Make the Basket

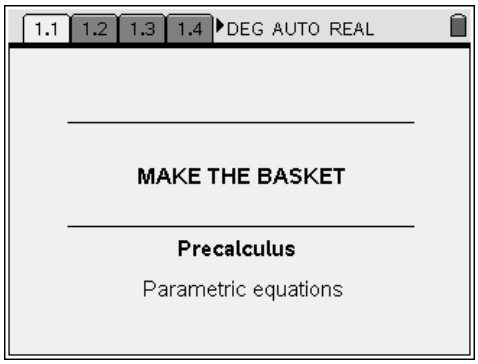
Name _____

ID: 10221

Class _____

In this activity, you will explore:

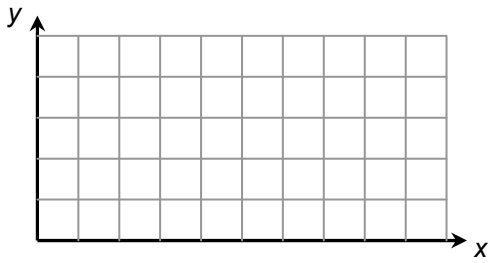
- *Modeling projectile motion with parametric equations*



Open the file *PreCalcAct33_MakeTheBasket_EN.tns* on your handheld and follow along with your teacher to work through the activity. Use this document as a reference and to record your answers.

Introduction – The path of a projectile

When an object is thrown forward through the air, it generally follows a parabolic path. On the grid below, sketch the path of a baseball, from the time it is struck until it hits the ground.

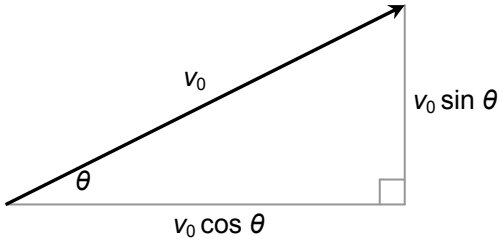


For such an object, factors that influence the path of the object include:

- the initial launch height of the object, h_0
- the initial velocity of the object, v_0.
- the angle at which the object was launched, θ
- the effect of gravity upon the object, -16 ft/sec^2

Each point on the graph of a projectile's path represents a location at a time t. The location has both a horizontal and a vertical component: the horizontal distance, x, from its initial starting point, and the vertical distance, y, from its initial launch height.

How far the object has traveled horizontally and vertically depends on the initial velocity, elapsed time in the air, and the angle at which it was launched. The initial velocity of is a vector, where the horizontal and vertical velocities affect the horizontal and vertical distances. The initial velocity can be illustrated using the right triangle shown here.



Using some trigonometry, the equations for the horizontal and vertical distances are given by the parametric equations:

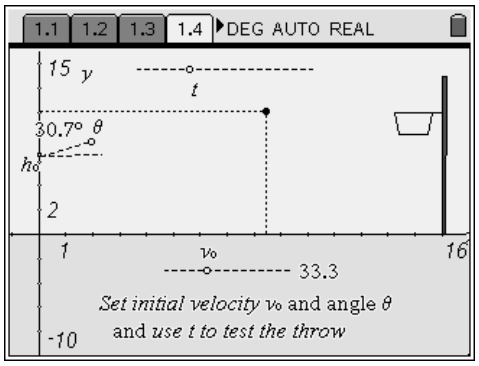
$$x(t) = v_0 (\cos\theta) t$$

$$y(t) = -16t^2 + v_0 (\sin\theta) t + h_0$$

You will now use these parametric equations to model two real-world situations.

Problem 1 – Free throws

To make a free throw, a person must toss a basketball through a hoop with 1.5-ft diameter that is roughly 14 ft away and 10 ft above the ground.



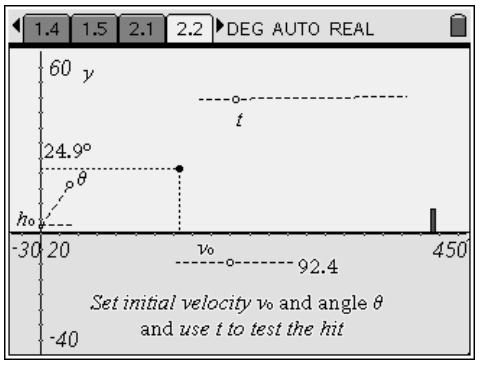
Use the sliders to determine the initial velocity, v_0, and angle, θ, so that the ball will go through the basket. (Assume that h_0 = 6.5 ft.)

- Record you parametric equations here.

Graph your parametric equations on page 1.5 to verify that the ball goes through the hoop.

Problem 2 – A home run

To hit a home run over center field in most major league ball parks, the batter must hit the ball a distance of roughly 410 ft over a 9-ft wall.



Use the sliders to determine the initial velocity, v_0, and angle, θ, so that the ball goes over the fence to score a home run. (Assume that h_0 = 2.5 ft.)

- Record you parametric equations here.

Graph your parametric equations on page 2.3 to verify that the ball goes over the fence.

Summarize

- For both of these models, is there more than one possible solution?

- How might you arrive at a "best" solution?