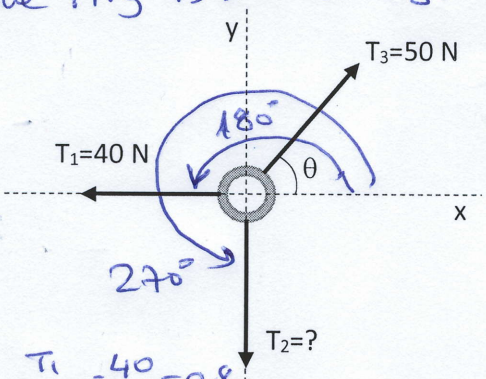
# Mechanics II – QUESTION BANK 10 –
## Forces - 4 – SOLUTIONS

1. Three forces are exerted on a ring. The ring remains stationary. $T_1$ = 40 N, and $T_3$ = 50 N. What is the magnitude of the second force($T_2$)?

$\vec{F}_{net} = m\vec{a}_{net}$ $a=0$ because the ring is stationary.

$\vec{F}_{net} = 0$

$\vec{T}_1 + \vec{T}_2 + \vec{T}_3 = 0$




Along x axis

$\vec{T}_{1x} + \vec{T}_{2x} + \vec{T}_{3x} = 0$

$T_1 \cos 180 + T_2 \cos 270 + T_3 \cos\theta = 0$

$\cos 180 = -1$, $\cos 270 = 0$

$-T_1 + T_3 \cos\theta = 0$

$\cos\theta = \frac{T_1}{T_3} = \frac{40}{50} = 0.8$

$\cos^{-1}(0.8) = \theta$

$\theta = 37°$

Along y axis

$\vec{T}_{1y} + \vec{T}_{2y} + \vec{T}_{3y} = 0$

$T_1 \sin 180 + T_2 \sin 270 + T_3 \sin\theta = 0$

$\sin 180 = 0$, $\sin 270 = -1$

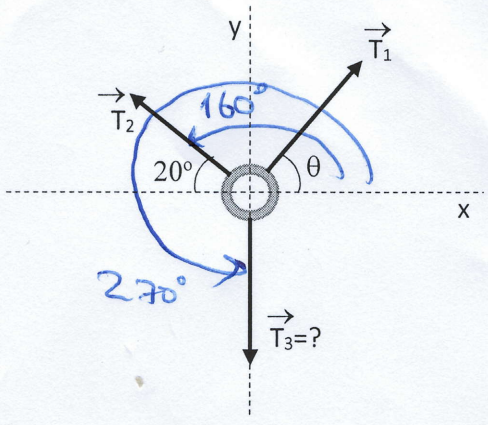
$-T_2 + T_3 \sin 37 = 0 \Rightarrow T_2 = T_3 \sin 37 \Rightarrow T_2 = 50 \cdot (0.6)$

$T_2 = 30\,N$

2. Three forces are exerted on a ring. The ring remains stationary. $T_1$ = 120 N, and $T_2$ = 100 N. What is the magnitude of the third force ($T_3$)?

$\vec{F}_{net} = m\vec{a}_{net}$ $(a=0)$

$\vec{F}_{net} = \vec{T}_1 + \vec{T}_2 + \vec{T}_3 = 0$




Along x axis

$\vec{T}_{1x} + \vec{T}_{2x} + \vec{T}_{3x} = 0$

$T_1 \cos\theta + T_2 \cos 160 + T_3 \cos 270 = 0$

$\cos 270 = 0$

$120 \cdot \cos\theta + 100 \cos 160 + 0 = 0$

$\cos\theta = \frac{-100 \cos 160}{120} = \frac{-100(-0.94)}{120} = 0.78$

$\theta = \cos^{-1}(0.78) = 38.74 \approx 39°$

Along y axis

$\vec{T}_{1y} + \vec{T}_{2y} + \vec{T}_{3y} = 0$

$T_1 \sin\theta + T_2 \sin 160 + T_3 \sin 270 = 0$ ($\sin 270 = -1$)

$120 \cdot \sin 39 + 100 \sin 160 - T_3 = 0$

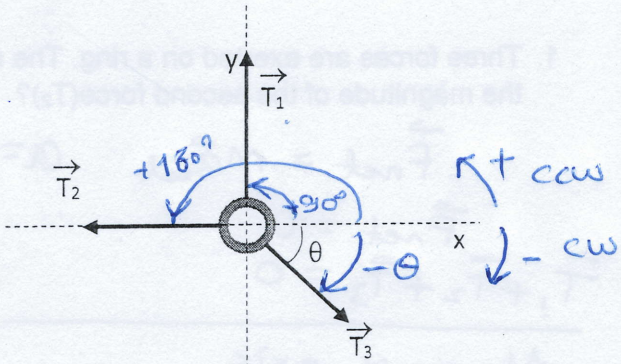
$75.5 + 34 = T_3$

$T_3 = 109.5\,N$

3. Three forces are exerted on a ring. The ring remains stationary. $T_1$ = 32 N, and $T_3$ = 50 N. What is the magnitude of the ~~third~~ second force ($T_2$)?

$\vec{F}_{net} = m\vec{a}_{net}$ $(a=0)$

$\vec{F}_{net} = \vec{T}_1 + \vec{T}_2 + \vec{T}_3 = m\vec{a}_{net} = 0$




**Along x axis**

$\vec{T}_{1x} + \vec{T}_{2x} + \vec{T}_{3x} = 0$

$T_1 \cos 90 + T_2 \cos 180 + T_3 \cos(-\theta) = 0$

$32 \cdot \cos 90 + T_2(-1) + 50\cos(-\theta) = 0$ ($\cos 90 = 0$)

$-T_2 = -50\cos(-\theta)$

$T_2 = 50\cos(-\theta)$

To find $T_2$, we need to find $\theta$.

**Along y axis**

$\vec{T}_{1y} + \vec{T}_{2y} + \vec{T}_{3y} = 0$

$T_1 \sin 90 + T_2 \sin 180 + T_3 \sin(-\theta) = 0$ ($\sin 180 = 0$, $\sin 90 = 1$)

$T_1 \cdot (1) + T_3 \sin(-\theta) = 0$

$32 + 50\sin(-\theta) = 0$

$\sin(-\theta) = \frac{-32}{50}$

$\sin(-\theta) = -0,64$

$\sin^{-1}(-0,64) = -\theta \Rightarrow -\theta = -39,8$

$\theta \cong 40°$

After finding $\theta$,

$T_2 = 50\cos(-40)$

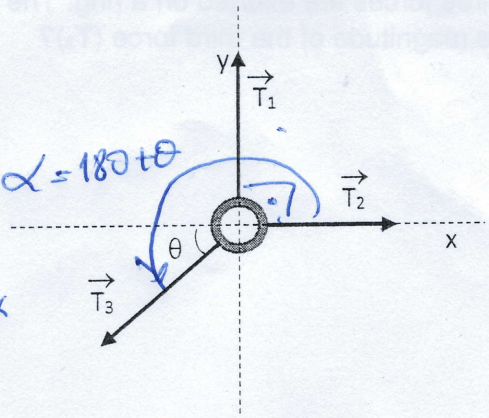
$T_2 = 50 \times (0,77)$

$T_2 = 38,3\ N$

4. Three forces are exerted on a ring. The ring remains stationary. $T_1$ = 80 N, and $T_3$ = 100 N. What is the magnitude of the second force ($T_2$)?

$\vec{F}_{net} = m\vec{a}_{net}$ $(a=0)$

$\vec{F}_{net} = \vec{T}_1 + \vec{T}_2 + \vec{T}_3 = m\vec{a}_{net} = 0$




**Along x axis**

$T_1 \cdot \cos 90 + T_2 \cos 0 + T_3 \cos\alpha = 0$ ($\cos 90 = 0$, $\cos 0 = 1$)

$T_2 + T_3\cos\alpha = 0$

$T_2 = -T_3\cos\alpha = -100 \cdot \cos\alpha$

we need to find $\alpha$.

**Along y axis**

$T_1 \sin 90 + T_2 \sin 0 + T_3 \sin\alpha = 0$ ($\sin 0 = 0$, $\sin 90 = 1$)

$T_1 + 100 \cdot \sin\alpha = 0$

$80 + 100\sin\alpha = 0$

$\sin\alpha = \frac{-80}{100} = -0,8$

$\sin^{-1}(-0,8) = \alpha \Rightarrow \alpha = 233$

$\alpha = 180 + \theta = 233$

$\theta = 53°$

$T_2 = -100\cos\alpha$

$= -100 \cdot \cos 233$

$= -100 \cdot (-0,60)$

$T_2 = 60\ N$