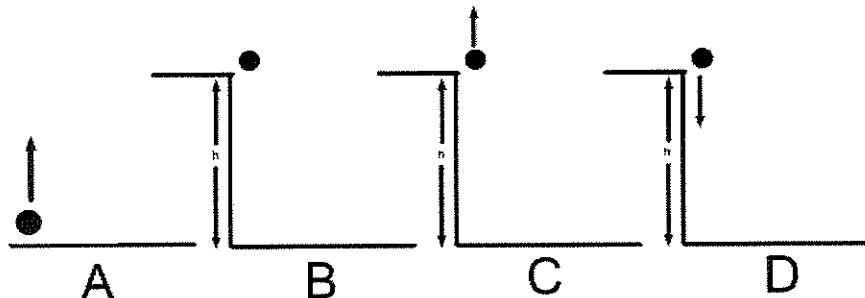


Student Practice
Projectile Motion- Vertical



A 5kg ball is dropped off a cliff. The cliff is 50m high.

1. Scenario B is likely the simplest. The ball is simply dropped off the cliff.

a. Determine the time for the ball to reach the bottom?

$$y_t = y_0 + v_i t + \frac{1}{2} a t^2$$

$$y_t = \frac{a t^2}{2} = \sqrt{\frac{2 y_t}{a}} = t \quad \sqrt{\frac{2(50)}{9.8}} = \boxed{3.19 \text{ sec.}}$$

b. Determine the speed of the ball at the bottom?

$$v_f = v_i + a t$$

$$= 0 + -9.8(3.19) = 31.2 \text{ m/s}$$

$$v_f^2 = v_i^2 + 2 a d$$

$$= 0 + 2(9.8)(50) = 980 \quad \sqrt{980} \quad \boxed{31.2 \text{ m/s}}$$

c. Student hypothesis: Halfway down the cliff the speed is half of "b". Justify or nullify this statement.

$$v_f^2 = v_i^2 + 2 a d$$

$$\hookrightarrow v_f^2 = 2 a d$$

$$v_f = \sqrt{2 a d}$$

NO, NOT LINEAR

2. Scenario A has a ball that is thrown up at 20m/s, after which it falls back down.

a. How high does the ball go?

$$v_f = v_i + a t$$

$$0 = 20 + -9.8 t$$

$$-20 = -9.8 t$$

$$t = \frac{20}{9.8} = 2.04 \text{ sec}$$

total time

b. How fast is the ball going just prior to impact?

$$v_f = v_i + a t$$

$$= 20 + -9.8(4.08) = \boxed{20 \text{ m/s}}$$

3. How fast is Scenario C is thrown straight up at 20m/s falling 50m to the bottom of the cliff.

a. How much time is the ball in the air?

b. How fast is the ball going when it hits the ground?

B) $v_f = v_i + a t$
 $= 20 + -9.8(5.8)$
 $= -36 \text{ m/s}$

$$y_t = y_0 + v_i t + \frac{1}{2} a t^2$$

$$-50 = 0 + 20t + \frac{1}{2}(-9.8)t^2$$

$$0 = 50 + 20t - 4.9t^2$$

use Quadratic

$$t = 5.83 \text{ sec}$$

4. How fast is Scenario D is thrown straight down at 20m/s falling 50m to the bottom of the cliff.

a. How much time is the ball in the air?

b. How fast is the ball going when it hits the ground?

c. Is there a relationship between the final speed of C and D?

a) $y_t = y_0 + v_i t + \frac{1}{2} a t^2$
 $-50 = 0 + -20(t) + -4.9t^2$
 $0 = 50 + -20t - 4.9t^2$
 Quadratic \rightarrow $t = 1.7 \text{ sec}$

b) $v_f = v_i + a t$
 $= -20 + -9.8(1.7)$
 $= -36 \text{ m/s}$

yes - equal 😊