

Question:

Standing with your friend on a bridge far above a river, you drop a rock. One second later, your friend throws a rock straight down with an initial speed of 2m/s.

- a) Three seconds after your friend's rock is thrown find the vertical distance between the rocks.
- b) What velocity does each rock have five seconds after you drop your rock?

Numerical Answer:

- a) ~28.5 m
- b) Your rock ~49m/s (downward), Friend's rock ~41m/s (downward)

Reasoning:

a) Distance between the rocks depends on their positions at some time. The time is 4 seconds for my rock (1 sec delay + 3 seconds elapsed) and the time is 3 seconds for my friend's rock.

Assumptions: g is constant, no air resistance. So, using the EOM for displacement, and defining downwards to be in the positive direction I can find that my rock has a final position given by:

$$y_f = 0 + 0 + \frac{1}{2}gt^2 = \frac{g}{2}(16) = 8g \sim 78.5$$

(with standard mks units, the equation yields meters)

while my friend's rock is described by:

$$y_f = 0 + 2t + \frac{1}{2}gt^2 = 6 + \frac{g}{2}(9) = 6 + 4.5g \sim 50$$

(with standard mks units, the equation yields meters)

The difference between them is thus ~28.5m

To find the final velocity, evaluate the EOM for time dependent velocity for each. For me:

$$v_f = 0 + gt = 5g \sim 49m / s$$

for your friend:

$$v_f = 2 + gt = 2 + 4g \sim 41m / s$$
