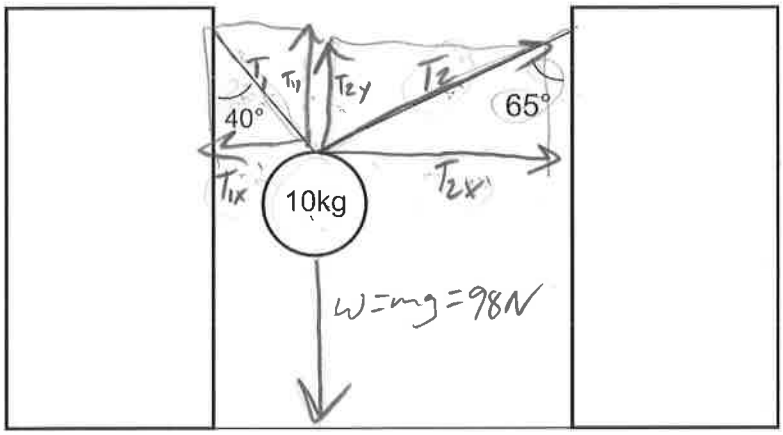
Physics 200
Practice Quiz – Newton's Laws in 2 Dimensions

Name: Answers

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



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

$T_{2x} = T_{1x}$

$\sin 65° T_2 = \sin 40 T_1$

$0.906 T_2 = 0.643 T_1$

$T_2 = 0.71 T_1$

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

$0 = \cos 40° T_1 + \cos 65° T_2 - 98N$

$0 = 0.766 T_1 + 0.423 T_2 - 98N = 0.766 T_1 + 0.423 (0.71 T_1) - 98N$

$0 = 0.766 T_1 + 0.3 T_1 - 98N$

$T_1 = 91.5N$

$T_2 = 0.71 T_1 = 65N$

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

a = $0 m/s^2$

T = $49N$

$W_\perp = \cos 40° (58.8N) = 45N$

$W_{||} = \sin 40° (58.8N) = 37.8N$

$\sum F_\perp = 0 = F_N - W_\perp \Rightarrow F_N = W_\perp$

$\sum F_{||} = 49N - W_{||} - F_{fr}$

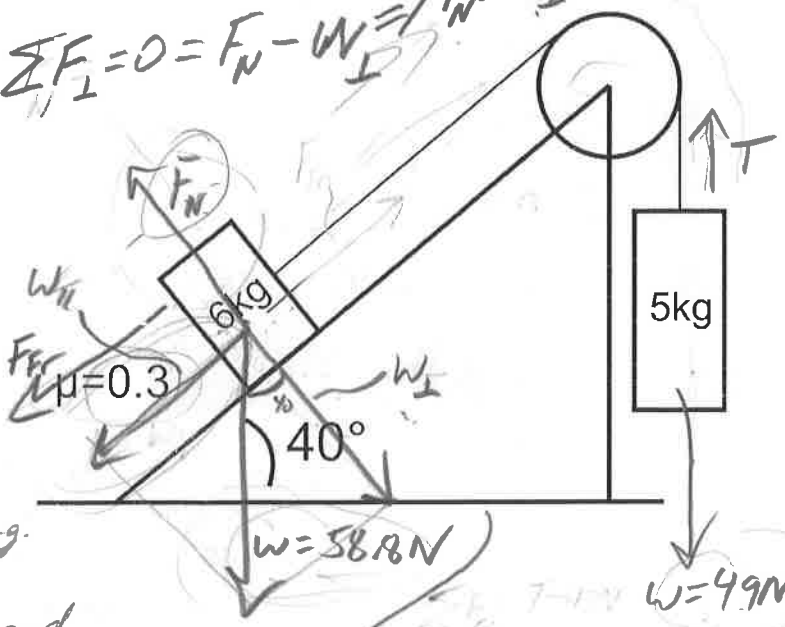
$\sum F_{||} = 49N - 37.8N - \mu F_N$

$\sum F_{||} = 11.N - 0.3(45N)$

$\sum F_{||} = 11N - 13.5N$

Friction too strong. Adjusts to 11N, so no acceleration and $\sum F = 0$.

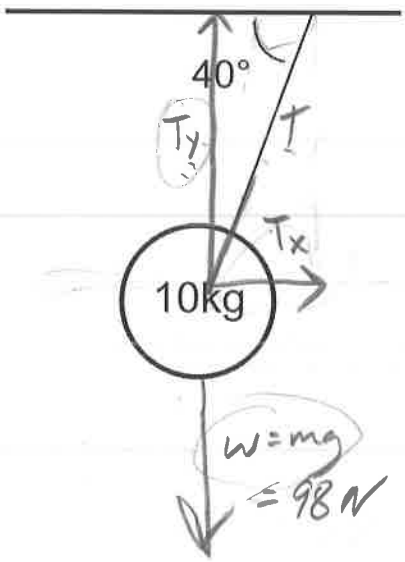
$a = 0 m/s^2$



$\sum F_{5kg} = T - 49N = ma = 0$

$T = 49N$

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 = $11.7 m/s^2$

T = 152N

$T_y = 98N$

$\frac{T_y}{T} = \sin 40°$

$T_y = \sin 40° T$

$98N = \sin 40 T$

$152N = T$

$\frac{T_x}{T} = \cos 40°$

$T_x = \cos 40° T$

$T_x = \cos 40°(152N)$

$T_x = 117N$

$\Sigma F = \Sigma F_x = T_x = ma$

$117N = 10kg(a)$

$a = 11.7 m/s^2$

4. Find the acceleration of the 8kg mass.

$F_y = \sin 40°(30N) = 19.3N$

$F_x = \cos 40°(30N) = 23.0N$

$\Sigma F_y = 0 = F_y + F_N - w$

$0 = 19.3N + F_N - 78.4$

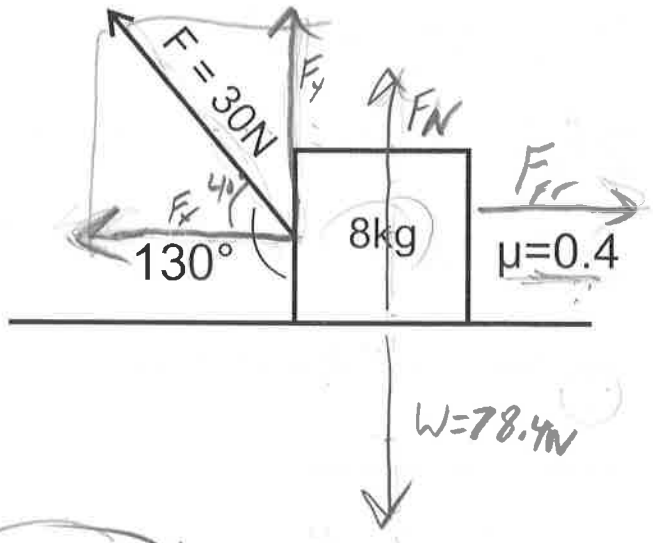
$F_N = 59.1N$

$\Sigma F_x = F_x - F_{fr}$

$\Sigma F_x = 23.0N - \mu(F_N)$

$\Sigma F_x = 23.0N - 0.4(59.1N)$

$\Sigma F_x = 23.0N - 23.6N$



11.18N leftward

Friction stronger than pull. Friction adjusts to 23N, so

$\Sigma F = 0$ and $a = 0 m/s^2$

$1.4 m/s^2$ leftward