Notes for Free Body Diagram Worksheet

Why do you need to split forces into parts? We want all forces to be at right angles or directly across from each other to make solving the problems easier.

Question to ask when splitting up the forces:

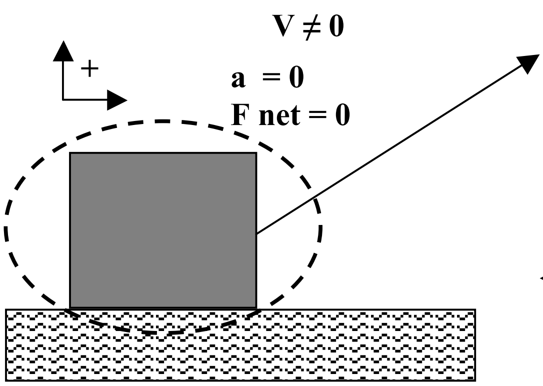
Is the object on a hillside / inclined plane?

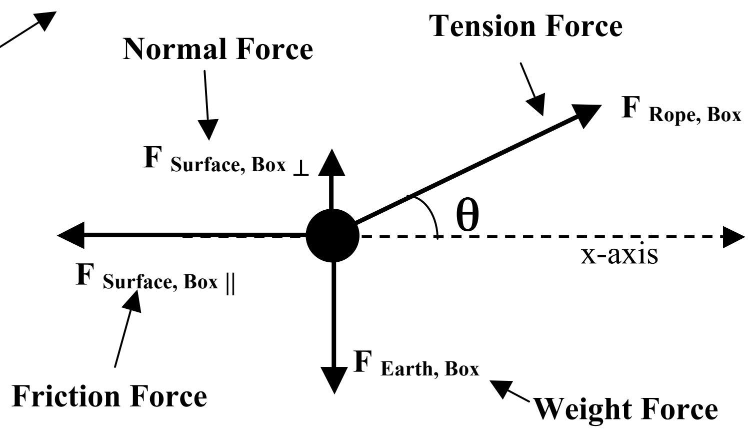
YES ➡ **Split the Force of the Earth ($F_{Earth, object}$) into two parts. Use parallel || and perpendicular ⊥ symbols at the end of the Force, ($F_{Earth, object}\perp$).**

NO ➡ **Split up any force not on an X or Y-axis line, in other words split any force not on a right angle or opposite of the $F_{Earth, object}$.**

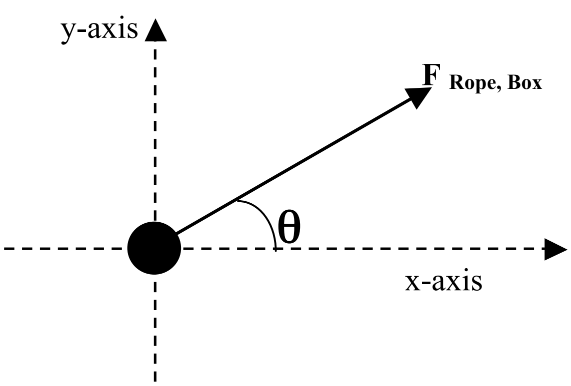
Here are a couple of examples of how to divide forces at an angle up in to parts.

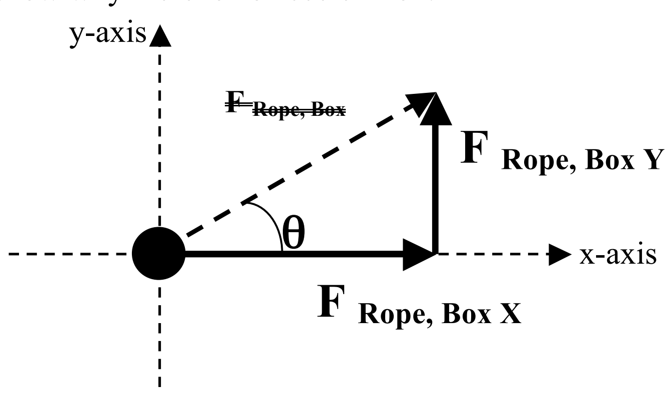
A box is pulled across the floor at a constant speed (**No acceleration = all Forces are balanced.)**





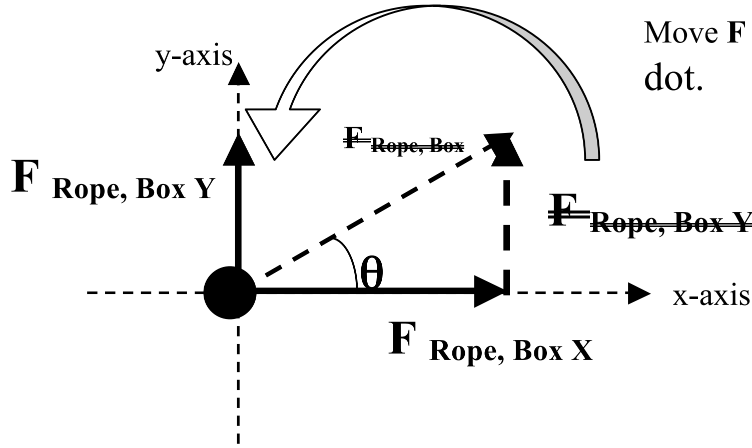
The Force of the rope on the box (**$F_{Rope, Box}$**) at the angle can be split up in to two parts, a horizontal and a vertical component. We do this to so we can show why there is no acceleration.





Another way of showing the parts that make up the $\mathbf{F}_{Rope,\ Box}$ is to draw the X and Y forces like I have below. Then cross out the Force you split into parts (~~$\mathbf{F}_{Rope,\ Box}$~~).

R = Rope
B = Box



Move **F** $_{\mathbf{R,\ By}}$ over to the dot.

Now put it together with the other forces we have.

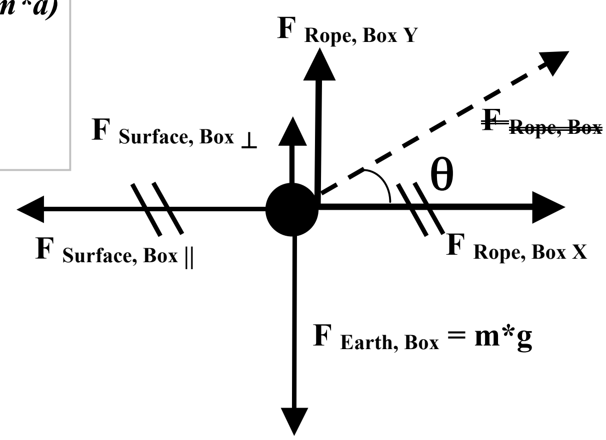
This is how your Free-Body Diagram (Force Diagram) will look on your paper.

NO ACCELERATION (NEWTON'S 2[ND] LAW Fnet = m*a)

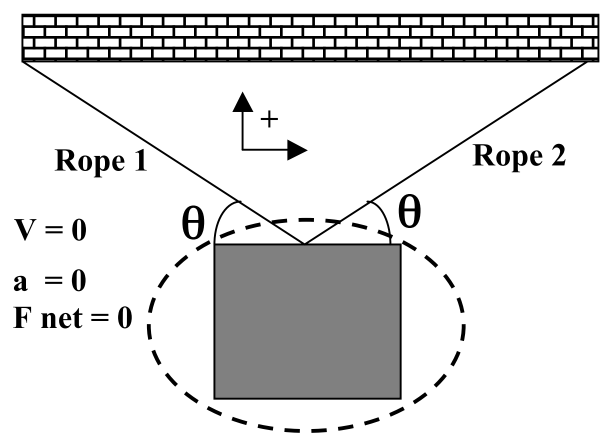
$$F_{Rope,\ Box\ X} - F_{Surface,\ Box\ \parallel} = m*\cancelto{0}{a_x}$$
$$F_{Rope,\ Box\ X} = F_{Surface,\ Box\ \parallel}$$

AND

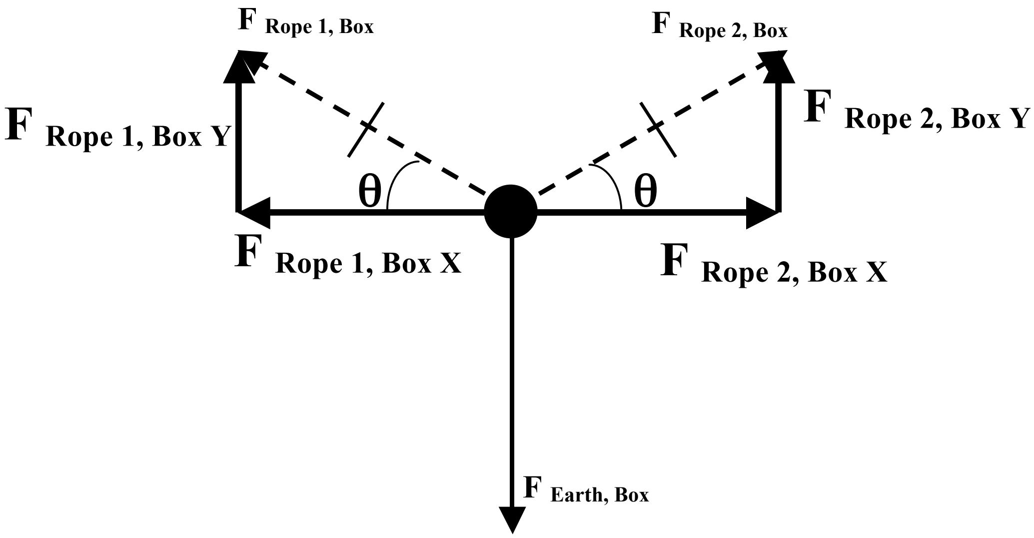
$$F_{Rope,\ Box\ Y} + F_{Surface,\ Box\ \perp} - F_{Earth,\ Box} = m*\cancelto{0}{a_y}$$
$$F_{Rope,\ Box\ Y} + F_{Surface,\ Box\ \perp} = F_{Earth,\ Box}$$
$$F_{Rope,\ Box\ Y} + F_{Surface,\ Box\ \perp} = m*g$$



Now we look at a box hanging on the ceiling.

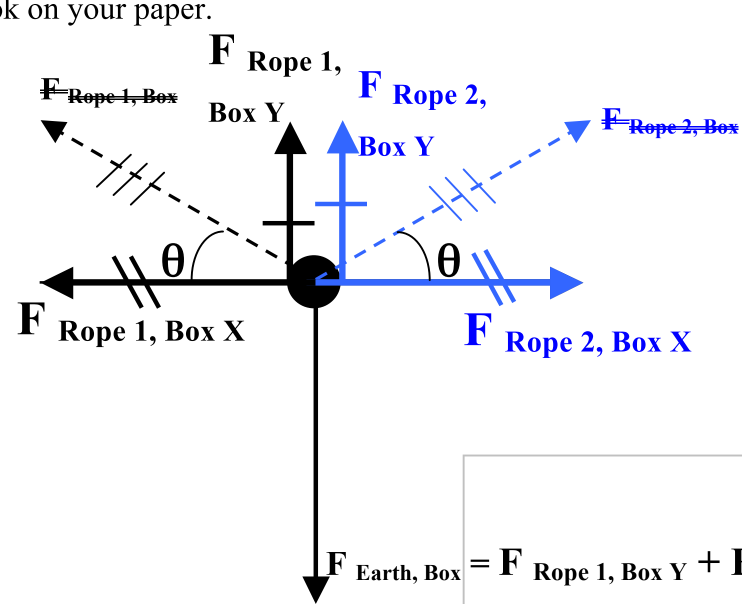


Split the two Tension forces ($\mathbf{F}_{\text{Rope 1, Box}}$, $\mathbf{F}_{\text{Rope 2, Box}}$) up into x and y parts.



Move the $\mathbf{F}_{\text{Rope 1, Box Y}}$, $\mathbf{F}_{\text{Rope 2, Box Y}}$ on to the center dot representing the box and stack the forces on top of the other.

This is how your Free-Body Diagram (Force Diagram) will look on your paper.

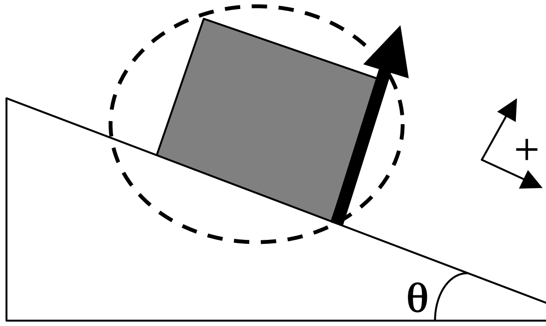


$\mathbf{F}_{\text{Earth, Box}} = \mathbf{F}_{\text{Rope 1, Box Y}} + \mathbf{F}_{\text{Rope 2, Box Y}}$

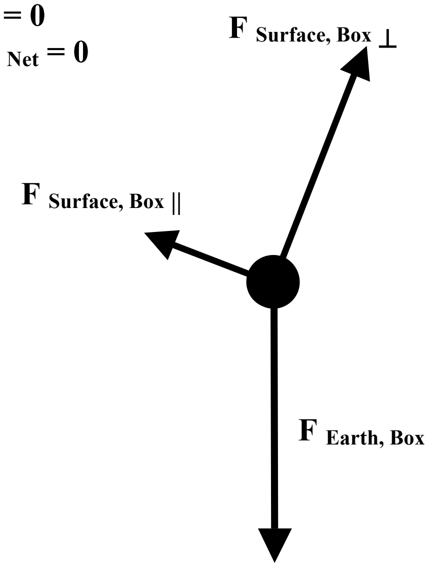
Since the box is not accelerating then $\mathbf{F}_{\text{Rope 1, Box Y}} + \mathbf{F}_{\text{Rope 2, Box Y}} - \mathbf{F}_{\text{Earth, Box}} = \cancel{m*a_y}^{\,0}$

so $\mathbf{F}_{\text{Earth, Box}} = \mathbf{F}_{\text{Rope 1, Box Y}} + \mathbf{F}_{\text{Rope 2, Box Y}}$

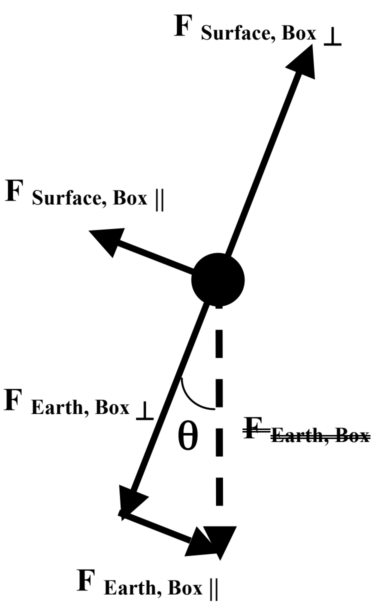
A box is sitting on a hillside of angle θ, not accelerating or moving.



V = 0
a = 0
F_{Net} = 0



Split the $\mathbf{F}_{\text{Earth, Box}}$ in to parallel and perpendicular components to show that the box is not accelarating.



The angle for the hill is the same as the angle between $\mathbf{F}_{\text{Earth, Box}\perp}$ **and** $\mathbf{F}_{\text{Earth, Box}}$

This is how your Free-Body Diagram (Force Diagram) will look on your paper.