In this experiment, we will launch a projectile at an oblique angle and use equations of motion to find missing values.

To do this we need:
A ball launcher.
A ball.
A light gate.
A timer.
You will also need a measuring tape.

Set up the ball launcher on a table or bench and position the light gate so that the ball will pass through it just after it is launched.

Adjust the angle of the launcher so it fires at an angle to the horizontal – in this case, fifty degrees.

Measure the height from the floor to where the ball leaves the launcher. In this case 1.16 metres. Load the ball into the launcher, set the timer and launch the ball.

The timer shows it took the ball 7.77 milliseconds to pass the light gate.

We have measured the angle of launch, the height the projectile was launched from and the time it took to pass the light gate. We can use this data to work out:

The initial velocity.
The horizontal and vertical components of the initial velocity.
The final vertical velocity.
The time of flight,
and the range.

First, we calculate the initial velocity using the equation: v equals s over t.
Where v is the velocity.
S is the diameter of the ball.
T is the time it took to pass the light gate.

In this case, v equals 0.025 divided by 0.00777, which equals 3.22 metres per second.

We can now calculate the horizontal and vertical components of velocity using trigonometry.

The horizontal velocity is equal to v cos theta. In this case, 3.22 times cos 50 degrees, which is 2.07 metres per second.

The vertical velocity is equal to v sin theta. In this case, 3.22 times sin 50, which is 2.47 metres per second upwards. As velocity is a vector value, we will treat this as a negative value, negative 2.47 metres per second.

Next, we can calculate the final vertical velocity using the equation
V squared equals u squared plus two as.

Where V is the final vertical velocity. u is the initial vertical velocity. a is the acceleration due to gravity, and s is the height.

In this case, V squared equals negative 2.47 squared plus two times 9.8 times 1.16. Which equals 6.10 plus 22.74, which is 28.84. So, v equals 5.37 metres per second.

Now we can calculate the time of flight. Use the equation: t equals vv minus uv all divided by a. So, t equals 5.37 minus negative 2.47 divided by 9.8, which equals 0.80 seconds.

Finally, we can work out the range using the equation: s equals vh times t. Where s is the range, vh is the horizontal velocity, and t is the time of flight. In this case, s equals 2.07 times 0.80, which equals 1.66 metres.