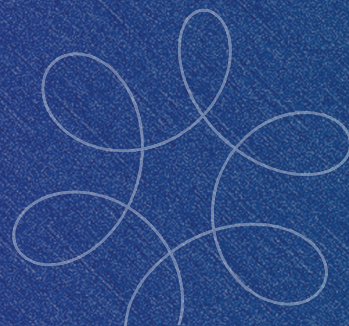


Chapter 12 Project



In this project you will use vector functions to develop a simple model for 3-point basketball shots. To keep the model simple, we will be ignoring air resistance, friction, and other forces. Furthermore, by “scoring,” we will mean that the ball falls straight into the basket on its way downward (i.e., we will ignore the possibility of the ball bouncing in off the backboard, or any energy losses as a result of spins, etc.). For further studies, or for more refined models, the interested student should consult resources such as John Fontanella’s book, *The Physics of Basketball*.

1. A basketball player is attempting a 3-pointer from a horizontal distance of 24.7 feet. He is releasing the ball from 7 feet above ground level, aimed directly toward the basket at an angle of elevation of 45° , with an initial velocity of v_0 . Supposing that the player stands at the origin and the basket is in the positive y -direction, use the three-dimensional coordinate system to find a vector function describing the position of the ball after release as a function of time. (Assume one unit on each axis corresponds to a distance of 1 foot.)
2. Use your answer to Question 1 to verify that the basketball’s trajectory is a parabola.
3. Assuming a standard hoop height of 10 feet, find the initial speed for the ball that ensures that the player described in Question 1 scores.
4. Use your answer from Question 3 to find the necessary initial velocity vector for the basketball if the player is to score from the same spot (i.e., the origin) but this time shooting while running along the line $y = x$ at a speed of 10 mph in the positive direction.
5. Find a formula for and graph the required initial speed as a function of the angle of elevation over the interval $(0, \pi/2)$ if the player is to score (assuming the same spot and release height as in Question 1).
6. Generalizing your work on Question 5, find a formula for the initial speed of a successful shot if the player stands d feet from the hoop and shoots at an angle α upward from horizontal, with a release height of h feet.