Time of Flight of the Car

How to determine the time of flight for a projectile shot at an angle from an elevated position.

1. Determine the initial vertical velocity by multiplying the sine of the launch angle by the initial velocity.

$$V\_{y}=V\_{photogate}\*\sin(θ)$$

1. Determine the time it takes for the projectile to reach its maximum height.

 $V\_{f}=0$ $V\_{i}=V\*\sin(θ)$ $a=-9.81\frac{m}{s^{2}}$

 $\frac{V\_{f}-V\_{i}}{a}=t$

1. Determine the height above or below the landing point that the projectile is launched from. (Determine the height of the lab table)
2. Determine how high the car traveled above its initial height by using the following formula where Vy is the initial vertical velocity and t is the time it takes to reach its peak:

$$d=V\_{y}\*t+\frac{1}{2}at^{2}$$

1. Determine the distance from the projectile's maximum height back to the ground by adding the height above the ground the projectile is launched.

For example, if the projectile was launched from 30 feet above where it landed and it went up 16.04 feet, the total height would be 46.04 feet.

1. Determine the fall time from maximum height.

$$d=\frac{1}{2}at^{2}$$

$$t=\sqrt{\frac{2d}{a}}$$

1. Add the time for the projectile to go up (step 2) to the fall time (step 6).

That is the total time the car is in the air. Piece of cake!

Using the Quadratic Equation to Find t

Example: A projectile is fired from the edge of a lab table 1 m tall with an initial speed of 3 m/s at an angle of 10o above the horizon.

* How long does it take for the projectile to reach the floor?

