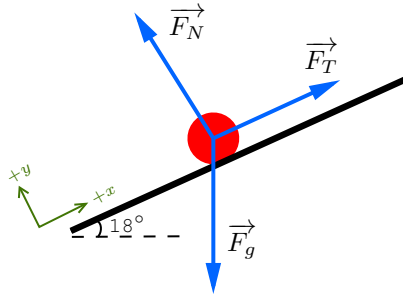
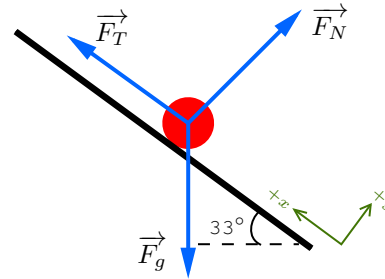


SPH4U: Dynamics Assignment

Q01.

(a) Draw FBD(s).

 m_1 FBD: m_2 FBD:

(b) Find the magnitude of the tension in the cable.

 m_1 :

$$F_{net1x}^{\rightarrow} = 0$$

$$0 = |\vec{F}_T| - F_{gx}$$

$$0 = |\vec{F}_T| - 380(9.81) \sin 18^\circ$$

$$|\vec{F}_T| = 380(9.81) \sin 18^\circ$$

$$|\vec{F}_T| = 1151.95 \text{ N}$$

$$|\vec{F}_T| = 1200 \text{ N}$$

\therefore The magnitude of tension in the cable is **1200 N**.

(c) Calculate the mass of m_2 needed to keep the system in equilibrium.

$$F_{net2x}^{\rightarrow} = 0$$

$$0 = \vec{F}_T - F_{gx}$$

$$0 = 1151.95 - m_2(9.81) \sin 33^\circ$$

$$m_2 = \frac{1151.95}{9.81 \sin 33^\circ}$$

$$m_2 = 215.6 \text{ kg}$$

$$m_2 = 220 \text{ kg}$$

\therefore The mass of the second box (m_2) is **220 kg**.

Q02.

(a) What will be the horizontal acceleration of the bale?

$$F_{netx}^{\rightarrow} = F_{ax} - \vec{F}_f$$

$$= 140 \cos 28^\circ - 55$$

$$= 68.81 \text{ N[forward]}$$

$$F_{netx}^{\rightarrow} = m\vec{a}$$

$$68.81 = 35\vec{a}$$

$$\vec{a} = 1.96 \text{ m/s}^2[\text{forward}]$$

$$\vec{a} = 2.0 \text{ m/s}^2[\text{forward}]$$

\therefore The horizontal acceleration of the bale will be **2.0 m/s²[forward]**.

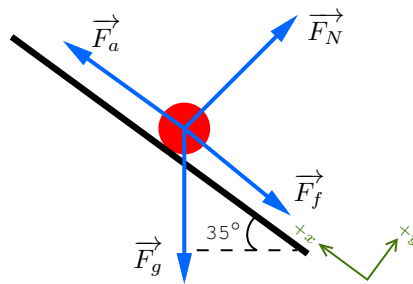
- (b) What is the coefficient of friction between the bale and the ground?

$$\begin{aligned}\vec{F}_f &= \mu_f \vec{F}_N \\ 55 &= \mu_f (\vec{F}_g - \vec{F}_{a_y}) \\ \mu_f &= \frac{55}{\vec{F}_g - \vec{F}_{a_y}} \\ \mu_f &= \frac{55}{35(9.81) - 140 \sin 28^\circ} \\ \mu_f &= 0.198 \\ \mu_f &= 0.20\end{aligned}$$

\therefore The coefficient of friction between the bale and ground is **0.20**.

Q03.

- (a) Draw an FBD showing a tilted coordinate system (label positive x-direction)



- (b) What minimum force, F , would be necessary to move the box up the ramp at a constant speed?

$$\begin{aligned}F_{net_x} &= \vec{F}_a - \vec{F}_{g_x} - \vec{F}_f \\ 0 &= \vec{F}_a - 15(9.81) \sin 35^\circ - 110 \\ \vec{F}_a &= 15(9.81) \sin 35^\circ + 110 \\ \vec{F}_a &= 194.4 \text{ N[uphill]} \\ \vec{F}_a &= 190 \text{ N[uphill]}\end{aligned}$$

\therefore Since constant speed implies no acceleration in this scenario ($F_{net}^\rightarrow = 0$), the force needed to move the box at constant speed must also result in 0 net force, meaning the minimum force required is **190 N[uphill]**.

Q04.

Since there is constant speed, $F_{net_x}^{\rightarrow} = 0$

m_1 :

$$F_{net_x}^{\rightarrow} = \vec{F}_T - \vec{F}_f - \vec{F}_{gx}$$

$$0 = \vec{F}_T - \vec{F}_f - 0.45(9.81) \sin 35^\circ$$

$$\vec{F}_T = \vec{F}_f + 0.45(9.81) \sin 35^\circ$$

$$\vec{F}_T = \vec{F}_f + 2.53 \text{ N[uphill]}$$

m_2 :

$$F_{net_y}^{\rightarrow} = \vec{F}_g - \vec{F}_T$$

$$0 = 0.35 \times 9.81 - \vec{F}_T$$

$$\vec{F}_T = 3.43 \text{ N[up]}$$

Set Equations for

F_T Equal:

$$3.43 = \vec{F}_f + 2.53$$

$$\vec{F}_f = 0.9 \text{ N[downhill]}$$

Solve for Friction Coefficient:

$$\vec{F}_f = \mu_f \vec{F}_N$$

$$0.9 = \mu_f \times 0.45(9.81) \cos 35^\circ$$

$$\mu_f = \frac{0.9}{0.45(9.81) \cos 35^\circ}$$

$$\mu_f = 0.249$$

$$\mu_f = 0.25$$

\therefore The coefficient of friction between the box and incline is **0.25**.