**Projectile Motion Worksheet (Case 1)**

**Directions:** Answer the following questions below using the projectile motion equations. List all variables and show your work. Circle your final answer with the correct units.

1. An arrow is fired directly horizontal off a cliff that is 10.0 meters tall with a velocity of 65.5m/s.
   a. How long is the arrow in the air?
   b. What is the range of the arrow?
   
   \[ v_{iy} = 0 \text{ m/s} \quad v_x = 65.5 \text{ m/s} \]
   \[ d_y = \frac{1}{2}gt^2 \]
   \[ v_{fy} = xxx \quad t = \]
   \[ g = -9.8 \text{ m/s}^2 \quad d_x = ? \]
   \[ t = ? \]
   \[ d_y = -10 \text{ m} \]
   \[ t = \frac{\sqrt{\frac{2d_y}{g}}}{g} \]
   \[ d_x = v_xt = (65.5 \text{ m/s})(1.43 \text{ s}) \]
   \[ d_x = 93.66 \text{ m} \]

2. A pool ball leaves a 0.60-meter high table with an initial horizontal velocity of 2.4 m/s.
   a. Predict the time required for the pool ball to fall to the ground.
   b. Predict the horizontal distance between the table's edge and the ball's landing location.
   
   \[ v_{iy} = 0 \text{ m/s} \quad v_x = 2.4 \text{ m/s} \]
   \[ d_y = \frac{1}{2}gt^2 \]
   \[ v_{fy} = xxx \quad t = \]
   \[ g = -9.8 \text{ m/s}^2 \quad d_x = ? \]
   \[ t = ? \]
   \[ d_y = -0.60 \text{ m} \]
   \[ t = \frac{\sqrt{\frac{2d_y}{g}}}{g} \]
   \[ d_x = (2.4 \text{ m/s})(0.35 \text{ s}) \]
   \[ d_x = 0.84 \text{ m} \]

3. A soccer ball is kicked horizontally off a 22.0-meter high hill and lands a distance of 35.0 meters from the edge of the hill. Determine the initial horizontal velocity of the soccer ball.

   \[ v_{iy} = 0 \text{ m/s} \quad v_x = ? \]
   \[ v_{fy} = xxx \quad t = \]
   \[ g = -9.8 \text{ m/s}^2 \quad d_x = 35 \text{ m} \]
   \[ t = ? \]
   \[ d_y = -22 \text{ m} \]
   \[ t = \frac{\sqrt{\frac{2d_y}{g}}}{g} \]
   \[ d_x = v_xt = \frac{d_x}{t} \]
   \[ v_x = \frac{35.0 \text{ m}}{2.12 \text{ s}} \]
   \[ v_x = 16.51 \text{ m/s} \]

4. A rock is thrown with a velocity of 23.7m/s horizontally off the top of an elevated hill. If the time it takes to reach the ground is 5.70 seconds. What is the height of the hill?

   \[ v_{iy} = 0 \text{ m/s} \quad v_x = 23.7 \text{ m/s} \]
   \[ v_{fy} = xxx \quad t = 5.70 \text{ s} \]
   \[ g = -9.8 \text{ m/s}^2 \quad d_x = \]
   \[ t = 5.70 \text{ s} \]
   \[ d_y = \frac{1}{2}gt^2 \]
   \[ d_y = \frac{1}{2}(-9.8 \text{ m/s}^2)(5.70 \text{ s})^2 \]
   \[ d_y = -159.20 \text{ m} \]

   \[ 159.20 \text{ m Tall Cliff} \]
5. An airplane is making an emergency drop of medical supplies to soldiers on the ground. If the plane is traveling at 358.0 km/hr directly parallel to the ground from a height of 230.0m, how far ahead of the landing site should the plane drop the supplies?

\[ v_{y} = 0 \text{ m/s} \quad v_{x} = 99.44 \text{ m/s} \]

\[ v_{fy} = xxx \quad t = 6.85 \text{ s} \]

\[ g = -9.8 \frac{m}{s^2} \quad d_{x} = ? \]

\[ t = ? \]

\[ d_{y} = -230 \text{ m} \]

\[ \frac{358 \text{ km}}{1 \text{ hr}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hr}}{3600 \text{ s}} = 99.44 \frac{m}{s} \]

\[ t = 6.85 \text{ sec} \]

6. You're a criminal investigator and need evidence to discover the mystery of a crash. A car traveled a horizontal distance of 22.3m before smashing into the ground after it ran off a horizontal road. The cliff is 7.2m high from the base to the top. At what speed was the car traveling at before it ran off the road?

\[ v_{y} = 0 \text{ m/s} \quad v_{x} = ? \]

\[ v_{fy} = xxx \quad t = \]

\[ g = -9.8 \frac{m}{s^2} \quad d_{x} = 22.3 \text{ m} \]

\[ t = ? \]

\[ d_{y} = -7.2 \text{ m} \]

\[ d_{y} = \frac{1}{2}gt^2 \]

\[ d_{x} = v_{x}t \]

\[ t = \frac{2d_{y}}{g} \]

\[ d_{x} = \left(99.44 \frac{m}{s}\right) \times (6.85 \text{ s}) \]

\[ t = \frac{(2)(-7.2 \text{ m})}{-9.8 \frac{m}{s^2}} \]

\[ t = 1.21 \text{ sec} \]

\[ v_{x} = 18.43 \frac{m}{s} \]

7. A bullet is fired from a gun with an unknown velocity towards an unwary deer in the valley. If the hunter is standing on top of a hill and fires the gun horizontally at the deer which is 200 yards away at an angle of 5.0 degrees below the horizontal. What is the initial velocity of the bullet?

\[ v_{y} = 0 \frac{m}{s} \quad v_{x} = ? \]

\[ v_{fy} = xxx \quad t = \]

\[ g = -9.8 \frac{m}{s^2} \quad d_{x} = 182.18 \text{ m} \]

\[ t = \]

\[ d_{y} = -15.94 \text{ m} \]

\[ y = 200 \sin(5.0) = 17.43 \text{ yards} \]

\[ x = 200 \cos(5.0) = 144.24 \text{ yards} \]

\[ 17.43 \text{ yards} = 15.94 \text{ m} \]

\[ 144.24 \text{ yards} = 182.18 \text{ m} \]