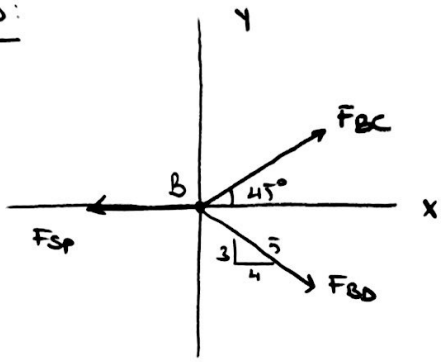
MAK 104 - STATICS

WORKING PROBLEMS - 3

1) FBD:



Stretch in the spring : $s = 0.5 - 0.2 = 0.3m$

$F_{sp} = 800(0.3) = 240N$

$(\stackrel{+}{\rightarrow}) \Sigma F_x = 0$

$F_{BC}\cos 45 + F_{BD}\left(\frac{4}{5}\right) - 240 = 0$

$0.7071\, F_{BC} + 0.8\, F_{BD} = 240 \quad (1)$

$(+\uparrow) \Sigma F_y = 0$

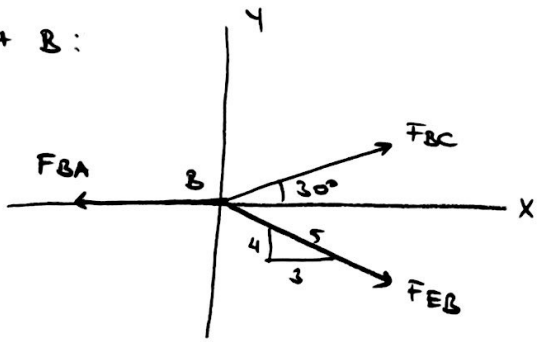
$F_{BC}\sin 45 - F_{BD}\left(\frac{3}{5}\right) = 0$

$F_{BC} = 0.8485\, F_{BD} \quad (2)$

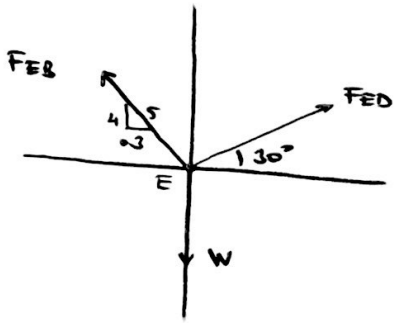
$\Rightarrow 0.7071(0.8485 F_{BD}) + 0.8 F_{BD} = 240$

$\boxed{F_{BD} = 171\,N}$ $\boxed{F_{BC} = 145N}$

2) Joint B:



Joint E:



If we write force equilibriums for Joint E;

$(\stackrel{+}{\rightarrow}) \Sigma F_x = 0 \quad F_{ED}\cdot\cos 30 - F_{EB}\left(\frac{3}{5}\right) = 0$

$(\uparrow+) \Sigma F_y = 0 \quad F_{ED}\cdot\sin 30 + F_{EB}\left(\frac{4}{5}\right) - W = 0$

$\Rightarrow F_{ED} = 0.6043W$, $F_{EB} = 0.8723W$

$F_{EB} = 0.8723W$ is found. Applying this result for Joint B we get

$(\uparrow+) \Sigma F_y = 0 \quad F_{BC}\cdot\sin 30 - 0.8723W\cdot\left(\frac{4}{5}\right) = 0$

$F_{BC} = 1.3957W$

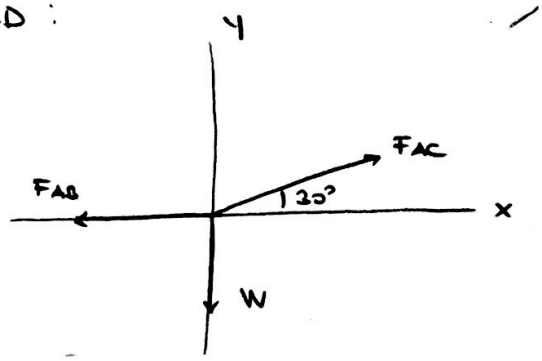
$\Sigma F_x = 0 \qquad 1.3857W\cos 30 + 0.8723W\left(\frac{3}{5}\right) - F_{BA} = 0$

$F_{BA} = 1.7320W$

In the question maximum allowable force for AB cable is given as 100N

$F_{BA} = 100N = 1.7320W \Rightarrow \boxed{W = 57.7N}$

3) F.B.D :



$(\rightarrow) \Sigma F_x = 0 \qquad F_{AC}\cos 30 - F_{AB} = 0$

$(+\uparrow) \Sigma F_y = 0 \qquad F_{AC}\sin 30 - W = 0$

$F_{AC}\cdot\cos 30 - 450 = 0$

$F_{AC} = 518.616 > 480lb$ X

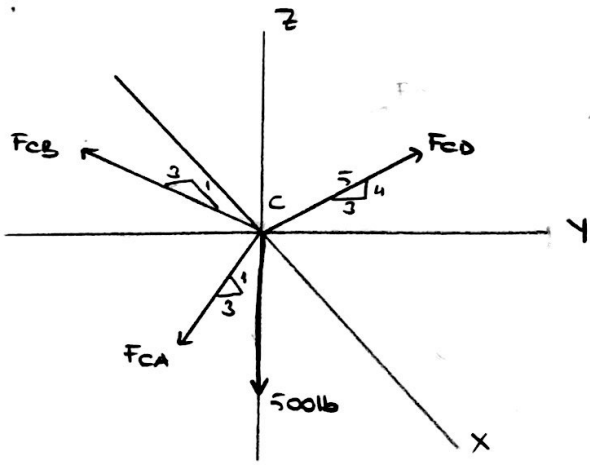
$F_{AC} = 480lb \Rightarrow 480\cos 30 - F_{AB} = 0$

$F_{AB} = 415.716 < 450lb$ (Satisfied)

$\Rightarrow (480)\sin 30 - W = 0$

$\boxed{W = 240lb}$

4) F.B.D :



$(+\uparrow) \Sigma F_x = 0$

$F_{CA}\left(\frac{1}{\sqrt{10}}\right) - F_{CB}\left(\frac{1}{\sqrt{10}}\right) = 0$

$F_{CA} = F_{CB}$

$(\rightarrow +) \Sigma F_y = 0$

$-F_{CA}\left(\frac{3}{\sqrt{10}}\right) - F_{CB}\left(\frac{3}{\sqrt{10}}\right) + F_{CD}\left(\frac{3}{5}\right) = 0$

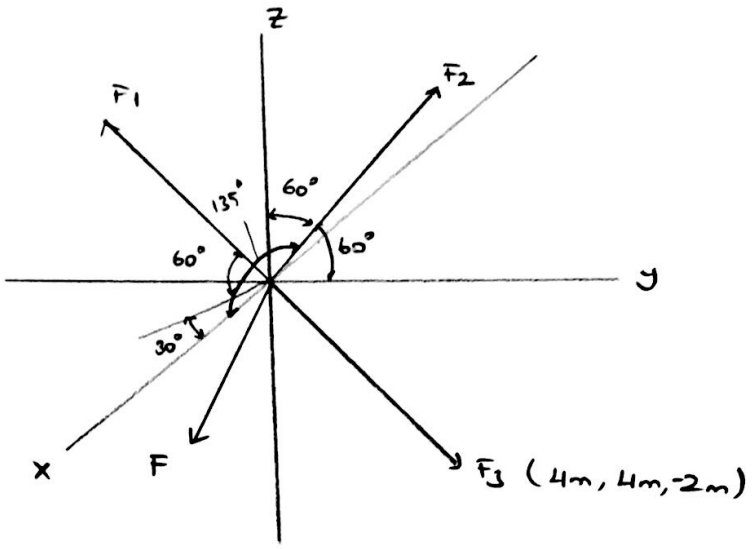
$(+\uparrow) \Sigma F_z = 0$

$-500 + F_{CD}\left(\frac{4}{5}\right) = 0$

$\boxed{F_{CD} = 625\,lb}$

$\boxed{F_{CA} = F_{CB} = 198lb}$

5) F.B.D :



$\Sigma F_x = 0$ $\quad F_1 \cdot \cos 60 \cos 30 + F_2 \cdot \cos 135 + \frac{4}{6} F_3 - 9 = 0$

$\Sigma F_y = 0$ $\quad -F_1 \cdot \cos 60 \cdot \sin 30 + F_2 \cdot \cos 60 + \frac{4}{6} \cdot F_3 - 8 = 0$

$\Sigma F_z = 0$ $\quad F_1 \cdot \sin 60 + F_2 \cdot \cos 60 - \frac{2}{6} F_3 - 5 = 0$

$0.433F_1 - 0.707F_2 + 0.667F_3 = 9$

$-0.250F_1 + 0.500F_2 + 0.667F_3 = 8$

$0.866F_1 + 0.500F_2 - 0.333F_3 = 5$

$F_1 = 8.26\ kN$

$F_2 = 3.841\ kN$

$F_3 = 12.2\ kN$