Homework Set #6

1) A worker stands still on a roof sloped at an angle of 36° above the horizontal. He is prevented from slipping by a static frictional force of 390 N. Find the mass of the worker.

2) Three forces act on an object. One force has a magnitude of 80.0 N and is directed due north. Another has a magnitude of 60.0 N and is directed due west. What must be the magnitude and direction of the third force, such that the object continues to move with a constant velocity?

3) A car is towing a boat on a trailer. The driver starts from rest and accelerates to a velocity of +11 m/s in a time of 28 s. The combined mass of the boat and trailer is 410 kg. The frictional force acting on the trailer can be ignored. What is the tension in the hitch that connects the trailer to the car?

4) In the drawing, the weight of the block on the table is 422 N and that of the hanging block is 185 N. Ignoring all frictional effects and assuming the rope and pulley to be massless, find (a) the acceleration of the two blocks and (b) the tension in the rope.

\[
S = 390 N
\]

\[
y \text{-dir: } N = mg \cos 36^\circ = 0
\]

\[
x \text{-dir: } mg \sin 36^\circ - S = 0
\]

\[
m (9.8) \sin(36^\circ) = S = 390 N
\]

\[
m = \frac{390 N}{(9.8) \sin 36^\circ} = 67.7 \text{ kg}
\]

2) Since moving at constant \( v \), \( a = 0 \) \( \Rightarrow F = 0 \)

\[
F_2 = 60N \hat{x} - 80N \hat{y}
\]

\[
F_3 = \sqrt{60^2 + 80^2} = 100 N
\]

\[
\theta = \tan^{-1} \left( \frac{60}{80} \right) = 36.9^\circ \text{ East of South}
\]
3) Look at trailer

\[
\begin{align*}
410\text{kg} & \quad T \quad \arrows \quad a \quad a = \frac{\Delta v}{\Delta t} = \frac{11\text{ m/s}}{2.85} \\
& \quad \quad a = 0.39\text{ m/s}^2
\end{align*}
\]

\[
T = ma
\]

\[
= (410\text{kg})(0.39\text{ m/s}^2)
\]

\[
T = 159.9\text{ N}
\]

4) \[
\begin{align*}
m_1 & = \frac{422\text{N}}{9.8\text{ m/s}^2} = 43\text{kg} \\
m_2g & = 185\text{N} \\
m_2 & = \frac{185}{9.8} = 18.9\text{ kg} \\
m_2g & = (m_1+m_2)a \\
a & = \left(\frac{m_2}{m_1+m_2}\right)g \\
& = \left(\frac{18.9\text{kg}}{43\text{kg}+18.9\text{kg}}\right)9.8\text{ m/s}^2 \\
& = 3\text{ m/s}^2
\end{align*}
\]

\[
T = m_1a = (43\text{kg})(3\text{ m/s}^2) = 129\text{ N}
\]