A projectile is launched from the ground with initial velocity 56 ft/sec. The equation for its height at time t (in seconds) is given by

$$h = -16t^2 + 56t$$

<u>Find its maximum height</u>

Since this is a parabolic equation, the projectile's maximum height is also the <u>vertex</u>

$h = -16\left(t^2 - \frac{7}{2}t \quad \right)$ Factor -16 as a first step towards completing the square

$-16\left(\frac{49}{16}\right) + h = -16\left(t^2 - \frac{7}{2}t + \frac{49}{16}\right)$ Add $\left(\frac{b}{2}\right)^2 = \frac{b^2}{4} = \frac{(-7/2)^2}{4} = \frac{49}{16}$ to both sides factoring in -16 on the left

$-49 + h = -16\left(t - \frac{7}{4}\right)^2$ Write the perfect square

$h = -16\left(t - \frac{7}{4}\right)^2 + 49$ Isolate h

The vertex is $\left(\frac{7}{4}, 49\right)$ or $(1.75, 49)$

at $t = 1.75$ seconds

The projectile reaches a maximum height of 49 feet

<u>How long is the projectile in the air?</u> What is its velocity when it hits the ground?

Since it is parabolic and therefore symmetric, the projective is in the air for $2(1.75) = 3.5$ seconds

And it hits the ground at -56 ft/sec