

Proficiency Check
Horizontal-Vertical projectile motion

1. A rock is thrown up vertically. It reaches a height of 22m high at its maximum.

a. How fast was it thrown up?

Need
time

$$x_f = x_0 + v_i t + \frac{1}{2} a t^2$$

$$22 = 0 + v_i t + \frac{1}{2} (-9.8) t^2$$

missing 2
variables

$$v_f^2 = v_i^2 + 2ad$$

$$0^2 = v_i^2 + 2(-9.8)(22)$$

$$v_i^2 = 431$$

$$v_i = 20.7 \text{ m/s}$$

b. How fast is it moving at 11m on the way up?

$$v_f^2 = v_i^2 + 2ad \quad v_f^2 = 20^2 + 2(-9.8)(11)$$

$$v_f = 13.5 \text{ m/s}$$

c. How fast is it moving at 11m on the way down?

$$13.5 \text{ m/s}$$

d. How much time does it take to hit the ground?

$$v_f = v_i + at \quad 0 = 20.7 + (-9.8)t$$

$$t_{1/2} = \frac{2.11 \times 2}{9.8}$$

$$4.23 \text{ sec}$$

e. How fast is it traveling when it impacts the ground?

$$v_f = v_i + at$$

$$= 20.7 + (-9.8)(4.2) = 21.1 \text{ m/s}$$

2. 2 rocks are thrown horizontally off a 22m high cliff. The first rock is thrown at 10m/s the second at 20m/s.

Notice

a. Which rock will be in the air the longest amount of time? (calculate this time)

use

$$x_f = x_0 + v_i t + \frac{1}{2} a t^2 \quad -22 = 0 + 0 + \frac{1}{2} (-9.8) t^2 \quad t = 2.11$$

b. How far will each rock land away from the cliff?

$$x_f = x_0 + v_i t + \frac{1}{2} a t^2$$

$$? = 0 + 10(2.11) = 21.1 \quad \rightarrow \text{faster rock}$$

$$x_2 = 42.2$$

c. For the first rock calculate its acceleration and velocity just as it impacts the ground.

Acceleration: x: 0 y: -9.8

Velocity x: 20 m/s y: 20.5 m/s

$$v_f = v_i + at$$

$$0 + 2.1(-9.8)$$

$$= 20.5$$

