Projectile Motion on an Air Table

Imagine that you are a "flatlander," a person confined to two dimensions, and your world is the tilted air table. In your world objects (pucks) fall when released, and the direction in which they naturally fall is down to you. Your goal is to understand the physics of projectile motion in your world.

You make two kinds of measurements: (1) You take the puck to a high location and let it fall freely, with the spark making dots as it falls. (2) You shoot the puck up at an angle and watch it go up and then back down. Do both these things using the same sheet of paper. Now draw a line parallel to the line of dots made when the puck fell freely and call that the y-axis; draw another line perpendicular to the y-axis and call it the x-axis.

Find the acceleration of a freely falling body in your world.

If the spark timer has produced 20 spots per second, circle alternate spots and use only 1/10 second intervals. For each pair of spots on the path of the projectile falling "straight down," compute the average speed by dividing the distance between the pair by 1/10 second. Now plot the average speeds against time and from the slope of the best straight line through the average speed points compute the acceleration. Use Excel as much as possible.

Study the motion of a projectile in your world.

For the projectile motion also use only spots 1/10 second apart. For each pair of spots, calculate the average x- and y- components of the velocity (v_x and v_y) by dividing the x or y distances between the spots by 1/10 second. (It may be faster to project all the dots onto the x and y axes. If you do that, use differently colored marks on the y-axis for the dots rising and descending.) Now plot the average velocities against time, remembering that you will have both positive y velocities (puck rising) and negative y velocities (puck descending). From the slope of the best straight line through the average velocity points compute both the x and y accelerations.

> Determine whether the x-component of velocity of a projectile is constant in your world.

Determine whether the vertical acceleration of a freely moving body is the same when the body has a horizontal component of velocity as when it does not.

What is the acceleration of a projectile thrown straight up at the time when its velocity is zero at the top of its flight? This can be answered either by doing another experiment or by reconsidering the data you already have.