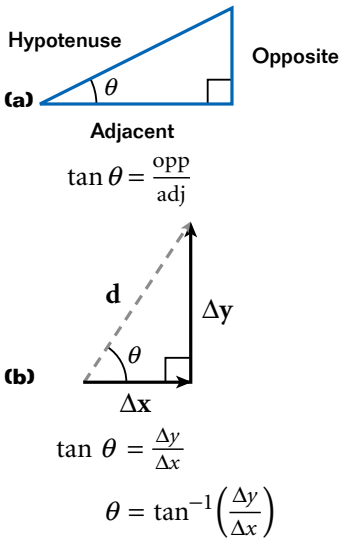


Figure 9
(a) The tangent function can be applied to any right triangle, and **(b)** it can also be used to find the direction of a resultant displacement.

Use the tangent function to find the direction of the resultant

In order to completely describe the tourist's displacement, you must also know the direction of the tourist's motion. Because **Δx, Δy,** and **d** form a right triangle, as shown in **Figure 9(b),** the inverse tangent function can be used to find the angle θ, which denotes the direction of the tourist's displacement.

For any right triangle, the tangent of an angle is defined as the ratio of the opposite and adjacent legs with respect to a specified acute angle of a right triangle, as shown in **Figure 9(a).**

As shown below, the magnitude of the opposite leg divided by the magnitude of the adjacent leg equals the tangent of the angle.

DEFINITION OF THE TANGENT FUNCTION FOR RIGHT TRIANGLES

$$\tan\theta = \frac{\text{opp}}{\text{adj}} \qquad \textbf{tangent of angle} = \frac{\textbf{opposite leg}}{\textbf{adjacent leg}}$$

The inverse of the tangent function, which is shown below, gives the angle.

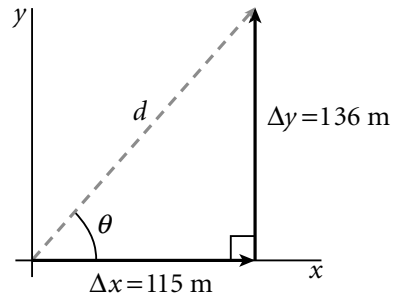
$$\theta = \tan^{-1}\left(\frac{\text{opp}}{\text{adj}}\right)$$

SAMPLE PROBLEM A

Finding Resultant Magnitude and Direction

PROBLEM

An archaeologist climbs the Great Pyramid in Giza, Egypt. The pyramid's height is 136 m and its width is 2.30×10^2 m. What is the magnitude and the direction of the displacement of the archaeologist after she has climbed from the bottom of the pyramid to the top?



SOLUTION

1. DEFINE

Given: $\Delta y = 136$ m $\quad \Delta x = \frac{1}{2}(\text{width}) = 115$ m

Unknown: $d = ?$ $\quad \theta = ?$

Diagram: Choose the archaeologist's starting position as the origin of the coordinate system.

2. PLAN

Choose an equation or situation:

The Pythagorean theorem can be used to find the magnitude of the archaeologist's displacement. The direction of the displacement can be found by using the tangent function.

$$d^2 = \Delta x^2 + \Delta y^2$$

$$\tan\theta = \frac{\Delta y}{\Delta x}$$