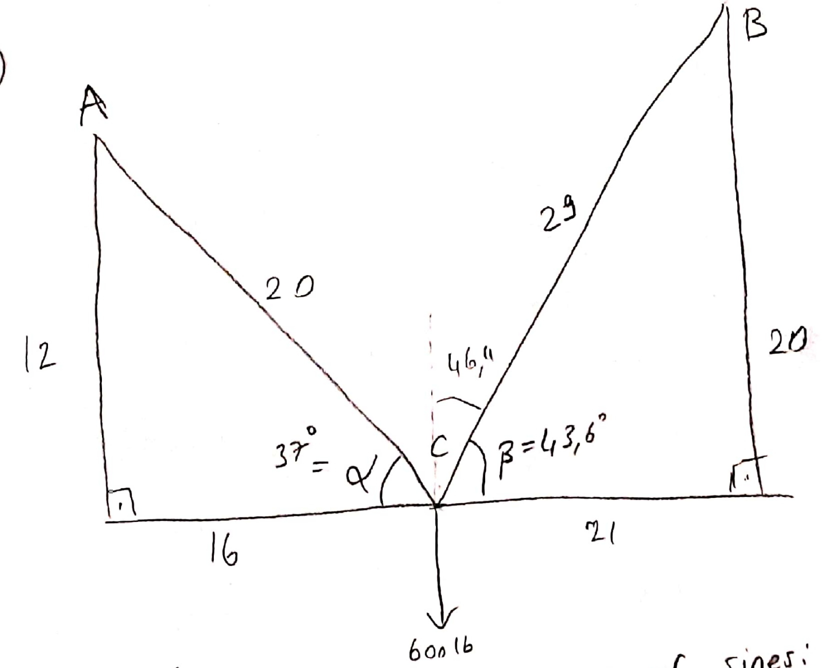
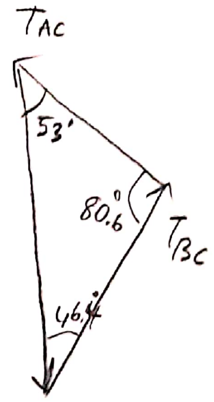
Q1





$\alpha = \tan^{-1}\left(\frac{12}{16}\right)$

$\cong 37°$

$\beta = \tan^{-1}\left(\frac{20}{21}\right)$

$= 43{,}6°$

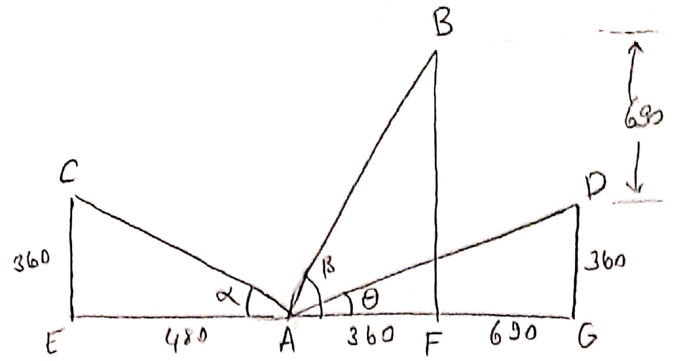
Law of sines:

$$\frac{T_{AC}}{\sin 46{,}4°} = \frac{T_{BC}}{\sin 53°} = \frac{600 lb}{\sin 80{,}6°}$$

a) $T_{AC} = \frac{600 lb}{\sin 80{,}6°} \cdot \sin 46{,}4° = \boxed{440{,}4 \text{ lb}}$

b) $T_{BC} = \frac{600 lb}{\sin 80{,}6°} \cdot \sin 53° = \boxed{485{,}7 \text{ lb}}$

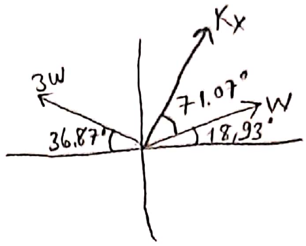
Q2



$\alpha = \tan^{-1}\left(\frac{360}{480}\right) = 36,87^0$

$\beta = \tan^{-1}\left(\frac{690+360}{360}\right) = 71,07^0$

$\theta = \tan^{-1}\left(\frac{360}{360+690}\right) = 18,93°$



a.) $K = 800\ N/m$

$\Sigma F_x = 0$

$W(\cos 18,93) + Kx.(\cos 71,07) - 3W(\cos 36.87) = 0$

$-1,454W + 259,53x = 0$ (1)

$\Sigma F_y = 0$

$W(\sin 18,93) + Kx.(\sin 71.07) + 3W(\sin 36,87°) - 400 = 0$

$2,124W + 756,732x = 400$ (2)

From (1) $W = \frac{259,53x}{1,454}$ put this value in (2)

$2,124 \cdot \left(\frac{259,53}{1,454}\right)x + 756,732x = 400$ from this we get $\boxed{X = 0,352\ m}$

and $\boxed{W = 62,85\ N}$

b.) Total length of the spring $l = \sqrt{(690+360)^2 + (360)^2} = 1110\ mm$

$= l - x$

$= 1110 - 352$

$\boxed{= 758\ mm}$

Q3 Given tension in cable AB, $T_{AB} = 4{,}2kN = F$

a) $F_x = F\cos 40^\circ \times \cos 40^\circ$
$= 4{,}2 \cos 40^\circ \times \cos 40^\circ$
$\boxed{F_x = 2{,}46 \text{ kN}}$

$F_y = -F\sin 40^\circ$
$= -4{,}2\text{kN} \times \sin 40^\circ$
$\boxed{F_y = -2{,}7 \text{ kN}}$

$F_z = F\cos 40^\circ \times \sin 40^\circ$
$= 4{,}2 \cos 40 \times \sin 40^\circ$
$\boxed{F_z = 2{,}07\text{kN}}$

b.) $\cos\theta_x = \frac{F_x}{F} = \frac{2{,}46}{4{,}2}$
$\boxed{\theta_x = \arccos 0{,}59 = 53{,}84^\circ}$

$\cos\theta_y = \frac{F_y}{F} = \frac{-2{,}7}{4{,}2}$
$\boxed{\theta_y = \arccos(-0{,}64) = 129{,}8^\circ}$

$\cos\theta_z = \frac{F_z}{F} = \frac{2{,}07}{4{,}2}$
$\boxed{\theta_z = \arccos(0{,}49) = 60{,}66^\circ}$

Q4 $T_{AB} = 2100N$

From figure we have

$O = (0,0,0)$
$A = (0,20,0)$
$B = (-4,0,5)$
$C = (12,0,3,6)$
$D = (-4,0,-14,8)$
$BA = OA - OB = (4,20,-5)$
$\overline{BA} = 4\bar{i} + 20\bar{j} - 5\bar{k}$

The force exerted by the wire AB on the bolt B is $\bar{F}_{BA} = T_{BA}\lambda_{AB}$

$\Rightarrow \bar{F}_{BA} = T_{AB} \cdot \frac{\overline{BA}}{|\overline{BA}|} = \bar{F}_{BA} = 2100N \cdot \frac{(4\bar{i} + 20\bar{j} - 5\bar{k})}{\sqrt{4^2 + 20^2 + (-5)^2}}$

$\bar{F}_{BA} = 400\bar{i} + 2000\bar{j} - 500\bar{k}$

$$\boxed{\begin{aligned}(T_{BA})_x &= 400N\\ (T_{BA})_y &= 2000N\\ (T_{BA})_z &= -500N\end{aligned}}$$

Q5

$W_A = -750 j \cdot 9{,}81$

$W_A = -7357{,}5$

$\vec{AB} = -0{,}725 + 1{,}2j - 0{,}54k$

$AB = 1{,}5\,m$

$\lambda_{AB} = -0{,}48i + 0{,}8j - 0{,}36k$

$T_{AB} = -0{,}48 \cdot T_{AB} i + 0{,}8 T_{AB} j - 0.36\, T_{AB} k$

$\vec{AC} = 1{,}2j + 0{,}64k$

$AC = 1{,}36$ $\qquad \lambda_{AC} = 0{,}88j + 0{,}47k$

$T_{AC} = 0{,}88\, T_{AC} j + 0{,}17\, T_{AC} k$

$\vec{AD} = 0{,}8i + 1{,}2j - 0{,}56k$

$AD = 1{,}53$

$\lambda_{AD} = 0{,}52i + 0{,}78j - 0{,}35k$

$T_{AD} = 0{,}52 \cdot T_{AD} i + 0{,}78\, T_{AD} j - 0{,}35\, T_{AD} \cdot k$

$-0{,}48\, T_{AB} + 0{,}52\, T_{AD} = 0$

$0{,}8\, T_{AB} + 1{,}2\, T_{AC} + 0{,}78\, T_{AD} = 7357{,}5$

$-0{,}36\, T_{AB} + 0{,}64\, T_{AC} - 0{,}35\, T_{AD} = 0$

$T_{AB} = 2626{,}95$

$T_{AC} = 2803{,}77$

$T_{AD} = 2424.88$