# Dilemma at Crocodile Chasm

**Team Members: _____ School: _____**

***Scenario***

Your team is on an expedition in the jungle when you run across a savage tiger. You take your spare leg of lamb out of your pocket and throw it at the tiger to keep it occupied while you escape. Your escape route requires you to pass over Crocodile Chasm where a rope bridge is the usual method of traversing. Unfortunately, the rope bridge has collapsed and is dangling haphazardly from your side of the chasm. At the same moment that you realize this, you notice that the pursuing tiger is no longer distracted and is heading your way. By the way, the raging river flowing at the base of the chasm is full of hungry crocodiles hoping for an easy meal. Good Luck!!! You must find a way across.

***Crocodile Chasm Information***

Both sides of the chasm are at equal heights and the distance from the top of one side to the top of the other side is 18 feet. The chasm walls are inclined in such a way that the distance between the chasm walls at the base is 30 feet. The vertical distance from the top of the chasm edge straight down to the river below is about 50 feet.

***Materials Required***

Measuring tape, stop watch, calculator, paper, pencil

***Projectile Motion Equations:***

1. $X = \frac{1}{2} \cdot a_x \cdot t^2 + V_{ix} \cdot t + X_i$
2. $V_{ix} = V_i \cdot \cos(\theta)$
3. $V_x = V_{ix} + a_x \cdot t$
4. $Y = \frac{1}{2} \cdot a_y \cdot t^2 + V_{iy} \cdot t + Y_i$
5. $V_{iy} = V_i \cdot sin(\theta)$
6. $V_y = V_{iy} + a_y \cdot t$
7. $t_f = \sqrt{\frac{X_f \cdot \sin\theta - (Y_f - Y_i) \cdot \cos\theta)}{-\frac{1}{2} \cdot a_y \cdot \cos\theta}}$
8. $V_i = \frac{X_f}{cos\theta \cdot t_f}$

***Variables***

- $t$ = time from launch
- $t_f$ = time from launch to impact
- $V_i$ = initial velocity
- $\theta$ = angle of elevation
- $X$ = horizontal displacement (distance)
- $X_i$ = initial horizontal displacement
- $X_f$ = final horizontal displacement
- $a_x$ = horizontal acceleration = 0 m/s/s = 0 ft/s/s
- $V_{ix}$ = initial horizontal velocity
- $V_x$ = horizontal velocity at time t.
- $Y$ = vertical displacement (distance)
- $Y_i$ = initial vertical displacement
- $Y_f$ = final vertical displacement
- $a_y$ = vertical acceleration = $-9.8$ m/s/s = $-32$ ft/s/s (acceleration of gravity)
- $V_{iy}$ = initial vertical velocity
- $V_y$ = vertical velocity at time t.

***Part 1: Can you jump for it?***
Can your team successfully jump across the chasm? Use your understanding of projectile motion, the formulas provided above, and your ingenuity to respond to each of the following.

(Show your work and label each response appropriately)

1) (6 pts) What angle of elevation would be optimal for each jump? Justify your response.

2) (6 pts) At what maximum velocity can each of your team members run?

   Velocity (Team Member 1):

   Velocity (Team Member 2):

3) Respond to each of the following assuming that each of your team members were to run towards the chasm at the velocities mentioned above and then jump.

   a) (6 pts) How much time will elapse before each team member is once again level with the top of the chasm?

   b) (6 pts) What horizontal distance will have been traveled once the time found in part (a) has elapsed?

   c) (6 pts) How much time will elapse before each team member reaches the highest point in his or her trajectory?

d) (6 pts) What horizontal distance will have been traveled once the time found in part (c) has elapsed?

e) (6 pts) How high above the top of the chasm will each team member reach once the time found in part (c) has elapsed?

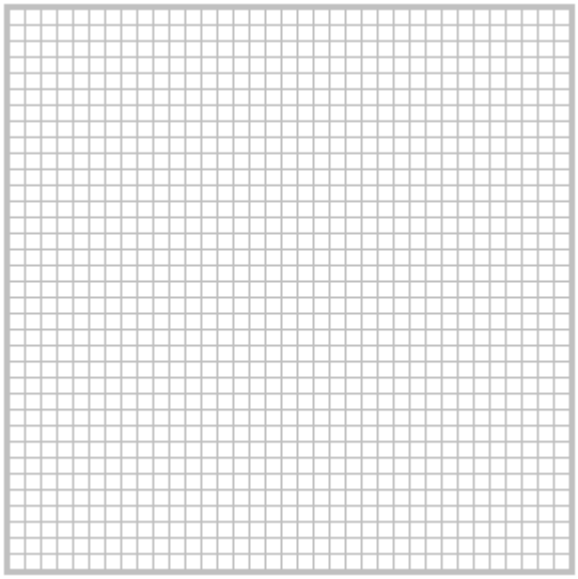
f) (6 pts) How much time will elapse before each team member has traveled a horizontal distance of 18 feet (the width of the chasm)?

g) (6 pts) How far above or below the top of the chasm will each team member be when they have traveled a horizontal distance of 18 feet (the width of the chasm)?

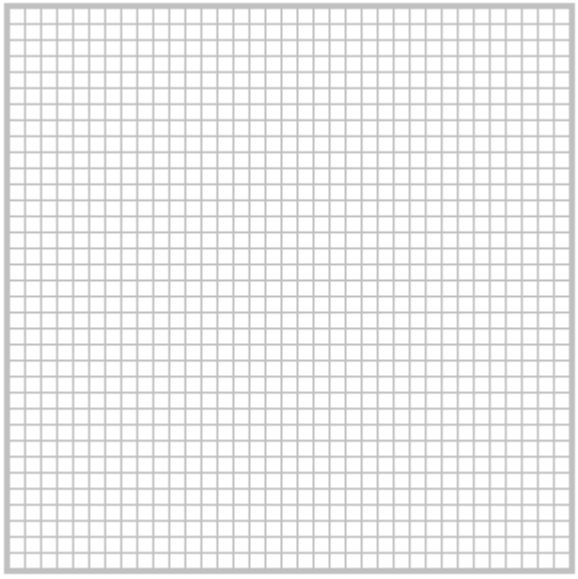
h) (6 pts) Will you team members make the jump? Justify your response using the data and calculations you have made previously.

i) (6 pts) Provide a graph showing the trajectory for the jump made by each of your team members. Label the graph appropriately and include at least three points (X, Y) on each trajectory.

Team Member 1:



Team Member 2:



***Part 2: Creative Alternatives***

(14 pts) Devise a creative alternative to the jumping scenario from part 1. Your goal is to successfully cross the chasm with all of your team members still in one piece. You may use anything at your disposal and in the surrounding area. This includes material you are likely to find in the jungle nearby, at the chasm, or in a typical expedition pack. Time is of the essence!