Quadratic equations: Vertical motion

The general form of equation for vertical motion is:

$$h(t) = -16t^2 + v_0 t + h_0$$

where:

$h(t)$ - Height at time t, in units of feet
v_0 - Starting (initial) vertical velocity, in units of feet-per-second
h_0 - Starting (initial) height, in units of feet
t - Time, in units of second

The time at the maximum height is

$$t_{maxHeight} = \frac{v_0}{32}$$

Question 1

A ball is thrown upward from a height of 15 ft. with an initial upward velocity of 5 ft/s. Use the formula $h(t) = -16t^2 + v_0 t + h_0$ to find how long it will take for the ball to hit the ground.

Question 2

Jason jumped off of a cliff into the ocean in Acapulco while vacationing with some friends. His height as a function of time could be modeled by the function $h(t) = -16t^2 + 16t + 480$, where t is the time in seconds and h is the height in feet.

a. How long did it take for Jason to reach his maximum height?

b. What was the highest point that Jason reached?

c. Jason hit the water after how many seconds?

Question 3

If a toy rocket is launched vertically upward from ground level with an initial velocity of 128 feet per second, then its height h after t seconds is given by the equation $h(t) = -16t^2 + 128t$ (if air resistance is neglected).

a. How long will it take for the rocket to return to the ground?

b. After how many seconds will the rocket be 112 feet above the ground?

c. How long will it take the rocket to reach its maximum height?

d. What is the maximum height?

Question 4

A trebuchet launches a projectile on a parabolic arc at a velocity of 35 ft/s. Using the function $h(t) = -16t^2 + v_0 t + h_0$, determine:

a. When the projectile will first reach a height of 80 ft.?

b. How many seconds later will it again be 80 feet ?

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