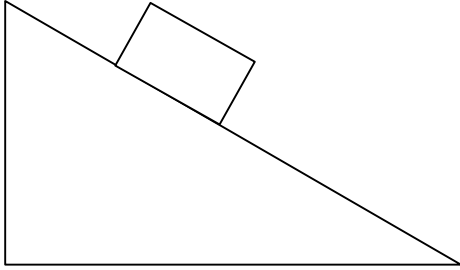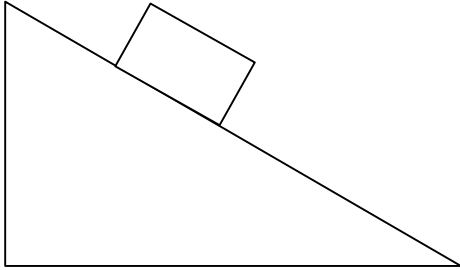# Inclined Plane Problems

Example 1

A 20 *kg* box is sliding down a frictionless ramp. The ramp makes an angle of $30°$ with the ground. If the ramp is 15 *m* long, and the box starts from rest, how long will it take to reach the bottom?
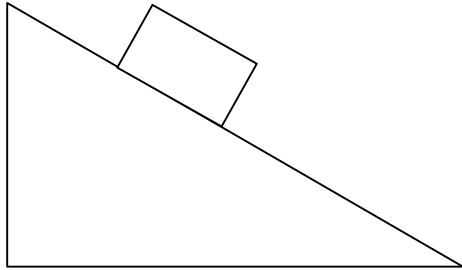
Example 2

How does the motion of the box in example 1 change if you exert a $40 \ N$ force on it, directed up the slope?

Example 3

What force would you need to exert on a $20\ kg$ box in order to push it up a frictionless ramp at a constant velocity? The ramp makes an angle of $30°$ with the ground.

Dynamics Worksheet #2

1. A girl sits at the top of a frictionless snow-covered hill on her inner tube. If the hill is inclined at an angle of $25°$ to the horizontal, what will be the girl's acceleration down the hill? ($4.14\ m/s^2$)

2. Evel Knievel is driving his motorcycle up a ramp inclined at $30°$ to the horizontal before jumping over a row of cars. Determine the force that the motorcycle engine must apply to accelerate the motorcycle up the ramp at $3.27\ m/s^2$. Assume that Evil and the motorcycle have a combined mass of $250\ kg$. Disregard friction. ($2043\ N$)

3. Two children are having a toboggan race down a frictionless hill inclined at $30°$ to the horizontal. The children's masses are $20\ kg$ and $40\ kg$.

   a) What is the acceleration of each child? (both $4.9\ m/s^2$)

   b) Which child reaches the bottom of the hill first?

4. A $95\ kg$ hockey player slides down a $50\ m$ long ice-covered hill on his skates. The frictionless hill is inclined at $35°$ to the horizontal. Assuming he started from rest, how fast will he be moving at the bottom of the hill? ($23.7\ m/s$)

5. A $15\ kg$ box is released from rest at the top of a frictionless $32°$ incline. If the box takes $4.5\ s$ to reach the bottom, determine the _height_ of the incline. ($27.9\ m$)

6. How much force would you need to exert on a $48\ kg$ crate in order to keep it at rest on a frictionless incline? The incline makes an $18°$ angle with the horizontal. ($145.4\ N$)

7. A $25\ kg$ box is held at rest on an incline by a $157\ N$ force directed up the slope. Determine the angle the incline makes with the horizontal. ($39.9°$)

8. A box is held at rest on an incline by a $200\ N$ force directed up the slope. If the incline makes a $30°$ angle with the horizontal, determine the mass of the box. ($40.8\ kg$)

9. A block of mass $2.0\ kg$ is placed on a frictionless plane, inclined to the horizontal at an angle of $15°$. The force of gravity, acting straight down on the block, is $20\ N$.

   a) What is the acceleration of the block down the plane? ($2.54\ m/s^2$)

   b) How far up the plane was the block released, if it took $1.5\ s$ to reach the bottom after it was released from rest? ($2.85\ m$)