HW #13:

Quadratic Models
Answer Key

1) The population (in thousands) for Alpha City, t years after January 1, 2004 is modeled by the quadratic function $P(t) = 0.3t^2 + 6t + 80$.

a) In what year does Alpha City's population reach twice its initial (1/1/2004) population?

b) What will the population of Alpha City be on January 1, 2016?

initial pop = 80
when will it equal 160?

2004 + 9 = 2013

$t = 12$

(a)

$160 = .3t^2 + 6t + 80$

$-160 \quad\quad -160$

$0 = .3t^2 + 6t - 80$

$a = .3 \quad b = 6 \quad c = -80$

$\frac{-6 \pm \sqrt{6^2 - 4(.3)(-80)}}{2(.3)}$

$\frac{-6 \pm \sqrt{132}}{.6} = \frac{-6 \pm 11.49}{.6}$

$\frac{-6 + 11.49}{.6} = 9.15$

$\frac{-6 - 11.49}{.6} = -29.15$

b)

$P(12) = .3(12)^2 + 6(12) + 80$

$P(12) = 195.2$ thousand

2) A ball is thrown straight up, from ground zero, with an initial velocity of 48 feet per second.

$h(t) = -16t^2 + V_0t + h_0$ a) Find the maximum height attained by the ball. When does this occur? Find the vertex

max height = 36 feet @ 1.5 seconds

$h(t) = -16t^2 + 48t$ b) How long does it take for the ball to return to ground zero? 3 seconds

a) x-coor: $-\frac{b}{2a} = \frac{-48}{2(-16)} = \frac{-48}{-32} = +1.5$

y-coor: $h(1.5) = -16(1.5)^2 + 48(1.5) = 36$

b) $0 = -16t^2 + 48t$

$0 = -16t(t-3)$

$\frac{0}{-16} = \frac{-16t}{-16}$ $\quad 0 = t-3$

$0 = t$ $\quad +3 \quad +3$

$3 = t$

3) From the top of a 48 feet tall building, a ball is thrown straight up with an initial velocity of 32 feet per second.

$h(t) = -16t^2 + 32t + 48$

a) Find the maximum height attained by the ball. When does this occur?
find vertex: (1, 64) | max height = 64 feet @ 1 second

b) How high will the ball be after 2.5 seconds? | evaluate $h(2.5) = 28$ feet

c) How long does it take for the ball to hit the ground? set equal to 0.
3 seconds

a) $\frac{-b}{2a} = \frac{-32}{2(-16)} = \frac{-32}{-32} = 1$

$h(1) = -16(1)^2 + 32(1) + 48 = 64$

b) $h(2.5) = -16(2.5)^2 + 32(2.5) + 48 = 28$

c) $0 = -16t^2 + 32t + 48$

this is factorable; $0 = -16(t^2 - 2t - 3)$

$0 = -16(t-3)(t+1)$

$0 = -16$ | $0 = t - 3$ (+3 +3) | $t + 1 = 0$ (−1 −1) | $t = -1$

$3 = t$

→ or use quadratic formula $a = -16$ $b = 32$ $c = 48$

$$\frac{-32 \pm \sqrt{32^2 - 4(-16)(48)}}{2(-16)}$$

$$\frac{-32 \pm \sqrt{4096}}{-32}$$

$$\frac{-32 \pm 64}{-32}$$

$\frac{-32+64}{-32} = -1$ $\quad \frac{-32-64}{-32} = 3$

Unit 3
Test Review