

Warm Up Exercises: Unit 2, Forces

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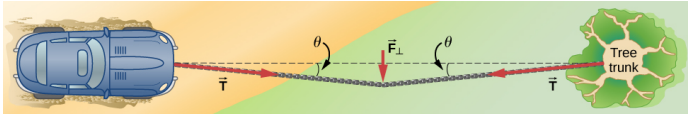


Figure 1: Person pushes in a direction orthogonal to a rope connecting a car and a tree.

3. Consider Fig. 1, in which a rope is tied to a tree and a car stuck in mud. The force is perpendicular to the middle of the rope, \vec{F}_\perp . Suppose \vec{F}_\perp , the left-pointing tension \vec{T} , and right-pointing tension \vec{T} all cancel to yield $\vec{F}_{net} = 0$, show that

$$2T \sin \theta = F_\perp \quad (1)$$

Hint: it helps if you think of the tension vectors as pointing the opposite direction as shown in Fig. 1.

1 Memory Bank

1. $\vec{F} = m\vec{a}$... Newton's 2nd Law
2. $\vec{a} = d^2\vec{x}/dt^2$... Definition of acceleration

2 Chapter 4 - Forces

1. A particle of mass m is falling under the influence of gravity, but experiences a thrust force upwards $\vec{F}_t = kt\hat{j}$, making the net force $\vec{F}_{Net} = kt\hat{j} - mg\hat{j}$. (a) Express the vertical *velocity* as a function of time, assuming the vertical velocity is v_0 at $t = 0$. (b) If $v_0 = 3$ m/s, $m = 20$ kg, and $v(10) = 30$ m/s, what is k ?
4. What is the tension in the rope if we find an angle $\theta = 10$ degrees, and $F_\perp = 500$ N?
2. A 20,000 kg jet fighter lands on an aircraft carrier, moving at 108 km/hr. A tow cable grabs the aircraft and pulls it to a stop in 100 meters. (a) What is the average acceleration? (b) What force does the tow cable exert to stop the jet?