Force and Motion 5

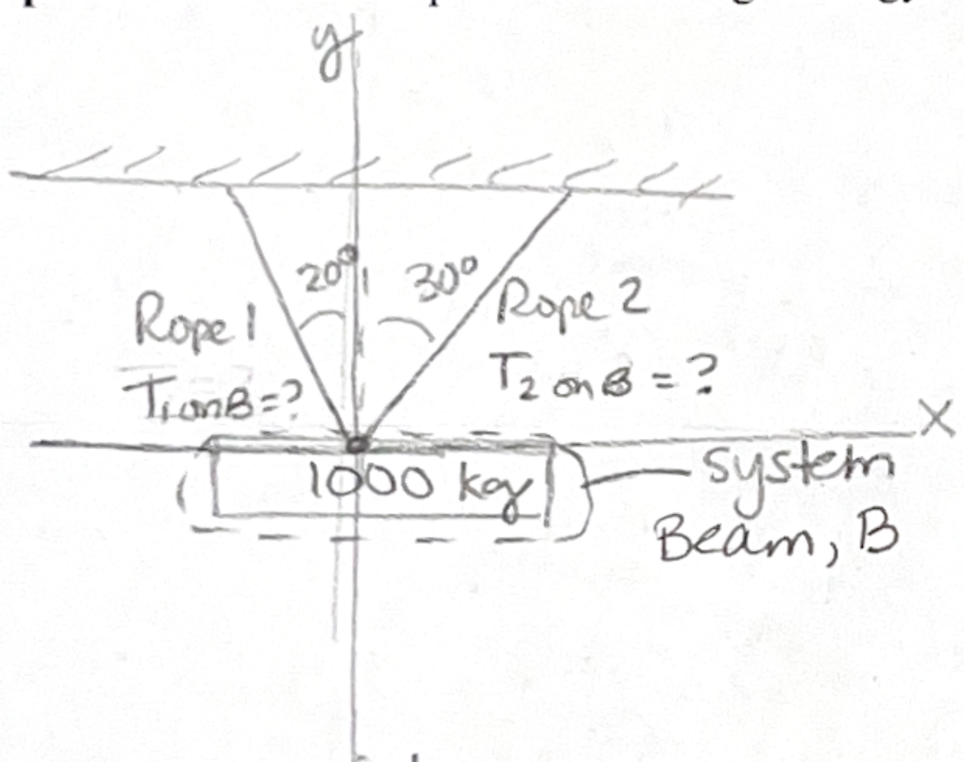
Name: Solution

Date: _____

As stated on the syllabus:

- You may consult posted solutions for help. If doing so, first write a * at the point in your work where you look at the solutions (every time). After looking at the solutions, close them or move to another room to continue your work.
- You must use the solutions to check your completed work for correctness. Correctly re-do anything you missed.
- No writing of any kind is ever allowed while the solutions are visible to you.

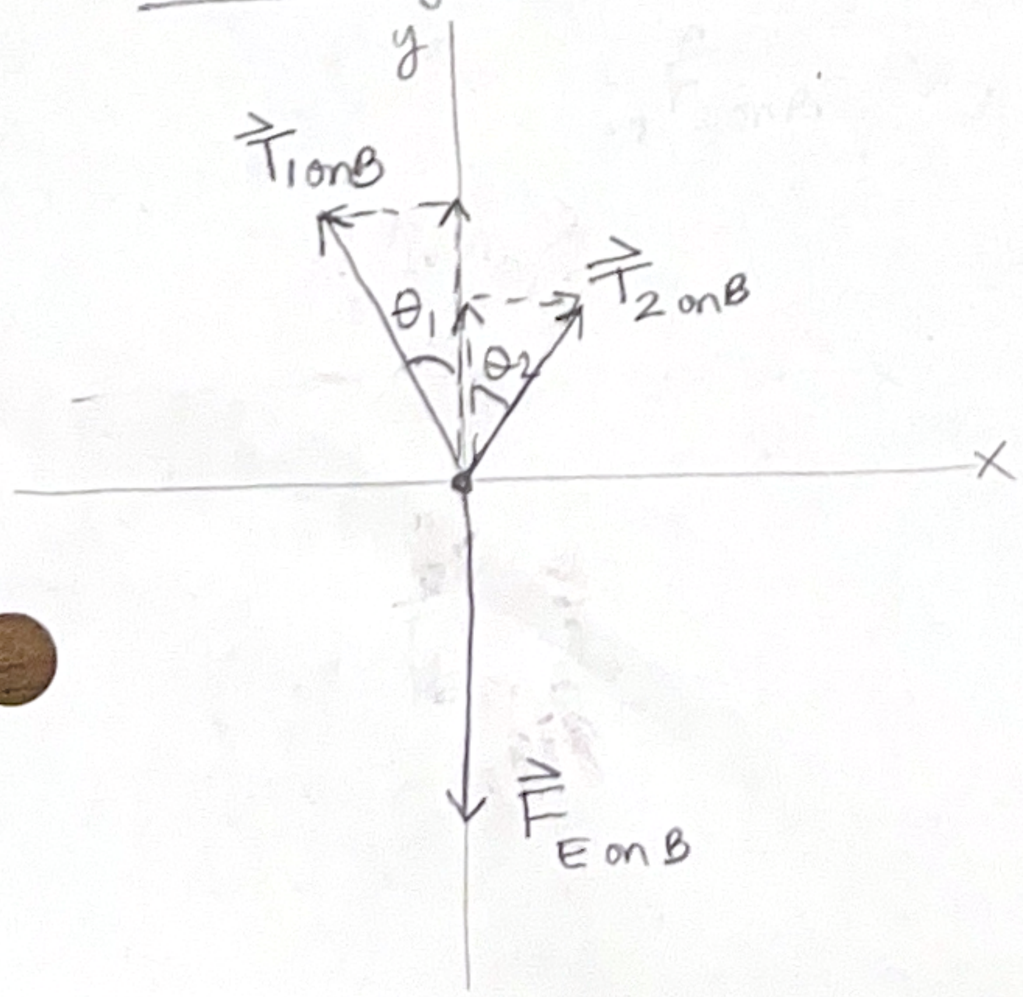
p. 156 #39: Use the problem-solving strategy. Find the force exerted by each rope.



- point particle
- at rest (constant velocity is 0)
- constant forces

motion diagram: • (not moving)

Force diagram:



Force Organizer:

$\vec{F}$	F_x	F_y
$\vec{F}_{E on B}$	$F_{E on Bx} = 0$	$F_{E on By} = -m_B g$
$\vec{T}_{1 on B}$	$T_{1 on Bx} = -T_{1 on B} \sin\theta_1$	$T_{1 on By} = +T_{1 on B} \cos\theta_1$
$\vec{T}_{2 on B}$	$T_{2 on Bx} = +T_{2 on B} \sin\theta_2$	$T_{2 on By} = +T_{2 on B} \cos\theta_2$

Find $T_{1 on B}$ and $T_{2 on B}$:

(x-direction)

$$a_{Bx} = \frac{\Sigma F_{on Bx}}{m_B}$$

$$a_{Bx} = \frac{F_{E on Bx} + T_{1 on Bx} + T_{2 on Bx}}{m_B}$$

$$0 = 0 + (-T_{1 on B} \sin\theta_1) + (+T_{2 on B} \sin\theta_2)$$

$$T_{1 on B} = \frac{T_{2 on B} \sin\theta_2}{\sin\theta_1}$$

$$T_{1 on B} = \frac{T_{2 on B} \sin 30°}{\sin 20°}$$

$$T_{1 on B} = (1.46) T_{2 on B}$$

at this point, I have 2 unknowns and 1 equation. But I need 2 equations to find 2 unknowns.

So I also need to get an equation from the y-direction:

$$a_{By} = \frac{\Sigma F_{on B\,y}}{m_B}$$

$$a_{By} = \frac{F_{E on B\,y} + T_{1 on B\,y} + T_{2 on B\,y}}{m_B}$$

$$0 = -m_B g + T_{1 on B}\cos\theta_1 + T_{2 on B}\cos\theta_2$$

$$0 = -1000\,kg\left(10\frac{N}{kg}\right) + T_{1 on B}\cos 20^\circ + T_{2 on B}\cos 30^\circ$$

$$10000N = (0.94)T_{1 on B} + (0.866)T_{2 on B}$$

Substituting expression for $T_{1 on B}$ from the first equation:

$$10000N = (0.94)(1.46)(T_{2 on B}) + (0.866)T_{2 on B}$$

$$10000N = (1.3724)T_{2 on B} + (0.866)T_{2 on B}$$

$$\boxed{4467N = T_{2 on B}}$$

Now I can sub this back into either equation to find $T_{1 on B}$. I'm using my first equation:

$$T_{1 on B} = (1.46)T_{2 on B}$$

$$T_{1 on B} = (1.46)(4467N)$$

$$\boxed{T_{1 on B} = 6521N}$$

The tension force exerted by Rope1 is (6521N, 20° from vertical), and the tension force exerted by Rope 2 is (4467N, 30° from vertical).