08.05 Assignment Instructions: Creating a Fruit Catapult

Instructions: You are a part of a team that will be competing at a Fruit Catapult Contest. The goal is to hit targets located at different distances. To help, you need to write a program to calculate the trajectory of a projectile based on launch angles and launch velocities.

1. Create a new project called 08.05 Catapult Trajectory in the Mod08 Assignments folder.
2. Determine the fruit you will be using during the contest. Then create two classes: one to implement your catapult object and the other to test it. The class names are your choice.
3. Review the information about calculating projectile trajectories in the **Background Information** section below.
4. Look up the **`toRadians()`** and the **`sin()`** methods in the Java API for the Math class. The **`sin()`** method parameter must be in radians.
5. Take time to plan your project. The program must use OOP design.
6. Determine the range of speeds and angles to use for the table. Use at least five speeds and six angles. Speeds can be in MPH or KPH, so be sure to label the output accordingly. A suggestion would be to assign the speeds and angles to one-dimensional arrays.
7. Calculate the distance an object can be catapulted for each speed and angle. Store the distance values in a two-dimensional array. The units used for the distance is up to you. Be sure to label your table accordingly. (See expected output).

Expected Output: When your program runs correctly, the format of the output table should resemble the following, but with the appropriate data for each row and column. You may use appropriate angles and velocities of your choice. Be sure to include the units used for speed and distance.

```
                          Projectile Distance (feet)
  MPH      25 deg      30 deg      35 deg      40 deg      45 deg      50 deg
================================================================================
   20
   25
   30
   35
   40
   45
   50
```

Background Information: Trajectory of a Projectile

The distance (R) of a projectile can easily be calculated using the following simple algebraic formula, if a

few complicating factors are ignored (e.g., wind speed, drag coefficient, etc.).

$$R = \frac{v_0^2 \sin(2\theta)}{g}$$

where, v_0 is the launch speed,
θ is the launch angle, and
g is the acceleration due to gravity

Suppose you could launch a projectile at a speed of 40 meters/second (about 90 miles per hour) and a launch angle of 25 degrees. How far down range (R) could the projectile be hurled?

The solution for finding the down range distance of a projectile launched at a speed of 40 m/s and a launch angle of 25° is shown here.

$$R = \frac{v_0^2 \sin(2\theta)}{g}$$

$$R = \frac{(40\text{m/s})^2 \sin(2 \cdot 25^0)}{9.8\text{m/s}^2}$$

$$R = \frac{1600\text{m}^2}{\text{s}^2}(0.7660)\frac{\text{s}^2}{9.8\text{m}}$$

$$R = 125\text{m}$$

$$R = 125\text{m}\frac{100\text{cm}}{\text{m}}\frac{1\text{in}}{2.54\text{cm}}\frac{1\text{ft}}{12\text{in}}$$

$$R = 125\text{m}\frac{3.2808\text{ft}}{\text{m}}$$

$$R = 410\text{ft}$$

Be sure that you can work through the algebra and solve the equation with a calculator. Soon, you will turn it into an arithmetic expression in Java.

Work out several answers with pencil, paper, and calculator first, before attempting to write the program. Pay close attention to units. If your speeds are miles per hour, convert them to meters per second. If you want your final result to be in feet, do that conversion, too.

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