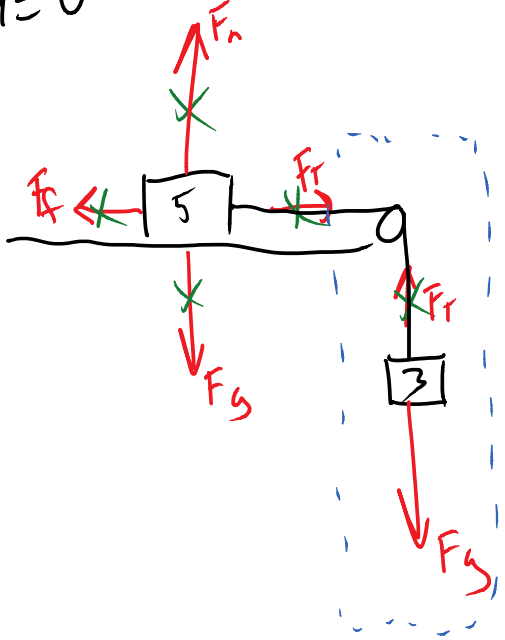
Determining Tension in a Multi-body System

Monday, November 14, 2011 10:24 AM

This is accomplished by 1) drawing a Free Body Diagram

2) Analysing the forces to find Fnet (whole system)
3) Divide F_{net} by system mass to find accel
4) Draw an FBD of only a single mass
5) Determine the F_{net} of JUST that mass using $F_{net} = ma$
6) Analyze the forces on that single mass to find the force of tension (F_T)

$\mu = 0$



$F_{net} = W - L$

$= F_g - F_T$

$= (3)(9.8)$

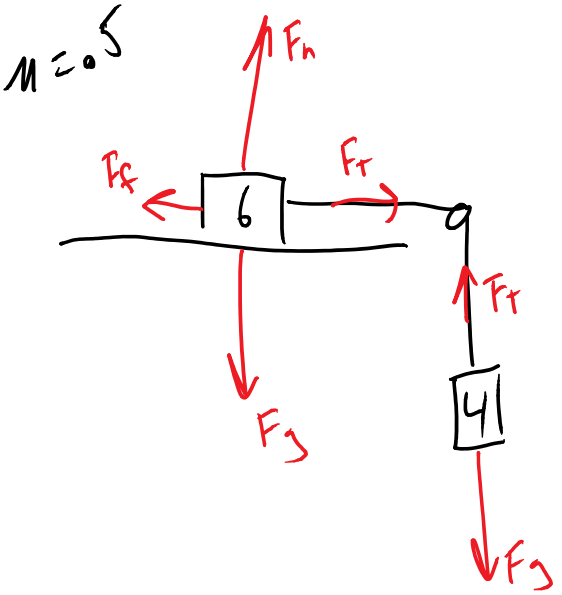
$= 29.4N$

$F_{net} = ma$

$29.4 = (5+3)a$

$\frac{29.4}{5+3} = a = 3.68 \frac{m}{s^2}$

$\mu = .5$



$F_{net} = W - L$

$F_f = \mu mg$

$= (.5)(6)(9.8)$

$= 29.4N$

$F_g = mg$

$= 4(9.8)$

$= 39.2N$

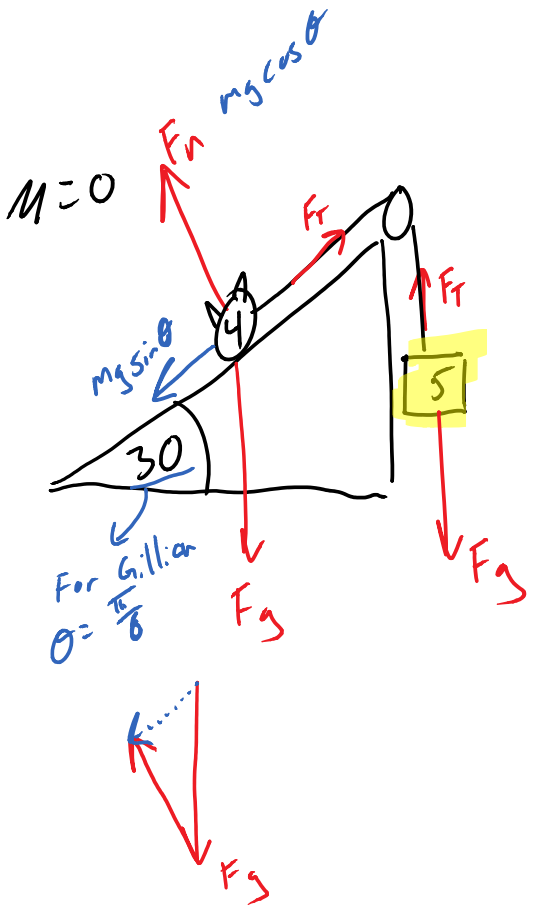
$W - L$

$39.2 - 29.4 = 9.8N$

On the whole system $F = ma$

$9.8 = (6+4)\,a$

$\frac{9.8}{6+4} = a = .98\ m/s^2$



$F = W - L$

$F_{down} = mg\sin\theta$

$= 4(9.8)\frac{1}{2}$

$= 19.6\,N$ (L)

$F_g = mg$

$= 5(9.8)$

$= 49\,N$ (W)

$F = 49 - 19.6 = 29.4\,N$

on the whole system

$F = ma$

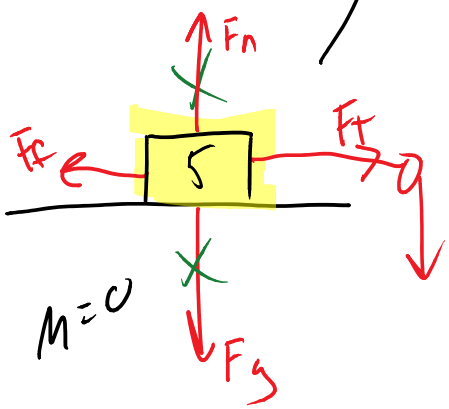
$29.4 = (5+4)\,a$

$\frac{29.4}{5+4} = a = 3.27\ m/s^2$

Tension

From above $a = 3.27\ m/s^2$

1) Find acceleration
2) Find Tension



$F = ma$

$F = 5(3.27)$

$= 16.4\,N$

$F_{net} = W - L$

$= F_T - F_f$

$16.4 = F_T - 0$

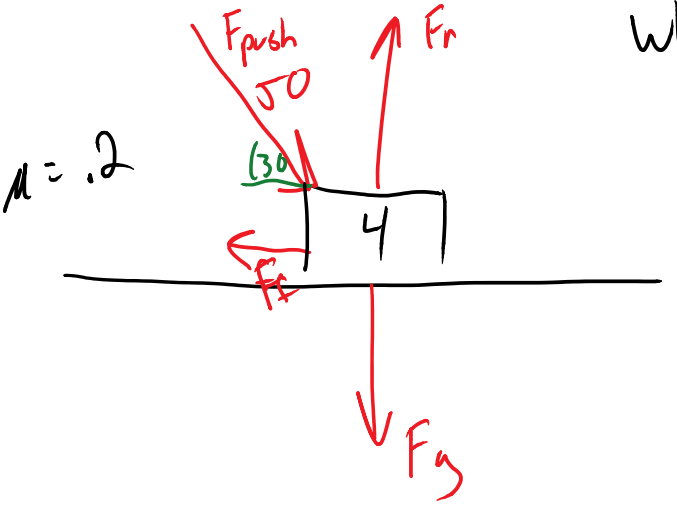
$16.4 = F_T$

F_g

$= 16.4 N$

$16.4 - T = 0$

$16.4 = F_T$



What is the acceleration of the system?

1) Components

$F_{px} = 43.3$

$F_{py} = 25$

$\therefore F_n = mg + F_{py}$

$= 4(9.8) + 25$

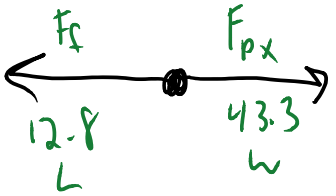
$= 64.2 N$

$F_f = \mu F_n$

$= .2(64.2)$

$= 12.8 N$

$F_{net} = W - L$



$F_{net} = 43.3 - 12.8 = 30.5 N$

$F = ma$

$30.5 = 4a$

$\frac{30.5}{4} = a$

$7.62 \frac{m}{s^2} = a$