PHY 621 Introduction to Inclined Planes

Note: I did not consider the angle measures when counting significant digits.

1. A 20. kg box is set on a frictionless plane inclined at 25°. What is the acceleration of the box when it is released?

2. David is helping to unload a truck. He sets a 30. kg crate on a frictionless plane inclined at 30°.
   a) What is the acceleration of the crate when he releases it?
   b) What force must David apply upward parallel to the plane if he doesn't want the crate to move?
   c) What is the acceleration of the crate if he lowers it down the incline with a rope, parallel to the plane, such that the rope applies 50. N up the ramp?

3. a) Mr. Desroches steps onto a frictionless plane inclined at 15°. What is his acceleration?
   b) What is the relationship between Mr. Desroche's mass and his acceleration if the surface of the inclined plane is considered frictionless?

4. Maya is pulling a 200. N crate up a frictionless plane inclined at 25°. The rope is parallel to the plane and has a tension of 125 N. What is the crate's acceleration?

Inclined Planes with Friction

5. Cynthia has a mass of 44 kg. She steps onto an icy plane inclined at 15°. Give that the coefficient of kinetic friction for sneakers-on-ice is 0.185, what is her acceleration?

6. This question continues from #5 above. Suppose Cynthia is now at the bottom of the incline but she can't climb back up, so Jack offers to pull her up. He throws her a rope and tells her to just hang on. He starts to pull with a force that causes Cynthia to accelerate at 0.25 m/s^2 up the slope. What force is the rope applying?

7. A 500. N crate slides up an incline of 18° with a constant speed due to a 400. N force being applied by a rope held parallel to the ramp.

   a) What is the kinetic force of friction exerted on the crate?
   b) What is the coefficient of kinetic friction?

8. Jessica steps onto an icy plane inclined at 20°. Given the coefficient of kinetic friction is 0.215 for her boots-on-ice, what is Jessica's acceleration down the plane?

Answers: 1. 4.15 m/s^2 [down ramp] (or -4.15 m/s^2 [up ramp])

2. a) 4.91 m/s^2 [down ramp] b) 1.5 x 10 ^{2} N [up ramp] c) 3 m/s^2 [down ramp]

3 a) 2.54 m/s^2 [down ramp]

4. 2.0 m/s^2 [up ramp]

5. 0.79 m/s^2 [down ramp]

6. 2.0 x 10 ^{2} N [up ramp]

7. a) 245 N [down ramp] b) 0.516

8. 1.37 m/s^2 [down ramp]

Additional Text Problems

p. 191 # 24, 25, 26 p. 194 # 27, 28

These problems incorporate Kinematics into the analysis. The basic idea is that the FBD and forces will yield an acceleration and then you use that along with d, v, and t to solve for whatever is being asked. All motion is 1D – along the plane – so angles are typically not involved once you get to the kinematics part.