Friday warm-up: Forces I

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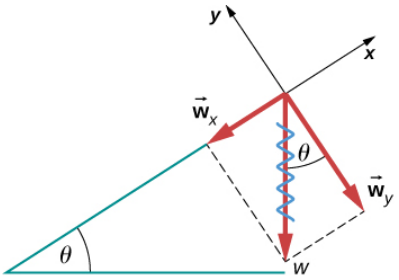
1 Memory Bank

1. $\vec{F}_{\rm net} = m\vec{a}$ ... Newton's Second Law, relating net force, mass, and acceleration.
2. Units of force: 1 N = 1 kg m s^{-2} ... The definition of a Newton of force, like 1 pound.
3. $g = 9.81$ m s^{-2} ... The gravitational acceleration near the Earth's surface.



$w_x = w\sin(\theta) = mg\sin(\theta)$
$w_y = w\cos(\theta) = mg\cos(\theta)$

Figure 1: Forces on an object on an incline.

2 Chapter 5 - Forces

1. Suppose an object with mass 40 kg is sliding down an incline (Fig. 1). In Figure 1, the weight force $\vec{w}$ is broken into components $\vec{w}_x$ and $\vec{w}_y$. (a) If $\theta =$ 30 degrees, calculate the magnitudes w_x and w_y. (b) What is the net force on the system, assuming there is no friction? (c) If the system slides 0.45 meters starting from rest, what is the final speed?

2. Suppose a 60 kg skiier is sliding down a slope with $\theta = 15$ degrees. Assume a frictional force of 40 N opposes the motion. (a) What is the net force on the skiier? (b) What is the acceleration of the skiier? (c) Starting with an initial velocity of 5 m s^{-1}, how far does the skiier travel in 30 seconds?

3. (a) Using Fig. 1, show that the magnitude of the weight force is mg, given the components w_x and w_y. (b) Show that, in the limit $\theta \rightarrow 90$ degrees, w_x approaches the full weight of the system. (c) Show that, in the limit $\theta \rightarrow 0$ degrees, w_y approaches the full weight of the system.

4. Prove that the two θ in Fig. 1 are equal, using geometric techniques and the properties of triangles.