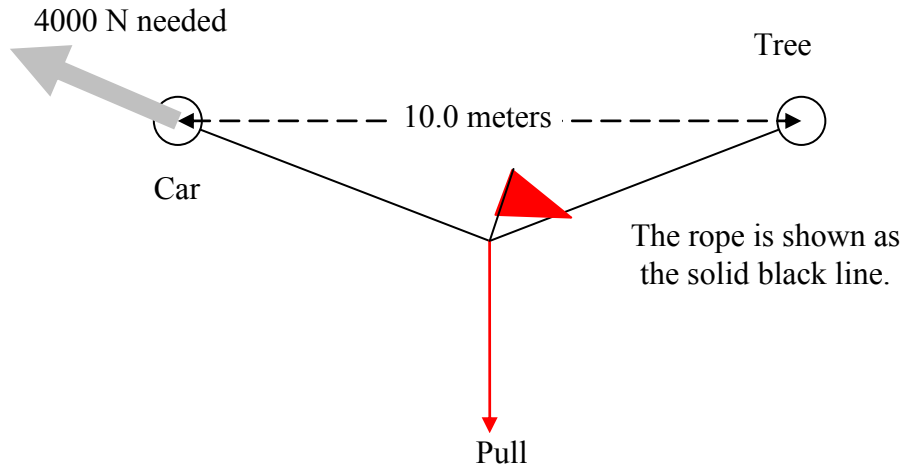


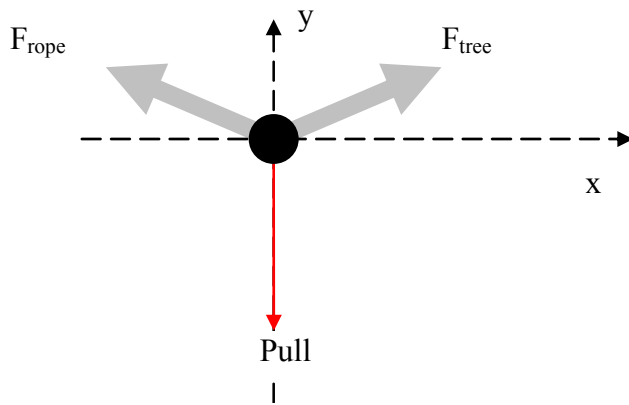
Homework assignment 3 solution

When we discuss the length of rope and the strategy of pulling car out of mud, we would take action as shown below: (Top view)



You are basically trying to handle a question about the balance (sum) of forces.

This is the free-body diagram. (from the top view)



Starting from the freebody diagram we have following:

	x direction	y direction
F_{rope}	$- 4000\cos(\theta)$	$4000 \sin(\theta)$
F_{tree}	$+ F_{tree} \cos(\theta)$	$F_{tree} \sin(\theta)$
F_{pull}	0	-800 N

$\sum F_x = 0$. e.g. $-F_{\text{rope}} \cos(\theta) + F_{\text{tree}} \cos(\theta) = 0$, which gives you $F_{\text{rope}} = F_{\text{tree}} = 4000\text{N}$

$\sum F_y = 0$. e.g. $+F_{\text{rope}} \sin(\theta) + F_{\text{tree}} \sin(\theta) - 800\text{ N} = 0$,

You will find out the solution of $\theta = 5.74^\circ$

Then, we can use trigonometry again to get the length of the rope to be
 $2 \times 5\text{m} \times \tan(5.74^\circ) = 10.005\text{meter}$.

(Note that the force 800N and 4000N doesn't directly "make" a triangle. Instead, the y component of the F_{rope} was only 400N, half of the 800 N.)