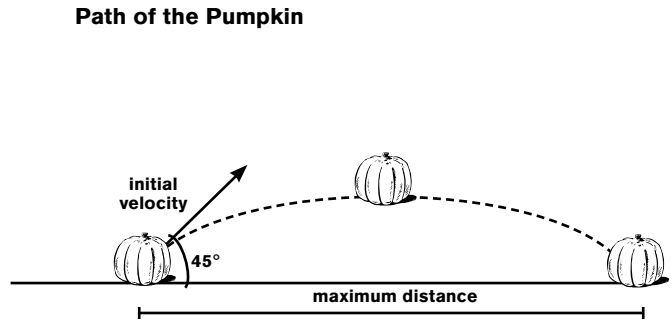
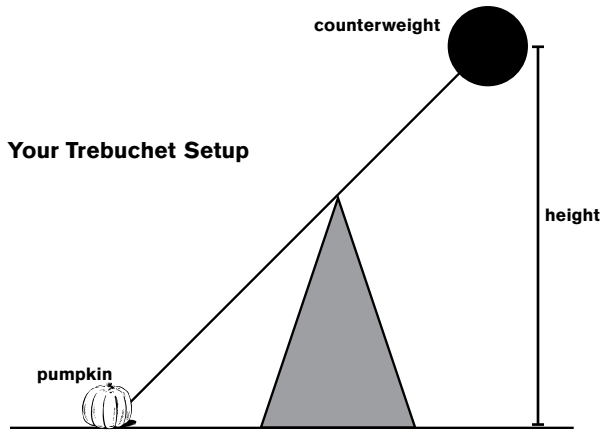


Name: _____

Tinkering With Trebuchets

In “Smashing Pumpkins” (p. 16), you read about the physics behind Punkin Chunkin contestants’ trebuchets. Now use what you learned to answer the following questions, using the equations below.



EQUATIONS*

$$\text{Kinetic Energy of Pumpkin (Joules)} = \frac{1}{2} \times \text{Pumpkin Mass (kilograms)} \times \text{Initial Velocity (meters/second)}^2$$

$$\text{Potential Energy of Counterweight (Joules)} = \text{Counterweight Mass (kg)} \times \text{Acceleration Due to Gravity (9.8 m/s}^2) \times \text{Counterweight Height (m)}$$

$$\text{Maximum Distance (m)} = 2 \times \text{Counterweight Mass (kg)} \div \text{Pumpkin Mass (kg)} \times \text{Counterweight Height (m)}$$

*Note: All of these equations assume that there is a perfect transfer of potential energy to kinetic energy in your trebuchet and that the pumpkin will launch at a 45-degree angle.

Directions:

For the following questions, assume you have a trebuchet with a counterweight having a mass of 30 kg, which you raise to a height of 4 meters.

- How much potential energy does your trebuchet store?
- For your first launch, you hurl a 2-kg pumpkin. What is the maximum distance this pumpkin will travel?
- For your second launch, you use an extra large pumpkin that weighs 4 kg. What’s the maximum distance that this new pumpkin will travel? Is this distance greater than or less than the distance your 2-kg pumpkin traveled?
- What will be the initial velocity of the 2-kg pumpkin when it leaves the trebuchet? (Hint: Since your trebuchet converts all of the potential energy to kinetic energy, use your answer from question 1 as the kinetic energy of the pumpkin to find the initial velocity.)
- If you add 10 kg to your counterweight, what’s the new maximum distance that the 2-kg pumpkin will travel? The 4-kg pumpkin?
- The world record for the longest distance a pumpkin was hurled in the youth trebuchet competition was beaten last year. It’s now 232 meters. Using a 2 kg pumpkin, how much weight would you have to add to your 30-kg counterweight to beat the record by one meter?
- If you didn’t have any extra weight to add to your trebuchet, what other changes could you make to break the record?