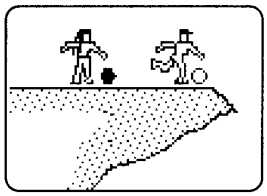
Name _____ Class _____ Date _____

13 Coconut Kick

This simulation investigates the use of vectors to solve physics problems.



Situation A

Kenji and Felecia find some coconuts near the edge of a cliff. They know they can calculate the height of the cliff by finding the time it takes the coconut to fall to the ground and then using the formula $d = 1/2gt^2$. They wonder if the formula will work for a coconut kicked off the cliff instead of dropped straight down over the edge. Kenji and Felecia design an experiment to find the answer. Kenji drops one coconut over the edge at the exact moment Felecia kicks the other coconut off the cliff.

Make a Prediction

1. Predict which coconut will hit the ground first—the coconut dropped over the edge or the coconut kicked outward off the cliff. Assume there is no air resistance. Place a check next to your prediction.
   - **a.** ___ The dropped coconut will hit the ground first.
   - **b.** ___ The kicked coconut will hit the ground first.
   - **c.** ___ Both coconuts will hit the ground at the same time.

Run Simulation Set *Initial y velocity* to 0.00 m/s. Set *Initial x velocity* to 5.00 m/s. Set all Vector Displays to *Off*. Click the *Tracking On* button. Click the *Run* button and observe the simulation.

2. List the forces acting on each coconut as it falls. In which direction, x or y, do these forces act?

3. Was your prediction correct? Explain the results in terms of the force vectors acting on each coconut.

4. How do the vertical positions of the falling coconuts compare?

5. Using the results of the simulation and the formula $d = 1/2gt^2$, calculate the height of the cliff ($g = 10.00$ m/s^2).

Situation B

Kenji and Felecia decide to investigate what will happen when one coconut is thrown vertically upward while the other is kicked upward and outward. Assume both the coconuts have the same initial vertical velocity.

Make a Prediction

6. Predict which coconut will hit the ground first—the coconut thrown upward or the coconut kicked upward and outward. Assume there is no air resistance. Place a check next to your prediction.
   - **a.** ___ The coconut thrown upward will hit the ground first.
   - **b.** ___ The coconut kicked upward and outward will hit the ground first.
   - **c.** ___ Both coconuts will hit the ground at the same time.

Run Simulation Click the *Reset* button. Set *Initial y velocity* to 6.00 m/s. Set *Initial x velocity* to 8.00 m/s. Set the *Force of gravity* and *Velocity* Vector Displays to *On*. Click the *Tracking On* button. Click the *Run* button and observe the simulation. Note: When the Vector Displays are on, two additional coconut images will appear on the screen. These images are used to show the *Force of gravity* vector, **FG**, and the *Velocity* vector, **V**, associated with each of the coconuts as they fall.

7. Was your prediction correct? Explain the results in terms of the force vectors acting on each coconut.

8. Explain what happens to the *Force of gravity* vector as the coconuts fall.

9. Describe what happens to the *Velocity* vector for each of the coconuts as they fall. Explain why the *Velocity* vector for the kicked coconut changes magnitude and direction during the fall.