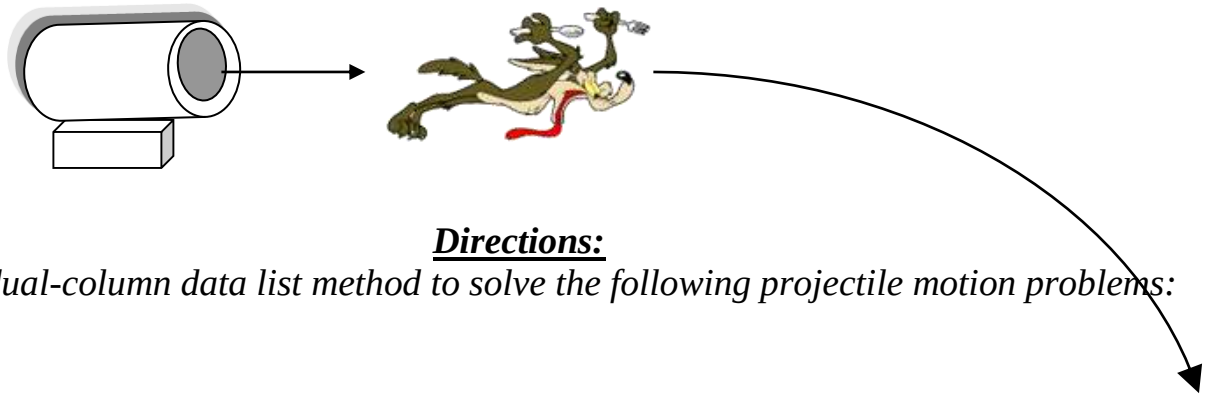
Name_____ Date: _____

# Horizontal Projectile Motion Problems



***Directions:***

*Use the dual-column data list method to solve the following projectile motion problems:*

***Example**: A hungry coyote is fired horizontally from a cannon at the top of a 100 meter tall cliff with an initial speed of 50 m/s.*

*a. How far will the coyote go in the horizontal direction?*

*b. With what velocity will the coyote hit the ground? (speed and direction)*

## Data List:

| | x | y |
|---|---|---|
| **d** | **?** | -100m |
| **t** | | |
| $\mathbf{v_o}$ | 50 m/s | 0 m/s |
| $\mathbf{v_f}$ | 50 m/s | |
| **a** | 0 $m/s^2$ | -9.8 $m/s^2$ |

## Solution:

**a)** $\mathbf{d_x = v_x t}$ *(need to solve for "t" first):*

$d_y = v_o t + \frac{1}{2} a t^2$

$-100 = \frac{1}{2} (-9.8) t^2$

$20.4 = t^2$

***t = 4.51 sec***

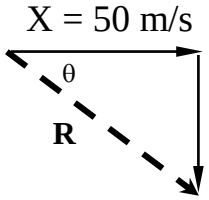
$d_x = v_x t = (50 \text{ m/s})(4.51) =$ ***225.9 m***

**b)** Find the ***y*** component of the final velocity, then add the ***x*** and ***y*** components together:

$a = (v_{fy} - v_{oy})/t$

$-9.8 = (v_{fy})/4.51$

$v_{fy} =$ ***- 44.2 m/s***




**R = 66.7 m/s at 41.5º below horizontal**

**1)** An arrow is shot horizontally at a speed of 40 m/s from a bow held 1.5 meters above the ground. It misses the target and hits the ground.

**a)** How much time does it take for the arrow to hit the ground? **0.55 sec**

**b)** How far does the arrow travel horizontally before hitting the ground? **22.1 m**

**c)** What velocity does the arrow have at impact with the ground? (speed & direction)

**40.3 m/s, 7.7ºbelow horizontal**

**2)** Another arrow is shot at the same speed from the same bow after carefully aiming it at the center of the target's bulls eye. This time the arrow hits a target that is 10 meters away.

**a)** How much time does it take for the arrow to strike the target? **0.25 sec**

**b)** How far below the center of the bulls eye does the arrow strike the target? **0.306 m**

**c)** What is the arrow's velocity at impact? (speed & direction) **40.07 m/s, 3.5º below horizontal**

**3)** A cliff diver must clear rocks that extend 15 meters out from the cliff's edge when diving from a cliff that is 40 meters above the water below.

**a)** How much time passes before the diver hits the water after jumping? **2.86 sec**

**b)** What minimum horizontal speed must the diver have in order to just clear the rocks below?

**5.25 m/s**

**4)** A ball rolls off a 1 meter tall table and hits the floor 1.5 meters horizontally from the edge of the table.

**a)** How much time does it take for the ball to hit the ground? **0.45 sec.**

**b)** How fast is the ball moving horizontally as it leaves the table edge? **3.32 m/s**

**c)** What velocity does the ball have at impact with the ground? (speed & direction)

**5.52 m/s, 53º below horizontal**

**5)** A hungry coyote accidentally runs horizontally off a high cliff at a speed of 25 m/s. He hits the canyon floor below 5.8 seconds later.

**a)** How high is the cliff? **164.84 m**

**b)** How far out from the cliff edge does he land in the canyon below? **145 m**

**c)** What velocity does he have at impact? (speed and direction)

**62.1 m/s, 66.3º below horizontal**

**6)** A rifle is aimed horizontally at shoulder height (1.5 meters above the ground) at a target bull's eye 700 meters away. The bullet leaves the barrel with a muzzle velocity of 1000 m/s.

**a)** Does it reach the target? **NO**

**b)** If so, where on the target does it strike relative to the center? If not, where on the ground does it hit? **146.7 meters before reaching the target**

**7)** A tiger leaps horizontally at 15 m/s across a 20 meter wide river gorge. The edge he leaves is level with the edge he is aiming for. With front legs outstretched, he can grab and claw his way up over the opposite ledge as long as he doesn't have to reach more than 1.5 meters above where he lands against the opposite wall of the gorge. Does he make it or go for a swim? Justify your answer.

**NO. He needs 1.33 seconds to reach the opposite side of the gorge. In that time, he will have fallen 8.7 meters, which is beyond his reach, and he will land in the river.**