Potential and Kinetic Golf Balls

You may work with a team during this activity.

Part 1 Two Golf Balls

You will need two inclines (two identical books will also work) and two golf balls. You may assume that the golf balls have the same mass *m* and that we are ignoring friction and air resistance. Set up the inclines at different, but not extremely steep, angles, about a meter from the end of the table so that when the golf balls are released they will travel down the inclines, the **same horizontal distance** across the table, and on to the floor. You will be releasing the golf balls from the same **vertical height *h*** from the table, so the length that they travel along the inclines will **not** be the same since the incline angles differ.

1. Compared with each other, how much potential energy do the golf balls have before they are released? Since you are releasing them from the same height, is their potential energy the same or different? Explain.

   The balls have the same potential energy since they are being launched from the same height, so $h_{i1} = h_{i2}$ and $U_{i1} = U_{i2} = mgh_{i1} = mgh_{i2}$

2. How much kinetic energy do the golf balls have before they are released? Explain.

   The balls have the same kinetic energy because they are not moving, $K_{i1} = K_{i2} = \frac{1}{2}mv_{i1}^2 = \frac{1}{2}mv_{i2}^2 = 0\ J$

3. **Before** you release the golf balls make a prediction about their behavior. Will they have the same velocity *v*? Will they travel the same distance *d* across the floor? Will it take the same amount of time *t* for them to hit the floor? Explain.

4. Compared with each other, when the golf balls hit the floor how much kinetic energy do they have?

   ball 1: $E_{i1} = U_{i1} + K_{i1} = mgh_{i1} \rightarrow E_{f1} = U_{f1} + K_{f1} = \frac{1}{2}mv_{f1}^2 \rightarrow E_{i1} = E_{f1} \rightarrow mgh_{i1} = \frac{1}{2}mv_{f1}^2$

   ball 2: $E_{i2} = U_{i2} + K_{i2} = mgh_{i2} \rightarrow E_{f2} = U_{f2} + K_{f2} = \frac{1}{2}mv_{f2}^2 \rightarrow E_{i2} = E_{f2} \rightarrow mgh_{i2} = \frac{1}{2}mv_{f2}^2$

   $\frac{1}{2}mv_{f1}^2 = \frac{1}{2}mv_{f2}^2 \rightarrow v_{f1}^2 = v_{f2}^2 \rightarrow v_{f1} = v_{f2}$

5. Did your observations agree with your predictions? Explain.

Part 2 One Golf Ball

You will be releasing one golf ball from three different locations along one of the inclines, near the bottom, near the middle, and near the top. This also means that the golf ball will fall different vertical heights before landing on the table.

6. **Before** you run the three golf ball trials, make a prediction about which trial will produce the golf ball that travels the farthest distance *d* across the floor in time *t*. Explain.

7. Run the three golf ball trials. Did your observations agree with your predictions? Explain.

$E_{i1} = mgh_{i1} = \frac{1}{2}mv_{f1}^2$, $E_{i12} = mgh_{i2} = \frac{1}{2}mv_{f2}^2$, and $E_{i3} = mgh_{i3} = \frac{1}{2}mv_{f3}^2$ where $h_{i1} < h_{i2} < h_{i3}$

it follows that $\frac{1}{2}mv_{f1}^2 < \frac{1}{2}mv_{f2}^2 < \frac{1}{2}mv_{f3}^2$ and $v_{f1} < v_{f2} < v_{f3}$, so the highest golf ball will roll the farthest, the lowest golf ball will roll the lowest distance in a given time *t*