

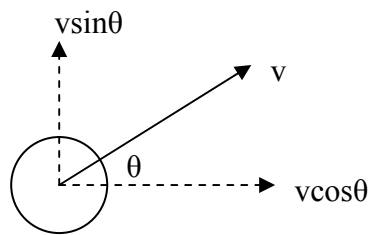
## Practical 5 Time of Flight

### Research Question

What is the relationship between the time of flight and the angle that a projectile is launched?

### Hypothesis

The motion of a projectile can be resolved into two components Horizontal and vertical as shown:



We will consider the ball thrown from the ground and returning to the ground.  
Taking the vertical component for this motion:

Total displacement = 0

Initial velocity =  $v \sin \theta$

Acceleration =  $-g$

Time of flight =  $t$

Using the equation for constant acceleration  $s = ut + \frac{1}{2}at^2$

We get:

$$0 = v \sin \theta t - \frac{1}{2}gt^2$$

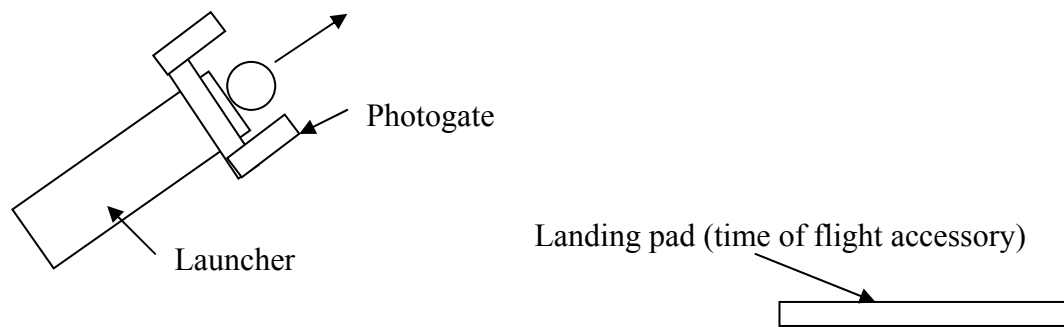
$$v \sin \theta t = \frac{1}{2}gt^2$$

### Procedure

You can measure time of flight by placing a light gate next to the exit hole of a launcher and a “landing pad” at the place where the ball lands. The computer will then measure the time taken between the ball coming out of the launcher and landing.

- Plug the Photogate and Landing pad into the interface and set up Data studio so it is ready to accept data.
- Choose “time of flight” from options available when you connect the “Time of flight accessory”.
- Double click digits and choose time of flight.

### Diagram



Perform a trial run to see if the set up works.

Note:

You don't have to keep starting and stopping as long as you hit the landing pad every time you pass something through the photogate.

### Data Presentation and Processing

Collect data and perform an experiment to test the hypothesis that  $\sin\theta \propto gt$ . Data must be entered into a table and processed according to the usual procedure. Using a graphical method find the velocity of the ball and decide if this is a reasonable value.