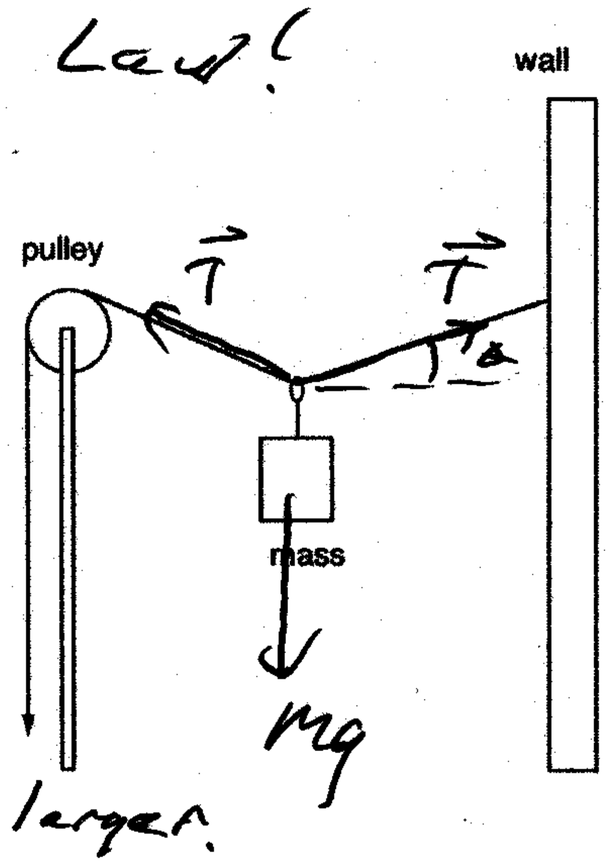
8. A stationary Smart Car is struck from the side by a speeding freight train. Which exerts the greater force on the other, or are the forces the same in magnitude, and why?

Newton's IIIrd Law!

9. Why does the force F required to raise the mass in the arrangement on the right become larger as the mass is raised higher? Is it possible to exert enough force to make the rope straight?



To balance the weight, we need a vertical component of the tensions. θ smaller, T = F must be larger.

No.

Big problems: (20 points each, drop the low one)

1. A rocket's altitude is given by $y(t) = (22\ m/s^2)t^2$.

a) What is its velocity at a height of 7 km?

at $y = 7km$ $\quad t = \sqrt{\frac{7000m}{22\ m/s^2}} = 17.84s$

$V(t) = \frac{dy}{dt} = (44\ m/s^2)t$

$= 785\ m/s$ at $t = 17.84s$

At the height of part a), the first stage falls away.

b) What maximum altitude will the first stage reach?

$V_{oy} = 785\ m/s \quad y_o = 7000m$

$V_f = 0$

$V_f^2 - V_{oy}^2 = -2g(y_m - y_o)$

$y_m = y_o + 31.4km = 38.4km$

c) How long after the first stage falls away will it be before the first stage hits the ground?

$y_f - y_o = v_{oy}t - \frac{1}{2}gt^2$

$0m - 7000m = (785\ m/s)t - (4.9\ m/s^2)t^2$

$(4.9\ m/s^2)t^2 - (785\ m/s)t - 7000m = 0$

$t = \frac{1}{9.8\ m/s^2}[785\ m/s \pm \sqrt{(785)^2 + 4(4.9)(7000)}\ m/s]$

$t = 170s, -8.5s$