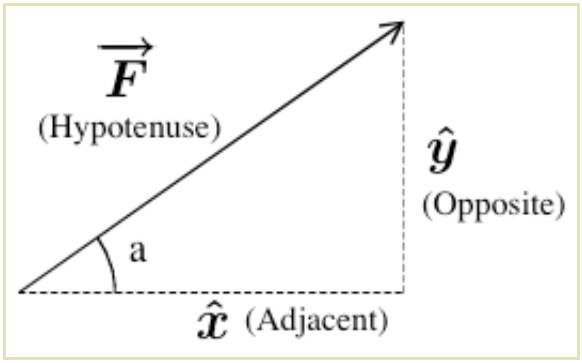
Resolving Components

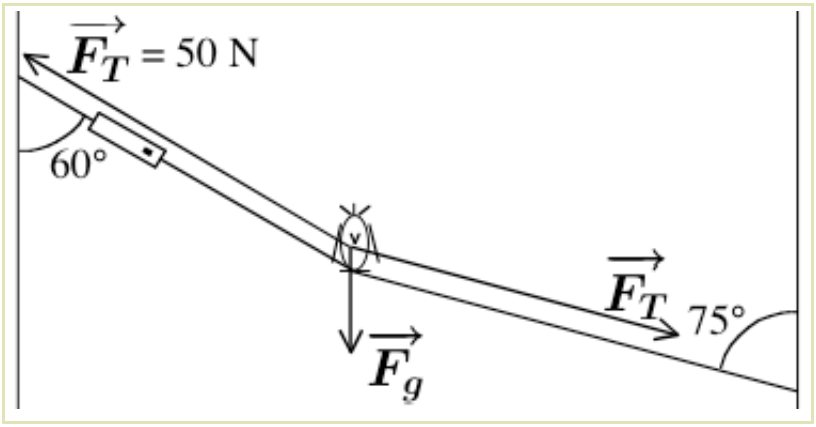
Name:
Period:
Mr. Z's Physics Class
Due: 11/16/06



Now that we know trigonometry, it is possible to take a force that points off at some angle and find its $\hat{x} + \hat{y}$ form. This, in turn, will allow us to add together all the forces acting on an object, even when those forces aren't obligingly lined up along the axes.

If you know the force and an angle, you can draw in dotted lines along the x and y direction to create a right triangle whose legs are the $\hat{x}$ and $\hat{y}$ components of the force $\vec{F}$ that makes the hypotenuse. You can then use trig to solve for the components.

Example: A bird rests on a wire as shown; I want its mass. I can use trigonometry to find out the the upper part of the wire exerts a tension force of $\vec{F_T} = (-43.3\hat{x} + 25\hat{y})$. The $\hat{x}$ component I just found must be balanced by the $\hat{x}$ of the other $\vec{F_T}$; it should be $43.3\hat{x}$. Now, I can use trig ratios again to find out how strong the other force is, and then what its y component is:



`sin(75) = 43.3 / F_t`, so `F_T = 44.8`
`cos(75) = y / 44.8`, so `y = 11.6`

So, my other force vector is $\vec{F_T} = (43.3\hat{x} - 11.6\hat{y})$ N. Assuming that the bird is not accelerating, I know that all the forces should add up to zero:

$$\vec{F_T} + \vec{F_T} + \vec{F_g} = 0$$
$$-43.3\hat{x} + 25\hat{y} + 43.3\hat{x} - 11.6\hat{y} + \vec{F_g} = 0$$
$$14.4\hat{y} + \vec{F_g} = 0$$
$$\vec{F_g} = -14.4\hat{y}$$

The bird has a weight of 14.4 N, which means it has a mass of about 14.4 / 9.8 = 1.47 kg - a very heavy bird!

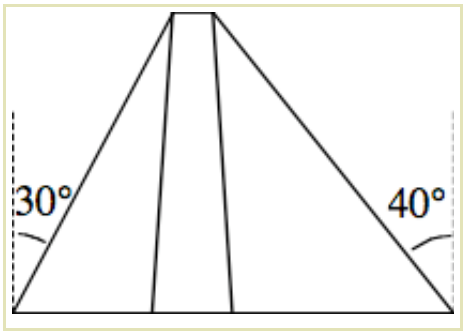
1. I'm trying to knock over a dead tree by attaching a rope to the trunk, about 20 ft up, and pulling from the ground. The rope makes an angle of 15° with the trunk. I'm pulling with a force of 600 N.

   a) Draw a sketch of this situation.

   b) What is the horizontal component of this force?

   c) What should I do to make my effort more effective?

The next two questions refer to the picture to the right. A tower is supported by two wires that are connected to the ground. One is at an angle of 30° away from vertical, the other at an angle of 40° away from vertical.



2. The force in the left wire (30°) is 60 N. What is the vector form of the force in this wire?

3. The horizontal forces from the two wires must be balanced - otherwise, they would pull the tower off to one side.

   a) What is the horizontal component of the tension in the right wire?

   b) What is the vector form of the tension force in that wire?

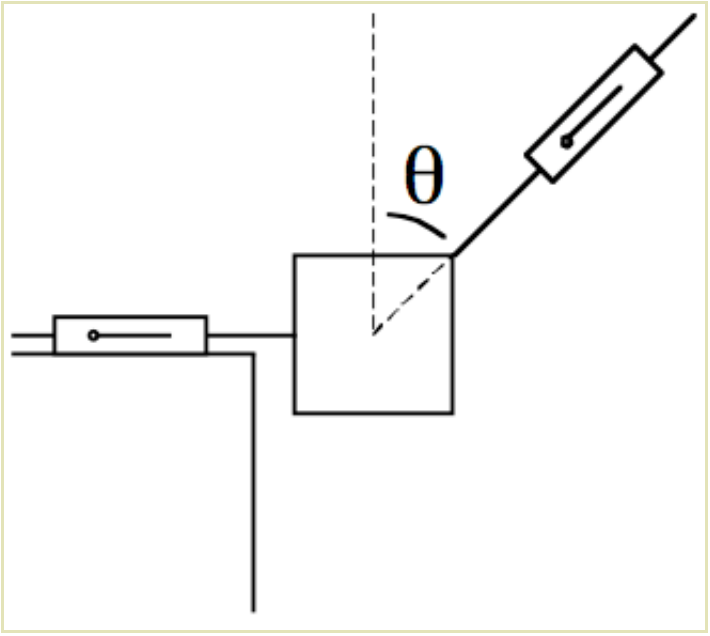
4. Shown at the right is a sketch of a situation from today's lab where the angle θ of the right scale is 45°. The tension force is 7 N.

   a) Draw an arrow showing the tension force.

   b) Draw arrows showing the components of that force. To make them the right length, they should be as long as the sides of a rectangle of which the tension force is the diagonal.

   c) Draw the other forces acting on the box, making their arrows as long as the components in their direction, so it is clear that the force is balanced.

   d) Find out how big each force is, and label that on the sketch as well.



Answers: ***1)*** *b) 155 N* ***2)*** $\vec{F_T} = (-30\hat{x} + 52\hat{y})$ *N* ***3)*** $\vec{F_T} = (30\hat{x} + 35.8\hat{y})$ *N*
4) *The other forces are* $\vec{F_T} = -5\hat{x}$ *N and* $\vec{F_g} = -5\hat{y}$ *N*