# Week 6 Quiz

Thursday, November 5, 2020 10:11 AM

The new owner of a beautiful VW van secured a 70-kg box on the back of the vertical surface of the van with two ropes and is driving down a straight road at a constant 30 mph. Both ropes make the same angle with respect to the horizontal, and the new owner ties the ropes such that the box is pushing against the vertical surface of the bus with triple the weight of the box. The van is also freshly waxed so you can ignore frictional forces.

(a) Draw a FBD for a system that includes only the box.

(b) How does the tension in rope 1 compare to the tension in rope 2: greater than, less than, or equal two? Briefly explain your reasoning in words, phrases, diagrams, etc…

(c) What is the magnitude of tension in each rope?

(d) Use Related Quantities sensemaking to evaluate your answer to part (c). How does it compare to your answer to part (b)?


**Rubric**

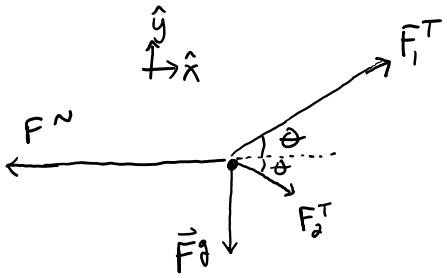
**Part (a)**
**2 pts - correct FBD**

**Part (b)**
**1 pt - T1 > T2 b/c gravity**

**Part (c)**
**1.5 pts - sum of forces in the x-direction**
**1.5 pts - sum of the forces in the y-direction**
**1 pt - equilibrium (a = 0)**
**1 pt - Force normal = 3mg**
**1 pt - algebra**
**0.5 pt - answer + units**

**Part (d)**
**0.5 pts - consistent discussion**

(a) FBD (Box)




(b) $F_1^T > F_2^T$ b/c it must have a greater y-component to counteract the force of gravity

(c) $\Sigma F_x = ma_x \Rightarrow F_1^T\cos\theta + F_2^T\cos\theta - F^N = m\cancel{a_x}^0$

w/ $F^N = 3F_g$, $F_1^T + F_2^T = \frac{3mg}{\cos\theta}$ (i)

$\Sigma F_y = ma_y \Rightarrow F_1^T\sin\theta - F_2^T\sin\theta - F_g = m\cancel{a_y}^0$

$F_1^T - F_2^T = \frac{mg}{\sin\theta}$ (ii)

} 2 eq's 2 unknowns

Substitute (i) into (ii)

$\frac{3mg}{\cos\theta} - F_2^T - F_2^T = \frac{mg}{\sin\theta} \Rightarrow 2F_2^T = \frac{3mg}{\cos\theta} - \frac{mg}{\sin\theta} \Rightarrow \boxed{F_2^T = 502.19\,N}$

Solve for $F_1^T$ using (i) $F_1^T = \frac{3mg}{\cos\theta} - F_2^T \Rightarrow \boxed{F_1^T = 1874\,N}$

(d) My results in part (c) are consitent w/ the relation predicted in part (b)