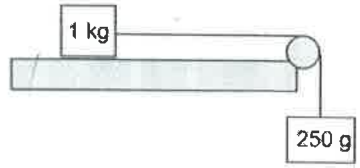
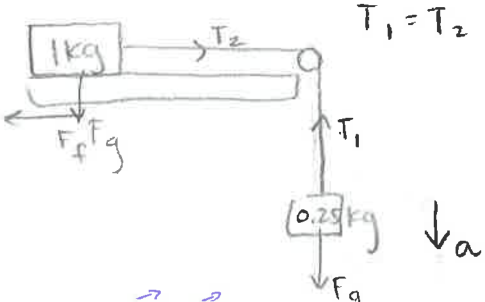
Big Exam #5

A

1) The system at right has a low friction pulley, a ligh string and a horizontal, smooth, slippery surface.

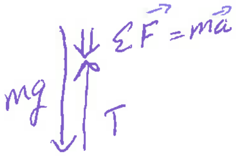


- The tension in the string holding the 250 g mass. What do you know about this tension? Is it <, =, > 2.5 N? How do you know?
- What would happen to the tension in the string if there was significant friction between the 1 kg mass and the surface?
- What would happen to the tension in the string if the horizontal surface was instead slightly inclined, such that the right side was lower than the left side? How do you know? What lens did you use?



$T_1 = T_2$ a. dynamics lens for entire problem, because tension is a force

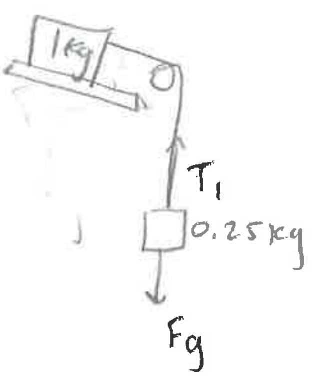
since the only force on the 1kg is T_2 it will accelerate right and 0.25 kg will accelerate down



since acceleration is down, tension has to be less than $F_g = 2.5$ N for the resultant vector to be down

* down = positive *

b. it would increase because the acceleration of 1kg would decrease with a force acting against T_2 ($\Sigma F = T_2 - F_f = ma$), so the acceleration of 0.25 kg would also decrease so T_1 must increase to reduce the effect of F_g on 0.25 kg ($\Sigma F = F_g - T_1 = ma$)



c. F_g is now pulling the 1kg mass down the ramp. so acceleration increases in both directions and the tension therefore decreases

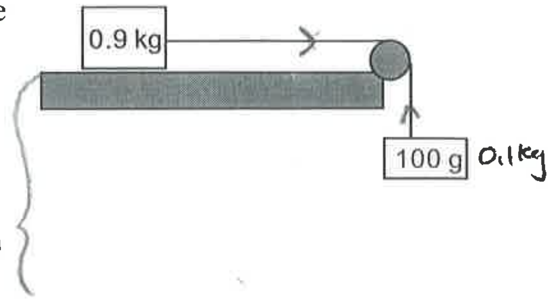
($\Sigma F_{0.25kg} = F_g - T_1 = m\vec{a}$)

if a increases then $\Sigma\vec{F}$ must increase, so $F_g - T$ must increase so T ⇓

great.

2) I release the system at right from rest with the 100 g mass 1 m above the floor. The thin string slides over a smooth bearing.

- Please find the speed of the 0.9 kg mass when the 100 g mass hits the floor.
- Using this information or by some other means, please find the time to fall, the acceleration of the hanging mass as it falls, and the tension in the string.



a. energy lens because energy is conserved

PE ⇒ KE

$mgh = \frac{1}{2}mv^2$

$0.1kg(10m/s^2)(1m) = \frac{1}{2}(1kg)v^2$ great

$V_f = \sqrt{2m^2/s^2}$

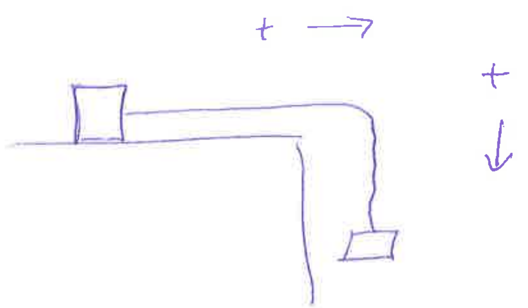
$V_f \approx 1.4$ ◯ units!   − 5 points.

b. kinematics lens because we are looking at motion as a func. of time

$V_{ave} = \frac{V_f + V_o}{2} = \frac{1.4m/s + 0m/s}{2} = 0.7\ m/s$

$t = \frac{\Delta x}{V_{ave}}$

$t = \frac{1m}{0.7m/s} \approx 1.4\ s$



$a = \frac{\Delta V}{\Delta t}$

$a = \frac{1.4m/s}{1.4s} = 1\ m/s^2$

Tension? ... look at the 0.9 kg mass − only 1 force, T, so $\Sigma \vec{F} = m\vec{a}$

$T = ma = 0.9kg \cdot 1 m/s^2 = 0.9N$

now, look at the other mass.

$\Sigma \vec{F} = m\vec{a} \Rightarrow F_g - T = ma \Rightarrow 1N - 0.9N = 0.1kg(1 m/s^2)$

$0.1N = 0.1N$ ☺