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(With acknowledgement to the parametric equation guru- George Woods)

THE MONKEY HUNTER PROBLEM

This problem is a classic demonstration of projectile motion and if done correctly and with a lot of fanfare, is a big hit with the students. We would encourage you to do it with your classes if you don't already.

Here is a sample problem that can be solved using parametric equations. We will refer you to George Woods' excellent writeup on projectile motion for more information. After the solution, we will show how to solve this using a Casio graphing calculator.

A monkey is in a tree 15 m above the ground. A hunter comes along with a blowgun, and stops 20. m away from the tree. He aims at the monkey and fires the dart with a velocity of 15 m/s. The monkey sees the hunter approach and drops out of the tree at the instant the dart is fired. A bad move on his part, as the dart gets him as he falls!
a) How long does it take for the dart to reach him?
b) Find the vertical position of where the monkey meets his end.
c) What does monkey taste like?

Algebraic Solution: Assume the origin is the dart gun, down is negative, $g = -9.8\ m/s^2$, and the students can find the angle of trajectory by using the given information and the tangent function.

Monkey Equations	Dart Equations
$x = 20.$	$x = v_x t = (15\cos 37°)\, t$
$y = 15 - 4.9t^2$	$y = v_{yi}t - 4.9t^2 = (15\sin 37°)t - 4.9t^2$

At the intersection of the dart and monkey, the x and y equations of the two objects are equal to each other(x = x, y = y). Solving for t and y, you should get t = 1.67 s, and y = 1.34 m. For the sig fig purists, this is 1.7 s and 1.3 m.
And yes, just like every other exotic animal, monkey tastes like chicken.

Casio Calculator Keystrokes and Instructions:
1) AC/ON (Just making sure you're all awake!)
2) 5 (GRAPH)
3) F3 (TYPE)

4) F3 (PARM)
5) Enter the horizontal and vertical functions for the monkey(Lines Xt1 and Yt1). Hit EXE after each line is entered. Use the x, θ, T key to get T.

Xt1 = 20
Yt1 = 15 - 4.9T^2 Note: to get the squared on T, hit the x^2 key.

6) Enter the horizontal and vertical functions for the dart(Lines Xt2 and Yt2). Hit EXE after each line is entered. Use () as shown!! Make sure your calculator is in degree mode; go to setup window to check this.

Xt2 = (15cos37)T
Yt2 = (15sin37)T - 4.9T^2

7) Now get the screen of the calculator ready to view the "monkey being shot."
SHIFT F3 (V-Window)
Enter values for the parameters on the screen.
Xmin: 0
Xmax:30
Scale: 10
Ymin: -2
Ymax: 15
Scale: 1
cursor down (¬)
T,θ
min: 0
max: 2.5
pitch: 0.01

8) EXIT
9) F6 (DRAW)
10) Use F1 (TRACE) to check your calculations. Use the arrow keys to move around on the graphs. Scroll to the intersection of the two lines, and the values for T and Y should match your calculations fairly well.