#2) $32 = (x)(x-4)$

$32 = x^2 - 4x + 4$

$+4$

$\sqrt{36} = \sqrt{(x-2)^2}$

$\pm 6 = x - 2$

$2 \pm 6 = x$

$x = 8$

$x = \cancel{-4}$

#3) $(3x)(3x) = 81$

$\frac{9x^2}{9} = \frac{81}{9}$

$\sqrt{x^2} = \sqrt{9}$

$x = \pm 3$

$x = 3$

$\sqrt{x^2} = \sqrt{9}$

$x = 3$

#4) $16 = (x)(3x+2)$

$16 = 3x^2 + 2x$

$-16 \qquad\qquad -16$

$0 = \underbrace{3x^2 + 2x - 16}$

$0 = 3x^2 + 8x - 6x - 16$

$0 = x(3x+8) - 2(3x+8)$

$0 = (x-2)(3x+8)$

$x = 2$ $\qquad$ $x = \cancel{-8/3}$

-48

$8 \qquad -6$

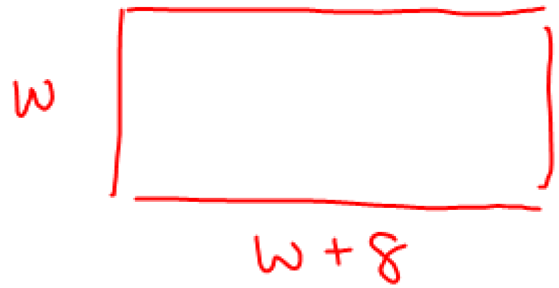
2

#6

#5)

Let w = width

Let $w+8$ = length



$$(w)(w+8) = 48$$

$$w^2 + 8w = 48$$

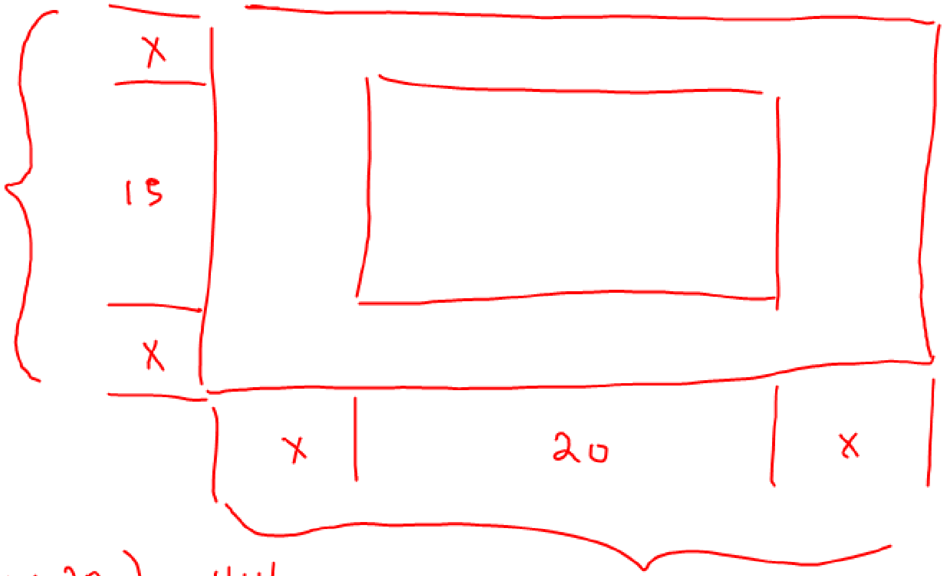
$$w^2 + 8w - 48 = 0$$

$$(w+12)(w-4) = 0$$

$w = \cancel{-12}$ $\quad$ $w = 4$

#6)

$x + 15 + x$



$$(2x+15)(2x+20) = 414$$

$$4x^2 + 40x + 30x + 300 = 414$$

$$4x^2 + 70x + 300 = 414$$
$$-414 \qquad -414$$

$$4x^2 + 70x - 114 = 0$$

$a = 4$

$b = 70$

$c = -114$

$$\frac{-70 \pm \sqrt{(70)^2 - 4(4)(-114)}}{2(4)} = \frac{-70 \pm \sqrt{6724}}{8}$$

$$\frac{-70 \pm 82}{8} = \frac{-70+82}{8} = \frac{3}{2} = 1.5 \text{ feet}$$

$$\frac{-70-82}{8} = \cancel{-19}$$

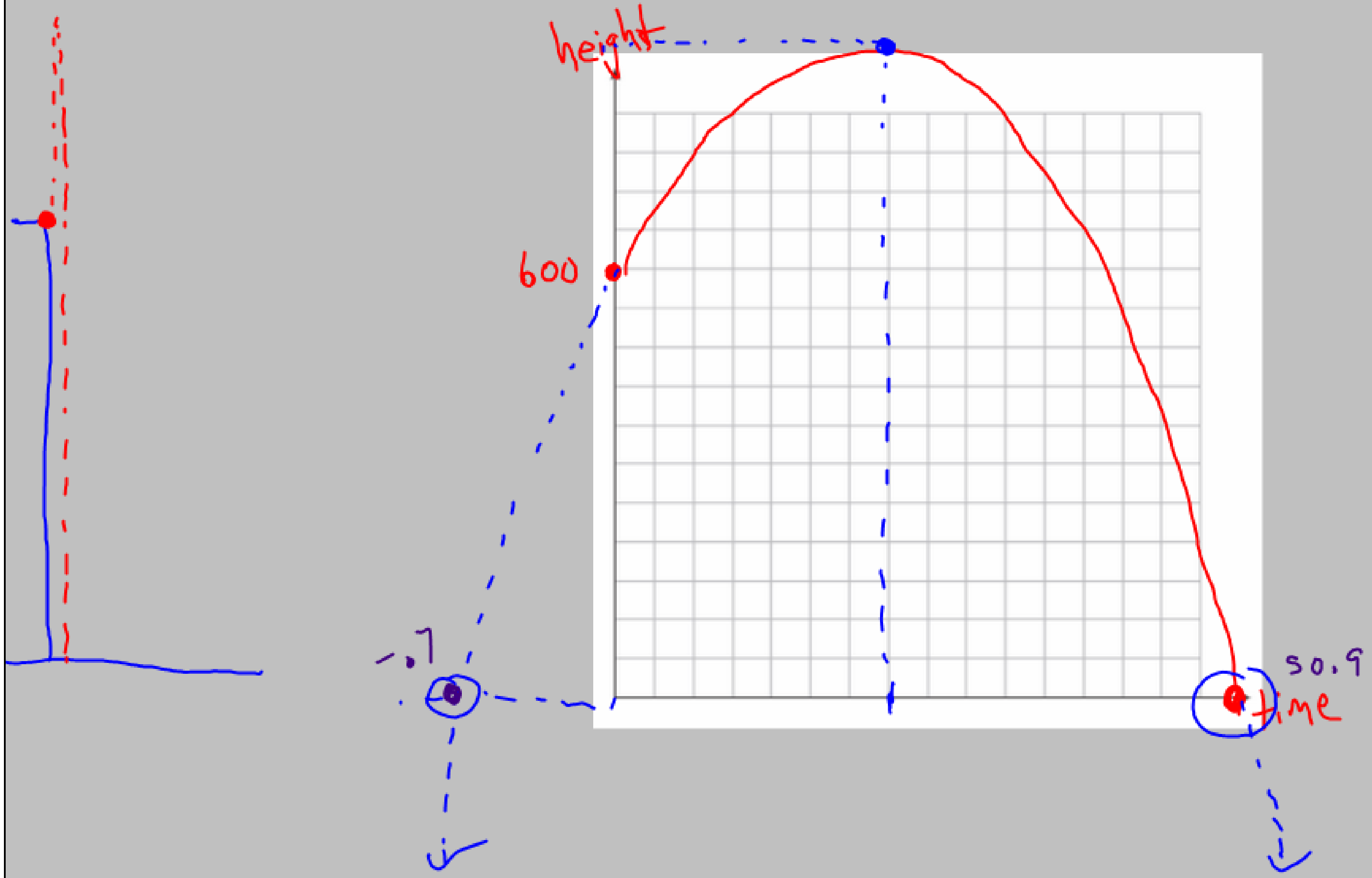
E.Q.:

How do we use a quadratic model to represent a real world situation?

Vertical Motion Problems

If an object is projected straight upward at time $t = 0$ from a point h_0 feet above ground, with an initial velocity v_0 ft/sec, then its height above ground after t seconds is given by $h(t) = -16t^2 + v_0 t + h_0$.

Example 1: A projectile is fired vertically upward from a height of 600 feet above the ground, with an initial velocity of 803 ft/sec.



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

$$h_0 = initial\ height$$

$$v_0 = initial\ velocity$$

Example 1: A projectile is fired vertically upward from a height of 600 feet above the ground, with an initial velocity of 803 ft/sec.

(a) Write a quadratic model for its height $h(t)$ in feet above the ground after t seconds.

$$h(t) = -16t^2 + 803t + 600$$

$$h(t) = -16t^2 + 803t + 600$$

(b) How high is the projectile after 10 seconds?

7030 ft.

time = 10

height = ?

$h(10) = -16(10)^2 + 803(10) + 600$

$h(10) = 7{,}030$ ft

$$h(t) = -16t^2 + 803t + 600$$

(c) During what time interval will the projectile be more than 5000 feet above the ground?

$h(t) = 5000$

$5000 = -16t^2 + 803t + 600$

$-5000 \qquad\qquad -5000$

$0 = -16t^2 + 803t - 4400$

$a = -16$

$b = 803$

$c = -4400$

$$\frac{-803 \pm \sqrt{(803)^2 - 4(-16)(-4400)}}{2(-16)} = \frac{-803 \pm 602.7}{-32}$$

$(6.3, 43.9)$

$$\frac{-803 + 602.7}{-32} = 6.3$$

$$\frac{-803 - 602.7}{-32} = 43.9$$

Domain

$[0, 50.9]$

$$h(t) = -16t^2 + 803t + 600$$

(d) How long will the projectile be in flight?

50.9 sec

$h(t) = 0$

$0 = -16t^2 + 803t + 600$

$a = -16$

$b = 803$

$c = 600$

$$\frac{-803 \pm \sqrt{(803)^2 - 4(-16)(600)}}{2(-16)} = \frac{-803 \pm 826.6}{-32}$$

$$\frac{-803 + 826.6}{-32} = -.7 \qquad \frac{-803 - 826.6}{-32} = 50.9$$

Range

[0 , 10675.1]

$$h(t) = -16t^2 + 803t + 600$$

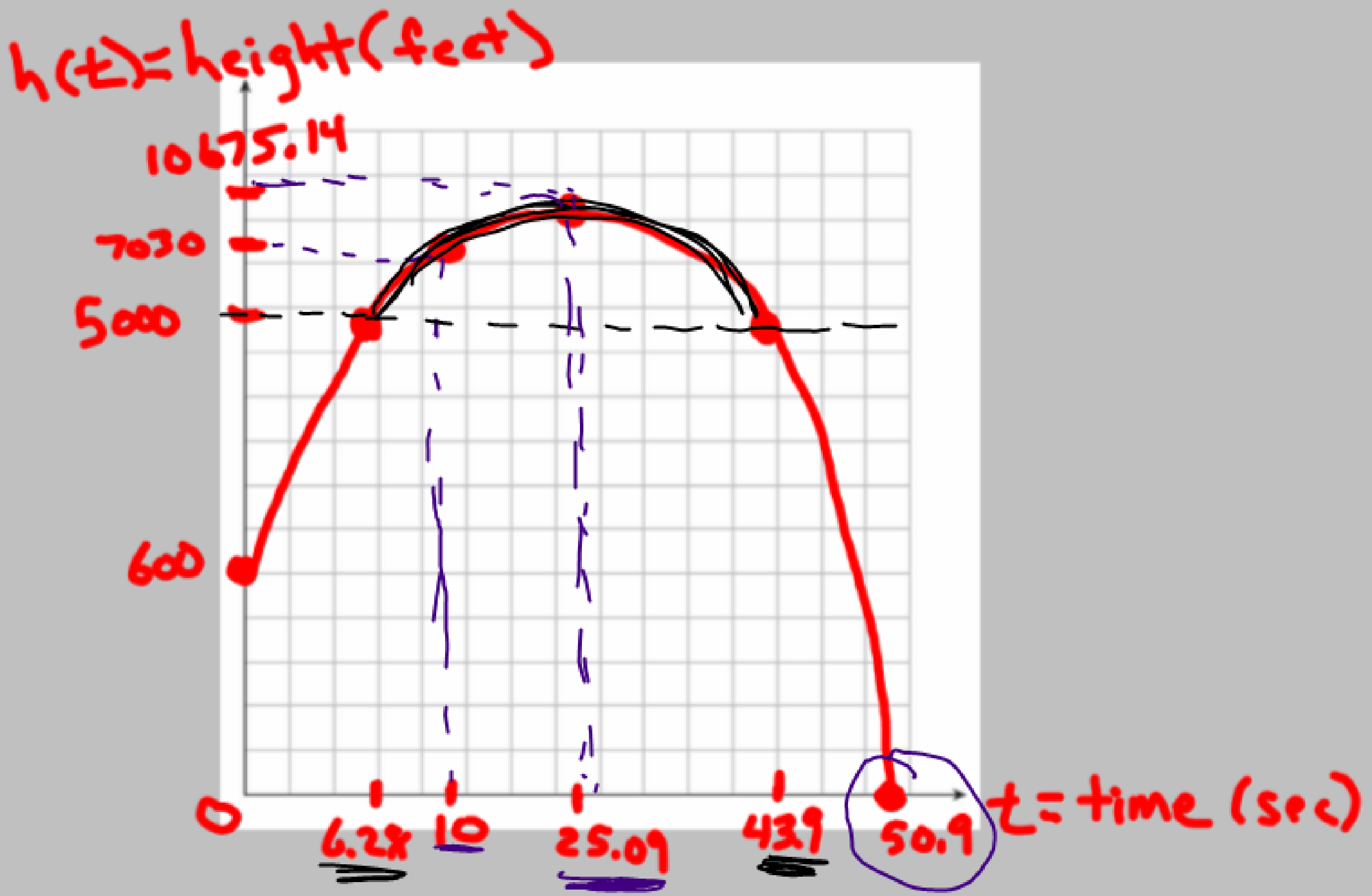
(e) What is the maximum height the projectile reaches?

$h(25.1) = -16(25.1)^2 + 803(25.1) + 600 = 10675.1$ feet

(f) At what time is the projectile this high? 25.1 seconds

$\frac{-b}{2a}$ = x-coor. (time)

$$\frac{-803}{2(-16)} = \frac{-803}{-32} = 25.1$$


h(t)=height(feet)
10675.14
7030
5000
600
0
6.28
10
25.09
43.9
50.9
t=time (sec)

Example 2: An apple is thrown upward from 5 feet above the ground, with an initial velocity of 30 ft/sec.

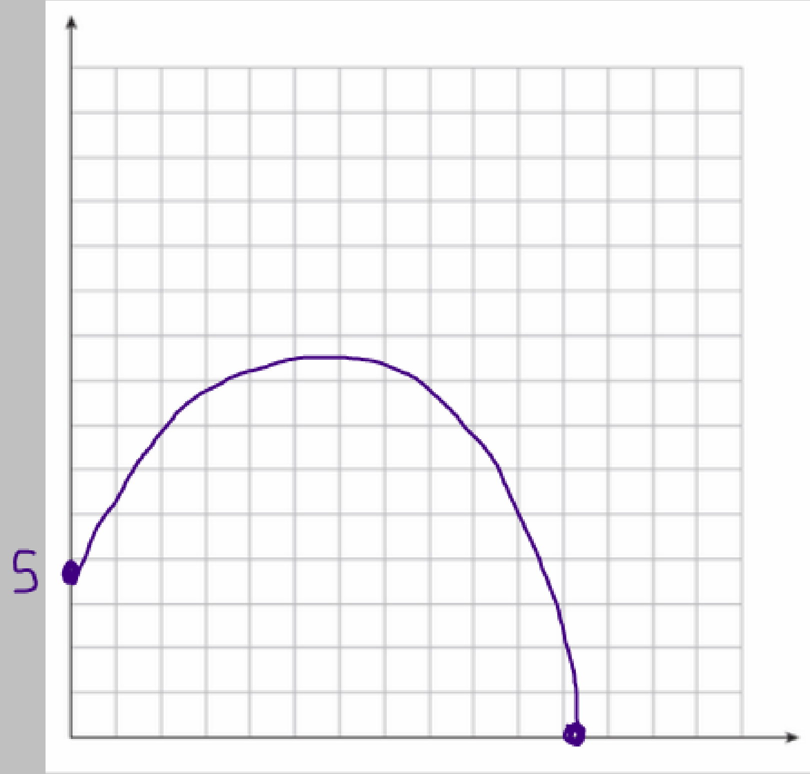
(a) Write a quadratic model for its height $h(t)$ in feet above the ground after t seconds.

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

$h_0 = initial\ height$

$v_0 = initial\ velocity$

$h(t) = -16t^2 + 30t + 5$



$$h(t) = -16t^2 + 30t + 5$$

(b) During what time interval will the apple be more than 15 feet above the ground?

$(.4, 1.4)$

$15 = -16t^2 + 30t + 5$

$-15 \qquad\qquad\qquad -15$

$0 = -16t^2 + 30t - 10$

$a = -16$

$b = 30$

$c = -10$

$$\frac{-30 \pm 16.1}{-32}$$

$$\frac{-30 + 16.1}{-32} = 1.4 \qquad \frac{-30 - 16.1}{-32} = .4$$

$$h(t) = -16t^2 + 30t + 5$$

(c) How long will the apple be in flight?

$$h(t) = -16t^2 + 30t + 5$$

(d) What is the maximum height the apple reaches? When does it get this high?

$h(.9) = \underline{19 \text{ feet}}$

$\underline{.9 \text{ seconds}}$

$$\frac{-b}{2a} = \frac{-30}{2(-16)} = \frac{-30}{-32} = .9$$

Quadratic Population Models: $P(t) = P_0 + bt + at^2$

We refer to P_0 as the initial population.

Example 3: Suppose that the future population of Stockton City t years after January 1, 2000 is described (in thousands) by the quadratic model $P(t) = 110 + 4t + 0.07t^2$.

(a) What is the population of Stockton City on January 1, 2007?

(b) When will the population of Stockton City reach 180 thousand?

HW #13:

Quadratic Models