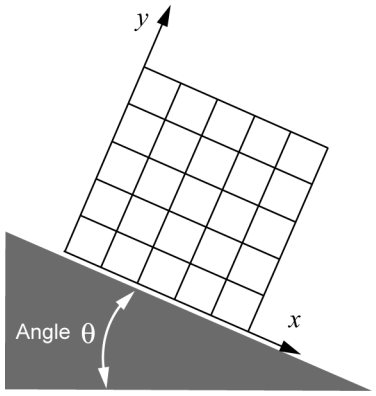
Name:

Skill Sheet 7.3B Inclined Planes

When an object is placed on an inclined plane, the weight force has a component parallel to the plane and a component perpendicular to the plane. The parallel component is pulling the object down the plane. Another force acting on the interface between the object and the place surface is due to friction. The friction force is acting parallel to the plane and opposite to the direction of motion. In this skill sheet, you will solve problems that involve objects moving on inclined planes.

1. Solving inclined plane problems

The angle of an inclined plane, θ, is measured from the horizontal.



The horizontal component of the force is $mg\sin\theta$ where m equals the mass of an object and g equals the acceleration of gravity (9.8 m/sec/sec).

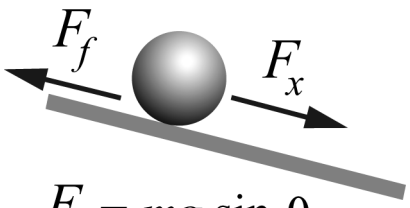
The vertical component of the force is $mg\cos\theta$.

The acceleration of an object on the plane is equal to $g\sin\theta$.

The friction force (F_{friction}) equals $mg\cos\theta$ multiplied by the coefficient of friction (μ).

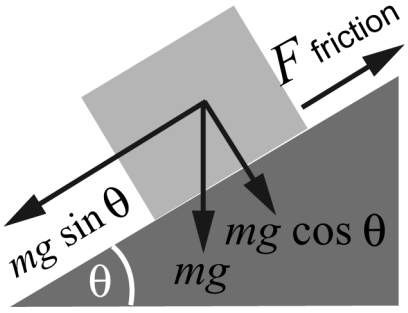
$$F_{\text{friction}} = \mu mg\cos\theta$$

Acceleration on a ramp



$$F_x = mg\sin\theta$$

$$F_f = -\mu mg\cos\theta$$



$$F_{\text{friction}} = \mu\, mg\cos\theta$$

$$\mu = 0.30$$

$$m = 10kg$$

2. Example problems

1. Calculate the components of weight of a 10-kilogram box on an inclined plane making an angle 30 degrees with the horizontal.

2. What is the acceleration of the box in problem 1 along the plane?

3. A mass of 30 kilograms is placed on an inclined plane making an angle of 25 degrees with the horizontal. Find the force parallel and perpendicular to the plane and the acceleration along the plane.

4. A box weighing 10 kilograms is placed on an inclined plane whose coefficient of friction is 0.30. Calculate the maximum inclination angle *before* the box begins to move down the plane.

5. What is the horizontal component of the force acting on the box in problem 4 at the maximum angle?

6. What is the vertical component of the force acting on the box in problem 4 at the maximum angle?

7. What is the total force along the plane acting on the box in problem 4 at the maximum angle?

8. When the angle of the plane of problem 4 is increased to 45 degrees, what is the acceleration parallel to the plane? Use the equation below to help you solve this problem:

$$\text{acceleration} = g(\sin\theta - \mu\cos\theta)$$