Physics 200 Name: Key

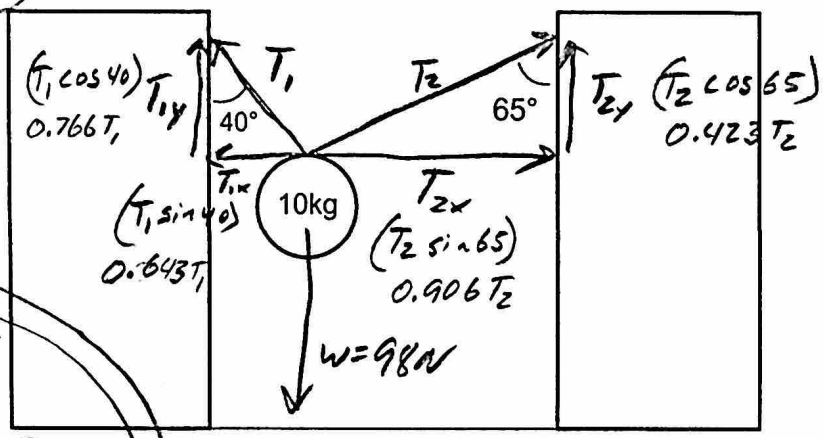
Newton's Laws in 2 Dimensions – Practice Problems #1

$\Sigma F = 0 = \Sigma F_x = \Sigma F_y$

1. The 10kg mass is in static equilibrium. Find the tensions in the two segments of rope.

$\Sigma F_x = 0 = T_{2x} - T_{1x} \Rightarrow T_{2x} = T_{1x}$

$\Sigma F_y = 0 = T_{1y} + T_{2y} - 98N$



$0.906T_2 = 0.643T_1$

$1.41T_2 = T_1$

$0 = 0.766T_1 + 0.423T_2 - 98N$

$0 = 0.766(1.41T_2) + 0.423T_2 - 98N$

$0 = 1.50T_2 - 98N$

$98N = 1.5T_2$

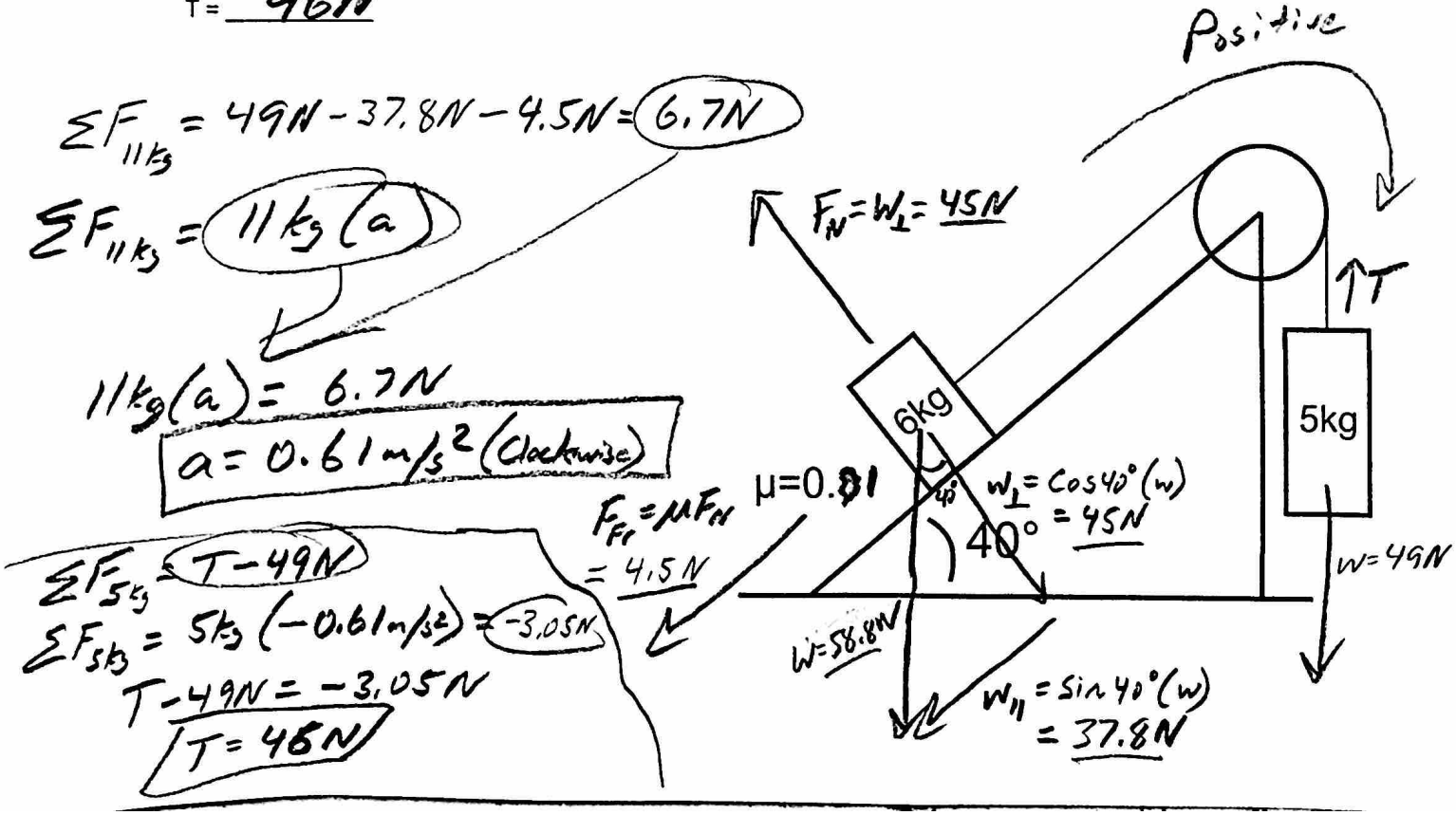
$T_2 = 65.2N$

$T_1 = 1.41(65.2N) = 91.9N = T_1$

2. Find the acceleration of the masses and the tension in the string.

a = $0.61 m/s^2$ CW

T = 46N



$\Sigma F_{11kg} = 49N - 37.8N - 4.5N = 6.7N$

$\Sigma F_{11kg} = 11kg(a)$

$11kg(a) = 6.7N$

$a = 0.61 m/s^2$ (clockwise)

$\Sigma F_{5kg} = T - 49N$

$\Sigma F_{5kg} = 5kg(-0.61 m/s^2) = -3.05N$

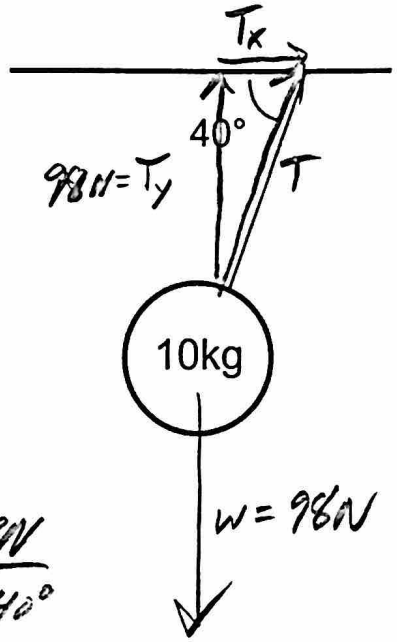
$T - 49N = -3.05N$

$T = 46N$

3. The mass is suspended from the ceiling of a moving vehicle. The angle shown is constant. Find the acceleration of the mass and the tension in the string.

a = 11.7 m/s², rightward

T = 152 N



$\Sigma F_y = 0 = T_y - 98N \Rightarrow T_y = 98$

$\Sigma F_x = T_x$ $\quad \tan 40° = \frac{98N}{T_x} \Rightarrow T_x = \frac{98N}{\tan 40°}$

$T_x = 117N$

$\Sigma F_x = 10kg(a)$

$10kg(a) = 117N$

$a = 11.7 m/s^2$

$T = \sqrt{98^2 + 117^2}$

$T = 152N$

4. Find the acceleration of the 8kg mass. ***To make this problem more interesting, use μ=0.2, instead***

$\Sigma F_y = 0 = F_N + 19.3N - 78.4N \Rightarrow F_N = 58.7N$

$\Sigma F_x = 11.8N - 23N = -11.2N$

$\Sigma F_x = 8kg(a)$

$8kg(a) = -11.2N$

$a = -1.4 m/s^2$

$a = 1.4 m/s^2$ leftward