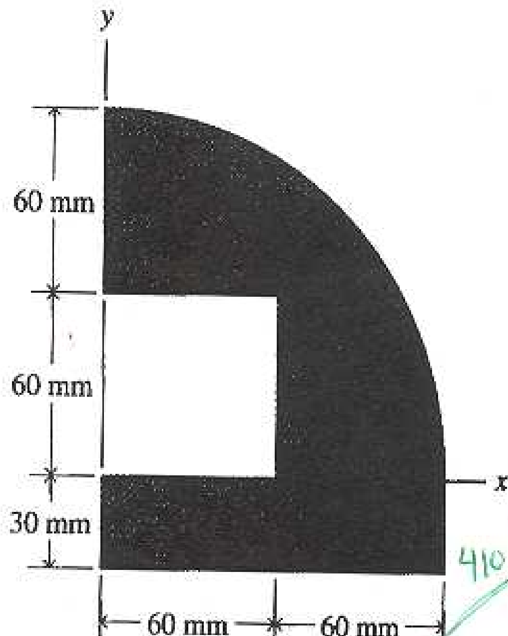
$\bar{Y} = 5''$

$I_{x_c} = 136\ in^4$

$I_{y_c} = 40\ in^4$

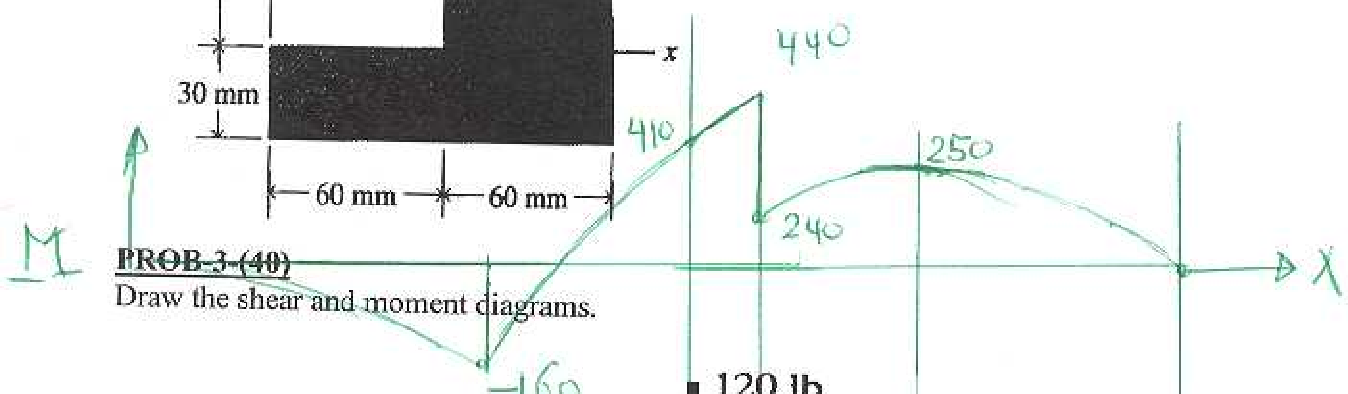
PROB-2-(25)

Determine the location of the x and y centroidal axes.



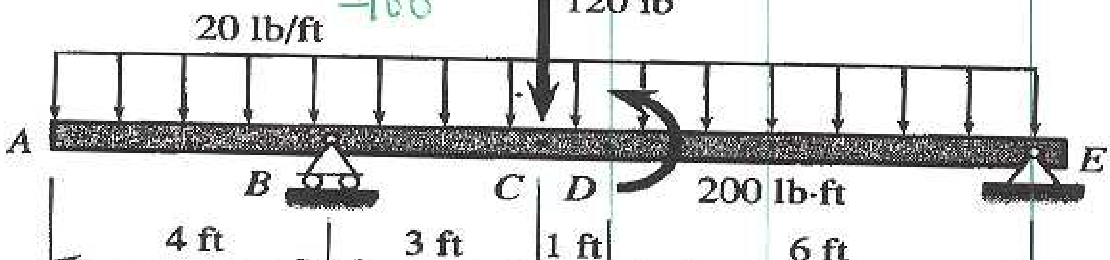
$\bar{y} = 36.61\ mm$

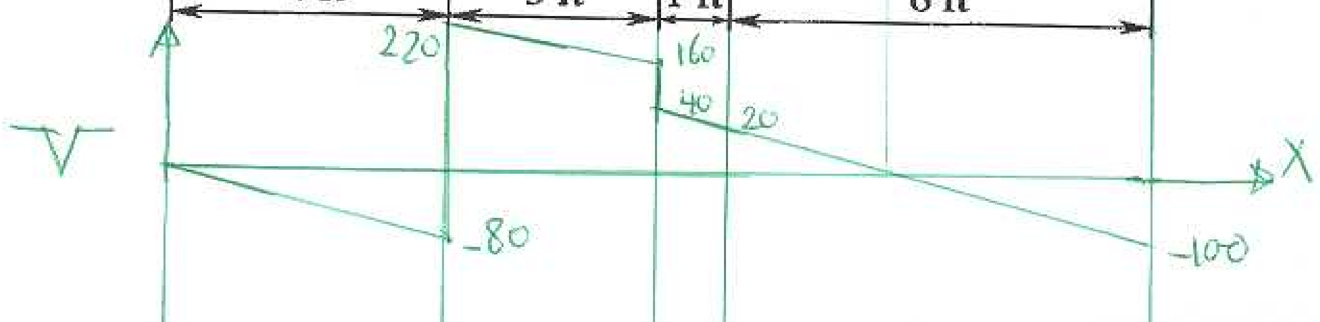
$\bar{X} = 60.47\ mm$



PROB-3-(40)

Draw the shear and moment diagrams.

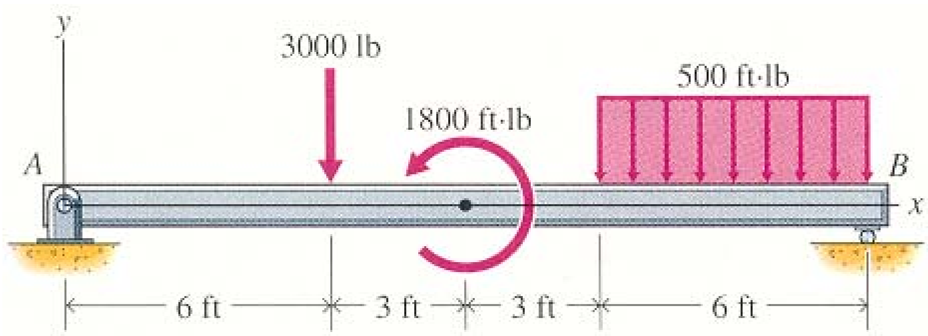




PHY211 Statics/F04 **Test #3** **NAME**______________________

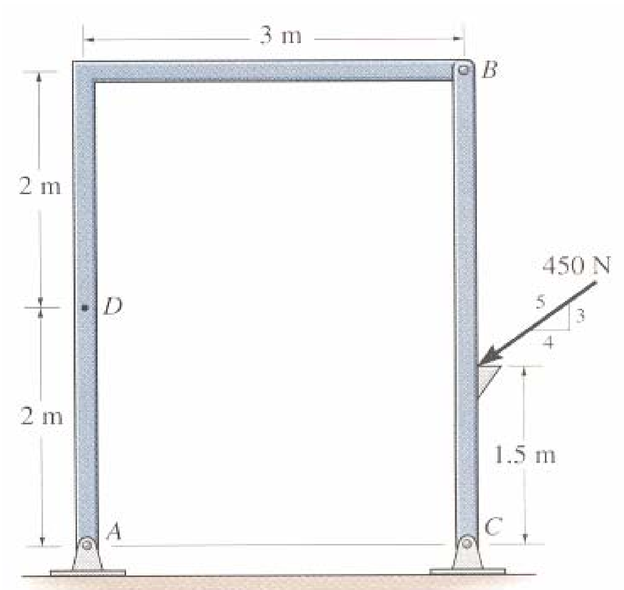
PROB-1-(35)

Draw the moment and shear diagrams for the beam shown below.



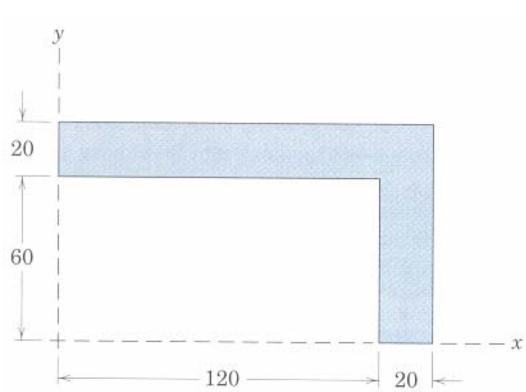
PROB-2-(35)

Find the internal forces at point D of the frame shown below.



PROB-3-(30)

Determine the x and y location of the centroid and the moment of inertia about the x and y centroidal axis.

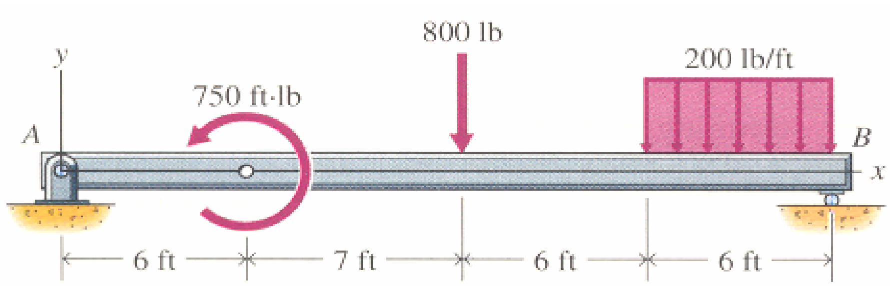


Dimensions in millimeters

PHY211 Statics/F05 **Test #3** **NAME**______________________

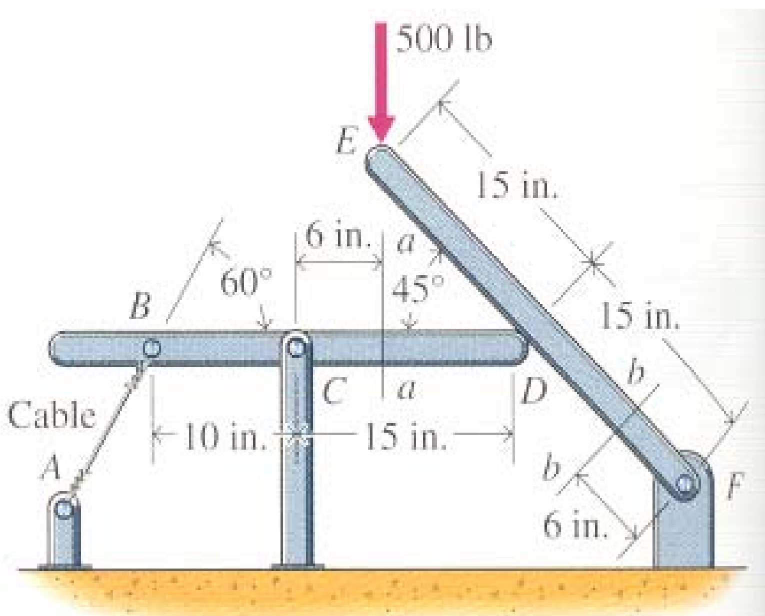
PROB-1-(35)

Draw the moment and shear diagrams for the beam shown below.



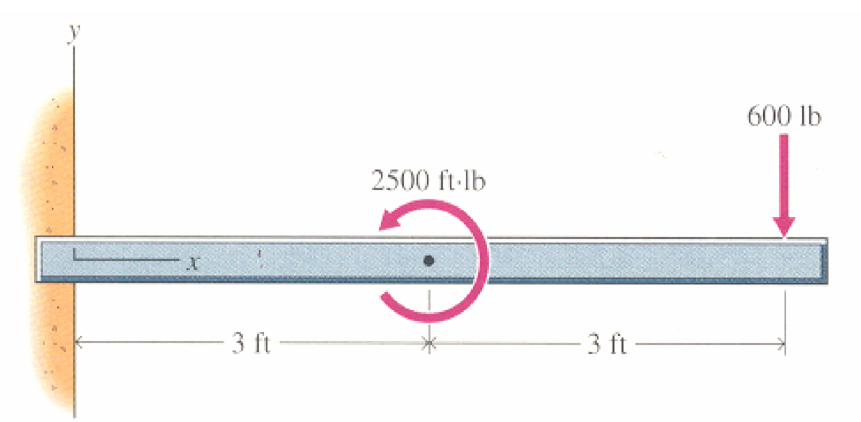
PROB-2-(40)

Find the internal forces at section a-a and section b-b of the frame shown below. **Hint:** Find the contact force at D.

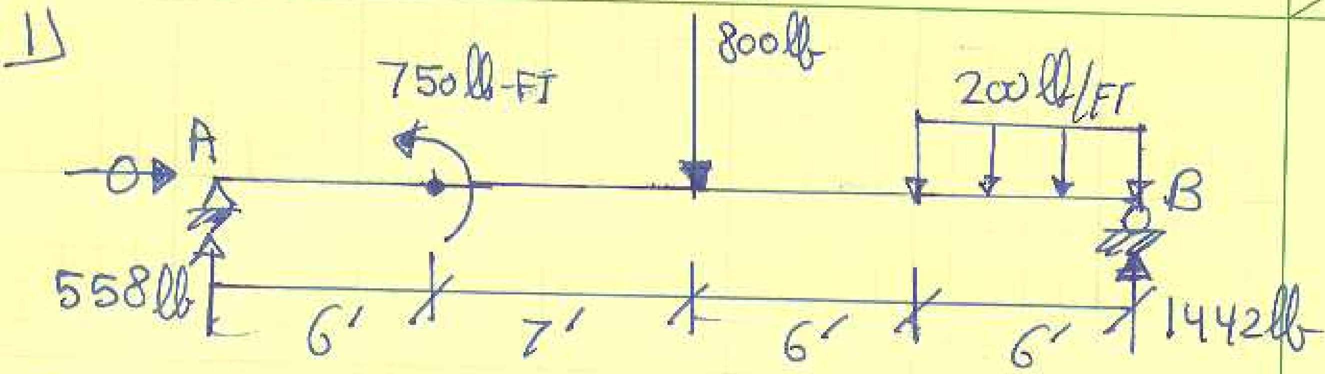


PROB-3-(25)

Draw the moment and shear diagrams for the beam shown below.

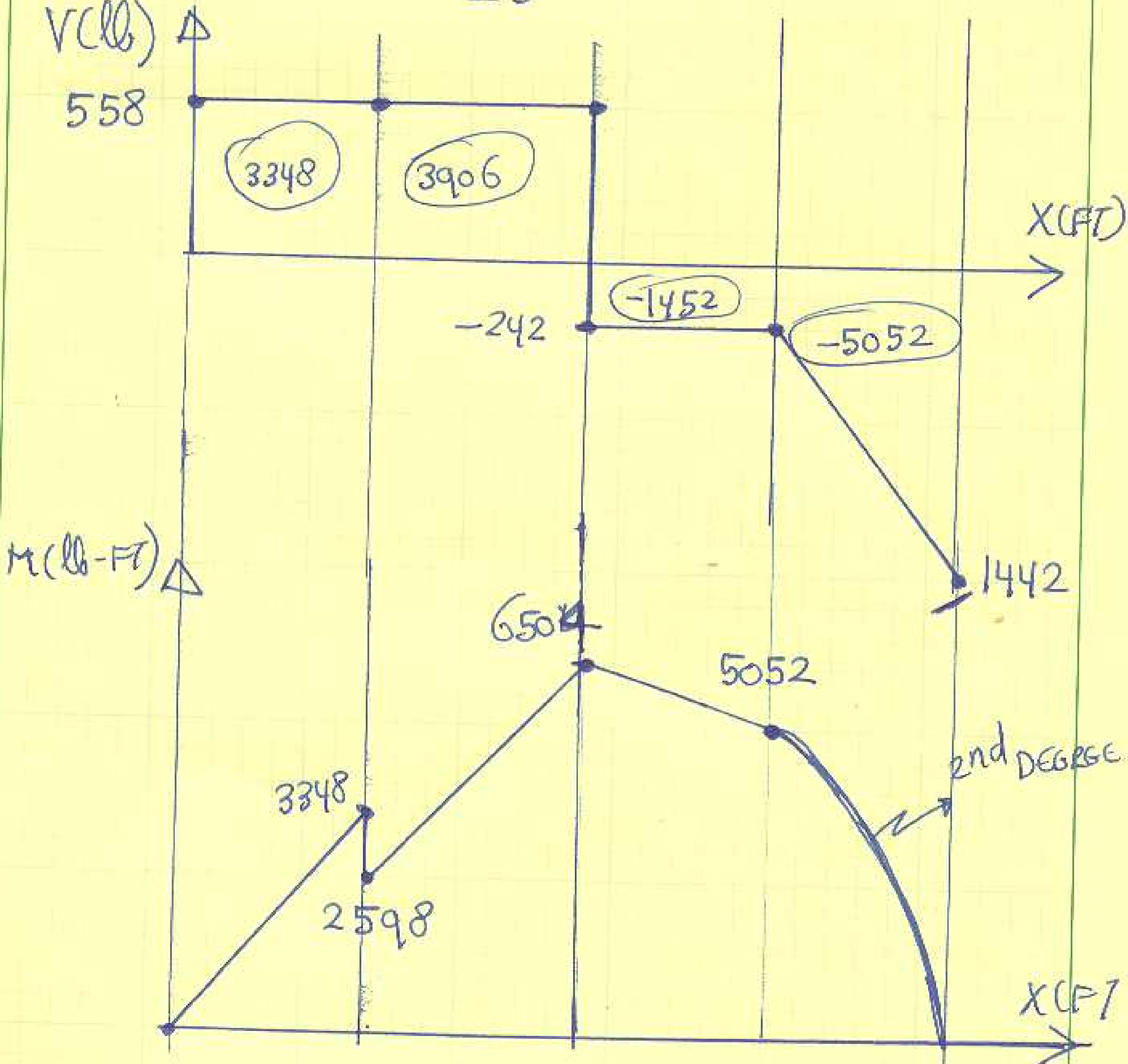


1)



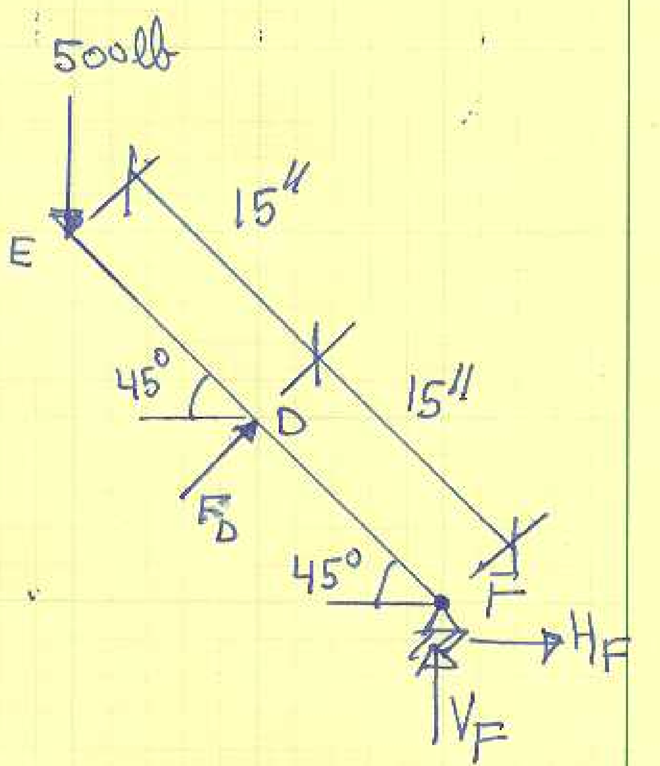
$$R_B = \frac{-750 + (800)(13) + (200)(6)(22)}{25} = 1442\ lb.$$

$$V_A = \frac{(200)(6)(3) + (800)(12) + 750}{25} = 558\ lb.$$



2) HINT: FIND CONTACT FORCE AT D

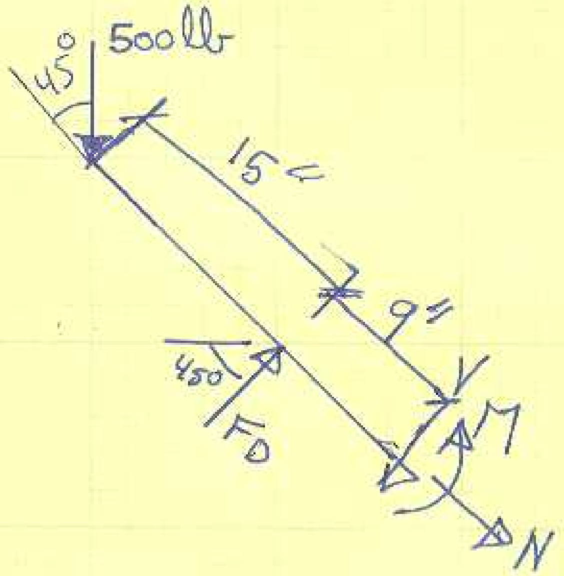
MEMBER EF.



$\Sigma M_F = 0 = (F_D)(15) - (500)(30\cos 45)$

$\Rightarrow F_D = 1000\cos 45 = 707.11\ lb$

SECTION b-b

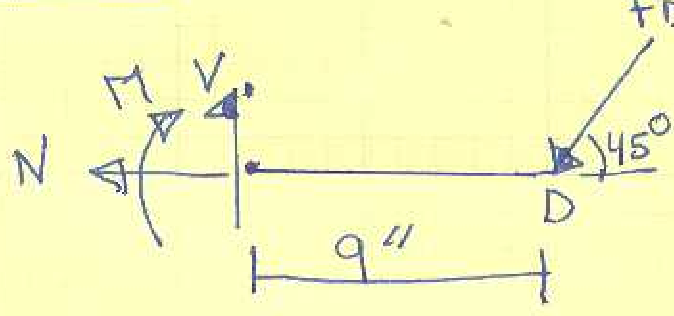


$N = -500\cos 45 = -353.55\ lb$

$V = 1000\cos 45 - 500\cos 45 = 500\cos 45 = 353.55\ lb$

$M = (1000\cos 45)(9) - (500\cos 45)(24) = -3000\cos 45 = -2{,}121.32\ lb\text{-}IN$

SECTION a-a

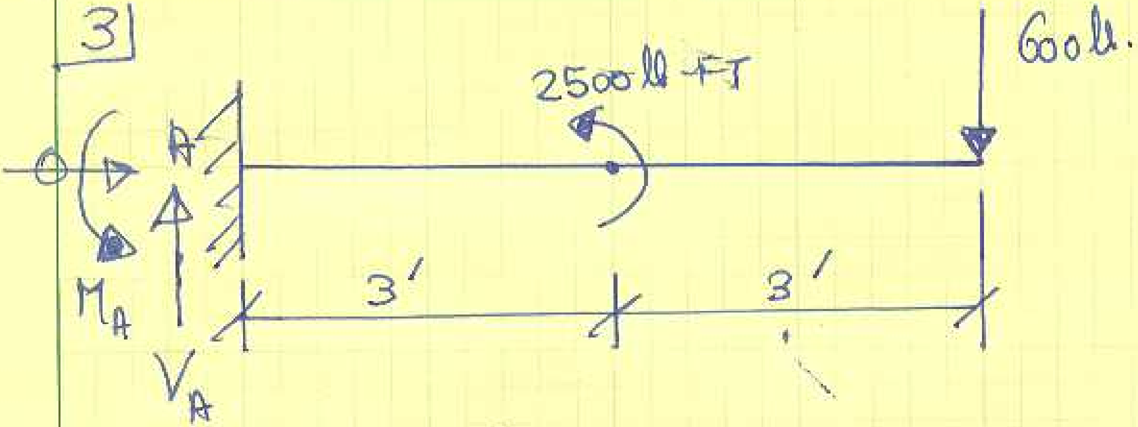


$V = F_D \sin 45 = 500\ lb$

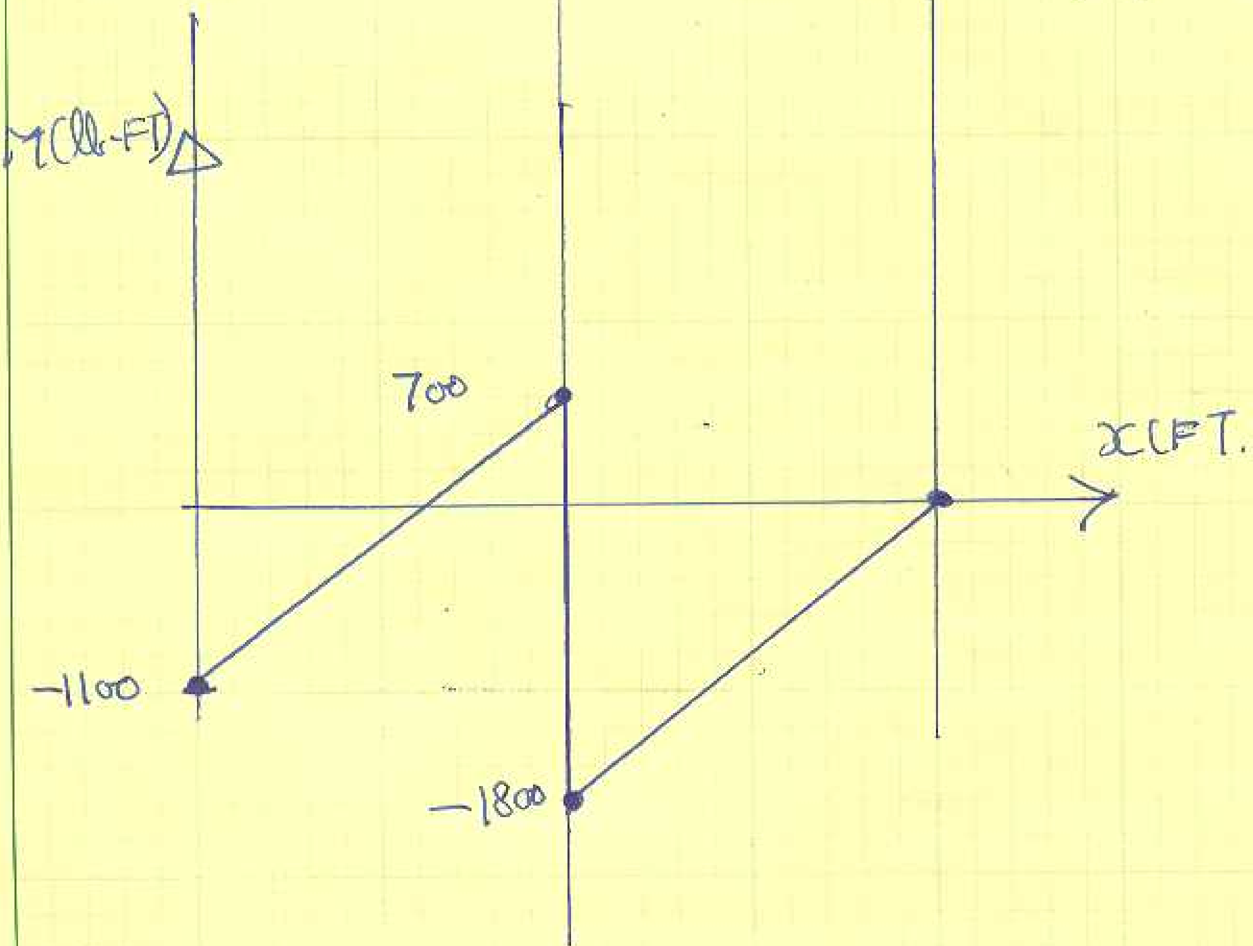
$N = -F_D\cos 45 = -500\ lb$

$M = -(F_D \sin 45)(9) = -4500\ lb\text{-}IN$

3



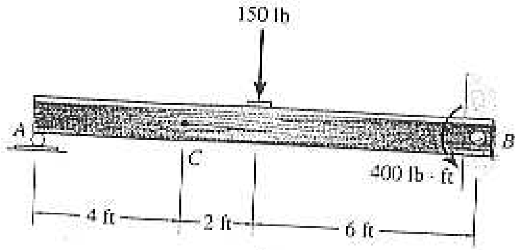
$V_A = 600$ lb, $M_A = -2500 + (600)(6) = 1{,}100$ lb-FT



PHY211 Statics/SP01 TEST#3 NAME Dr. ISSA

PROB-1-(20)

Determine the internal normal, shear, and moment at point C. Assume the support at A is a roller and the support at B is a pin.



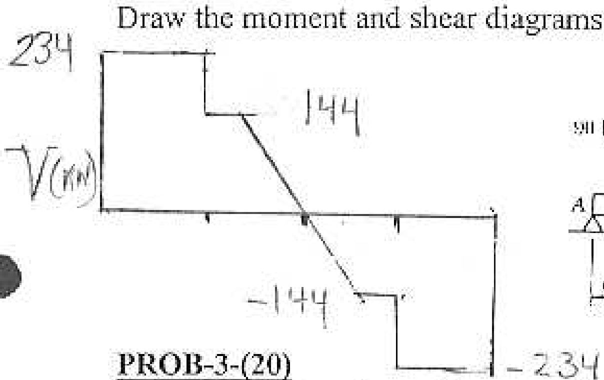
$V_C = 108.33$ lb.

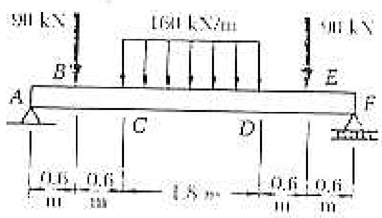
$N_C = 0$

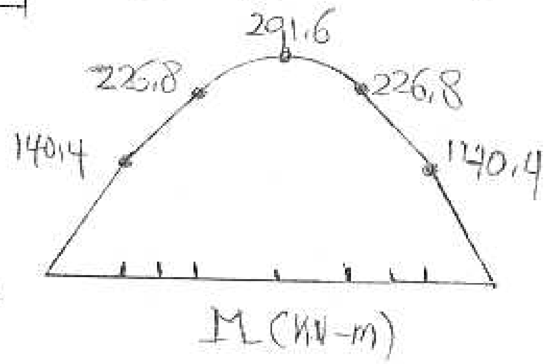
$M_C = 433.33$ lb-FT

PROB-2-(35)

Draw the moment and shear diagrams





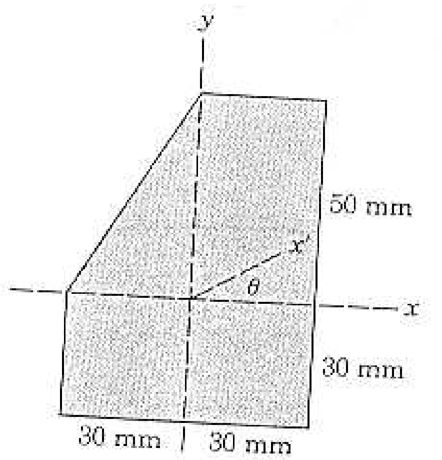


PROB-3-(20)

Determine the location of the centroid.

$\bar{X} = 3.70$ mm

$\bar{y} = 5.68$ mm

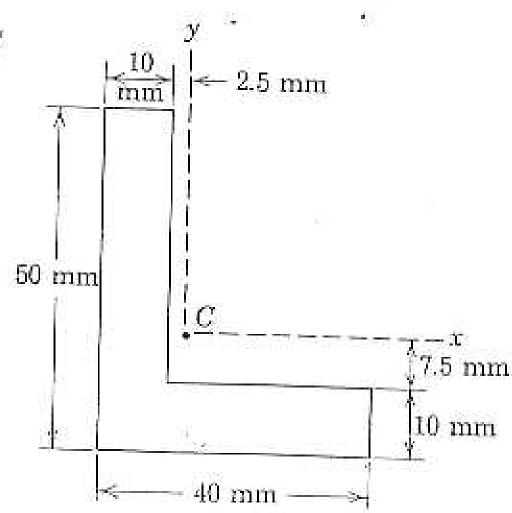


PROB-4-(25)

Determine the moment of inertia about the x and y centroidal axis.

$I_{X_C} = 181,666.67 \text{ mm}^4$

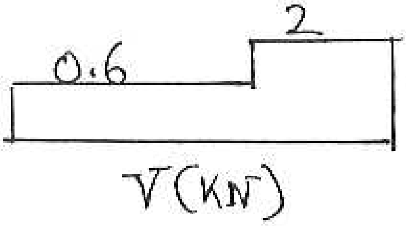
$I_{y_C} = 101,666.67 \text{ mm}^4$

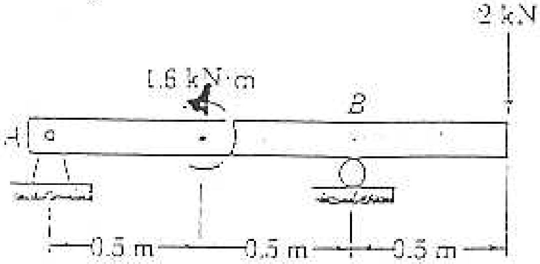


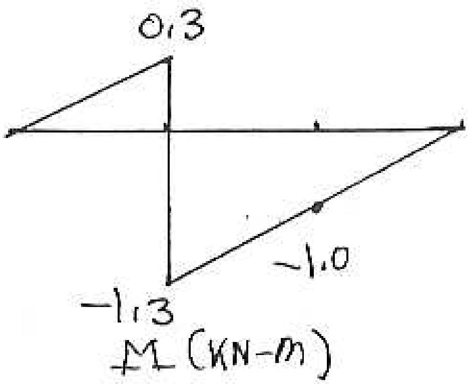
PHY211 Statics/F01 Test #2 NAME Dr. ISSA

PROB-1-(30)

Draw the moment and shear diagrams



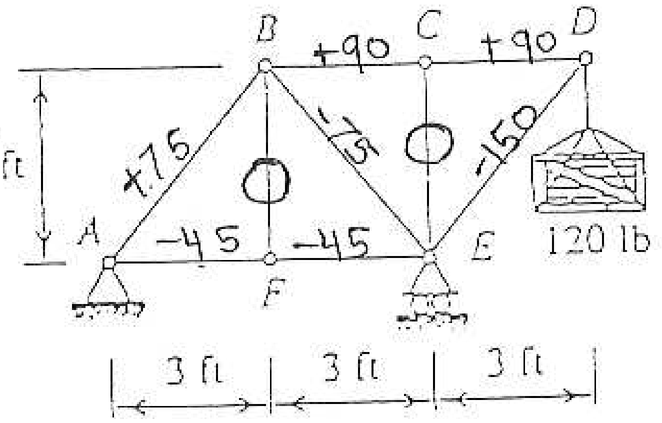




PROB-2-(35)

Determine the force in each member of the truss shown below.

$F_{AB} = 75$ lb.
$F_{AF} = -45$ lb.
$F_{BE} = -75$ lb
$F_{BC} = 90$ lb
$F_{DE} = -150$ lb.



PROB-3-(35)

The frame shown below, supports a 400 kg load in the manner shown. Determine the horizontal and vertical components of forces acting on member BEF.