Topic: Ball thrown up from the ground

Question: A ball's thrown straight up from the ground with initial velocity $v_0 = 64$ ft/s. What is the ball's maximum height, and what is its velocity when it hits the ground?

Answer choices:

A Maximum height is 32 ft; Velocity is -32 ft/s

B Maximum height is 32 ft; Velocity is -64 ft/s

C Maximum height is 64 ft; Velocity is -64 ft/s

D Maximum height is 64 ft; Velocity is -32 ft/s

Solution: C

Substitute $g = 32$ ft/s², $v_0 = 64$ ft/s, and $y_0 = 0$ into the vertical motion formula.

$$y(t) = -\frac{1}{2}gt^2 + v_0t + y_0$$

$$y(t) = -\frac{1}{2}(32)t^2 + (64)t + 0$$

$$y(t) = -16t^2 + 64t$$

To find velocity when the ball hits the ground, set the position function equal to 0, since height is 0 when the ball hits the ground.

$$-16t^2 + 64t = 0$$

$$-16t(t - 4) = 0$$

$$t = 0, 4$$

We know that the height is 0 when the ball is initially thrown up from the ground at $t = 0$, which means it hits the ground again when $t = 4$.

To find velocity when the ball hits the ground at $t = 4$, we need to find the velocity function by taking the derivative of the position function.

$$y'(t) = -32t + 64$$

$$v(t) = -32t + 64$$

Substitute $t = 4$ to find velocity when the ball hits the ground.

$$v(4) = -32(4) + 64$$

$$v(4) = -128 + 64$$

$$v(4) = -64$$

The ball's velocity when it hits the ground is -64 ft/s.

The ball reaches its maximum height when $v(t) = 0$, so set the velocity function equal to 0.

$$-32t + 64 = 0$$

$$32t = 64$$

$$t = 2$$

The ball reaches maximum height at $t = 2$, so substitute $t = 2$ into the position function.

$$y(2) = -16(2)^2 + 64(2)$$

$$y(2) = -64 + 128$$

$$y(2) = 64$$

The ball's maximum height is 64 ft.

Topic: Ball thrown up from the ground

Question: A ball's thrown straight up from the ground with initial velocity $v_0 = 128$ ft/s. What is the ball's maximum height, and what is its velocity when it hits the ground?

Answer choices:

A Maximum height is 256 ft; Velocity is -256 ft/s

B Maximum height is 128 ft; Velocity is -128 ft/s

C Maximum height is 128 ft; Velocity is -256 ft/s

D Maximum height is 256 ft; Velocity is -128 ft/s

Solution: D

Substitute $g = 32$ ft/s², $v_0 = 128$ ft/s, and $y_0 = 0$ into the vertical motion formula.

$$y(t) = -\frac{1}{2}gt^2 + v_0t + y_0$$

$$y(t) = -\frac{1}{2}(32)t^2 + (128)t + 0$$

$$y(t) = -16t^2 + 128t$$

To find velocity when the ball hits the ground, set the position function equal to 0, since height is 0 when the ball hits the ground.

$$-16t^2 + 128t = 0$$

$$-16t(t - 8) = 0$$

$$t = 0, 8$$

We know that the height is 0 when the ball is initially thrown up from the ground at $t = 0$, which means it hits the ground again when $t = 8$.

To find velocity when the ball hits the ground at $t = 8$, we need to find the velocity function by taking the derivative of the position function.

$$y'(t) = -32t + 128$$

$$v(t) = -32t + 128$$

Substitute $t = 8$ to find velocity when the ball hits the ground.

$$v(8) = -32(8) + 128$$

$$v(8) = -256 + 128$$

$$v(8) = -128$$

The ball's velocity when it hits the ground is -128 ft/s.

The ball reaches its maximum height when $v(t) = 0$, so set the velocity function equal to 0.

$$-32t + 128 = 0$$

$$32t = 128$$

$$t = 4$$

The ball reaches maximum height at $t = 4$, so substitute $t = 4$ into the position function.

$$y(4) = -16(4)^2 + 128(4)$$

$$y(4) = -256 + 512$$

$$y(4) = 256$$

The ball's maximum height is 256 ft.

Topic: Ball thrown up from the ground

Question: An apple is thrown straight up from the ground with an initial velocity of 100 m/s. Assuming constant gravity, find the apple's maximum height.

$$s(t) = -\frac{1}{2}gt^2 + v_0t + y_0$$

Answer choices:

A 520.1 m

B 512.0 m

C 51.02 m

D 510.2 m

Solution: D

Substitute $g = 9.8$ m/s², $v_0 = 100$ m/s, and $y_0 = 0$ into the vertical motion formula.

$$s(t) = -\frac{1}{2}gt^2 + v_0t + y_0$$

$$s(t) = -\frac{1}{2}(9.8)t^2 + 100t + 0$$

$$s(t) = -4.9t^2 + 100t$$

Take the derivative of the position function.

$$s'(t) = -9.8t + 100$$

$$v(t) = -9.8t + 100$$

The apple reaches its maximum height when $v(t) = 0$, so set the velocity function equal to 0.

$$-9.8t + 100 = 0$$

$$9.8t = 100$$

$$t = 10.2$$

The apple reaches maximum height at $t = 10.2$, so substitute $t = 10.2$ into the position function.

$$s(10.2) = -4.9(10.2)^2 + 100(10.2)$$

$$s(10.2) \approx -509.8 + 1{,}020$$

$$s(10.2) \approx 510.2$$

The apple's maximum height is about 510.2 m.