Inclined Plane

eexample: An object of mass $m = 8\text{kg}$ slides down a plane with inclination angle of 35° with respect to the horizontal. It starts from rest at a height of 2m. The coeff. of kinetic friction is 0.4. After what time does it reach the bottom?

1) Draw Picture:

\[ \begin{align*}
V(0) &= 0 \\
\mu_k &= 0.4 \\
\theta &= 35°
\end{align*} \]

2) Tilt your coordinate system

\[ \begin{align*}
\mathbf{\Sigma F}_y &= N - mg\cos\theta = ma_y = 0 \\
N &= mg\cos\theta \\
f_k &= \mu N = 0.4 N \\
\mathbf{\Sigma F}_x &= mg\sin\theta - f_k = ma_x \\
x &= g\sin35° - 0.4g\cos35° = 2.4 m/s^2 \\
\mu &= \text{constant}
\end{align*} \]

\[ \begin{align*}
V(t) &= a_x t + V(0) \\
X(t) &= \frac{1}{2} a_x t^2 + X(0) \\
\sin35° &= \frac{2m}{X} \\
\Rightarrow X &= 3.5 m
\end{align*} \]

\[ 3.5 m = \frac{1}{2} (2.4 m/s^2) t^2 + 0 \]

\[ t = 1.7 s \]
Last year's exam problem #4. no friction

\[ \text{force on } M_B \leq T_c \]

a.) \( P_{\text{max}} = ? \) w/out \( M_B \) being 

"composite object"

one object with \( M_A + M_B \)

\[ \sum F_{\text{comp}} = P \cos \theta = (M_A + M_B) a \]

\[ a = \frac{P \cos \theta}{M_A + M_B} \]

Isolate \( M_B \) and draw force diagram

\[ F_{AB} = \frac{P \cos \theta}{M_A + M_B} \]

\[ F_{AB} = M_B a \]

\[ F_{\text{max}} = T_c \]

\[ T_c = \frac{M_B P \cos \theta}{M_A + M_B} \]

\[ P_{\text{max}} = \frac{T_c (M_A + M_B)}{M_B \cos \theta} \]
Now isolate $MA$ (alternate way to solve)

\[ \sum F_{Ax} = P \cos \theta - F_{BA} = MA \cdot \alpha \]
Elevator Problem

If elevator is not accelerating (moving with constant velocity)

\[ \sum F_y = 0 \]

\[ N - F_g = 0 \]

\[ N = F_g \]

Scale reading = force with which person is pushing down on scale

= and opposite to force w/ which scale pushes up on person

\[ \therefore \text{scale reading} = \text{Normal force} \]

\[ a = 0 \Rightarrow N = F_g \]

apparent weight = true weight
\[ \sum F_y = N - mg = ma_c > 0 \]

\[ \Rightarrow N = mg + ma_c \]

Apparent weight > true weight
\[ \sum F_y = ma_y \]

\[ N - F_g = -ma_c \]

\[ N = mg - ma_c \]

Apparent weight < true weight