Section 4.4: applications of quadratic equations

1) When a ball is thrown straight upward into the air, the equation

$h = -16t^2 + 80t$

gives the height (h) in feet that the ball is above the ground t seconds after it is thrown.

a) How long does it take for the ball to hit the ground? 5 seconds

b) When does the ball reach its maximum height? 2.5 seconds

c) What is the maximum height of the ball? 100 feet

1a) $-16T^2 + 80T = 0$

$-16T(T-5) = 0$

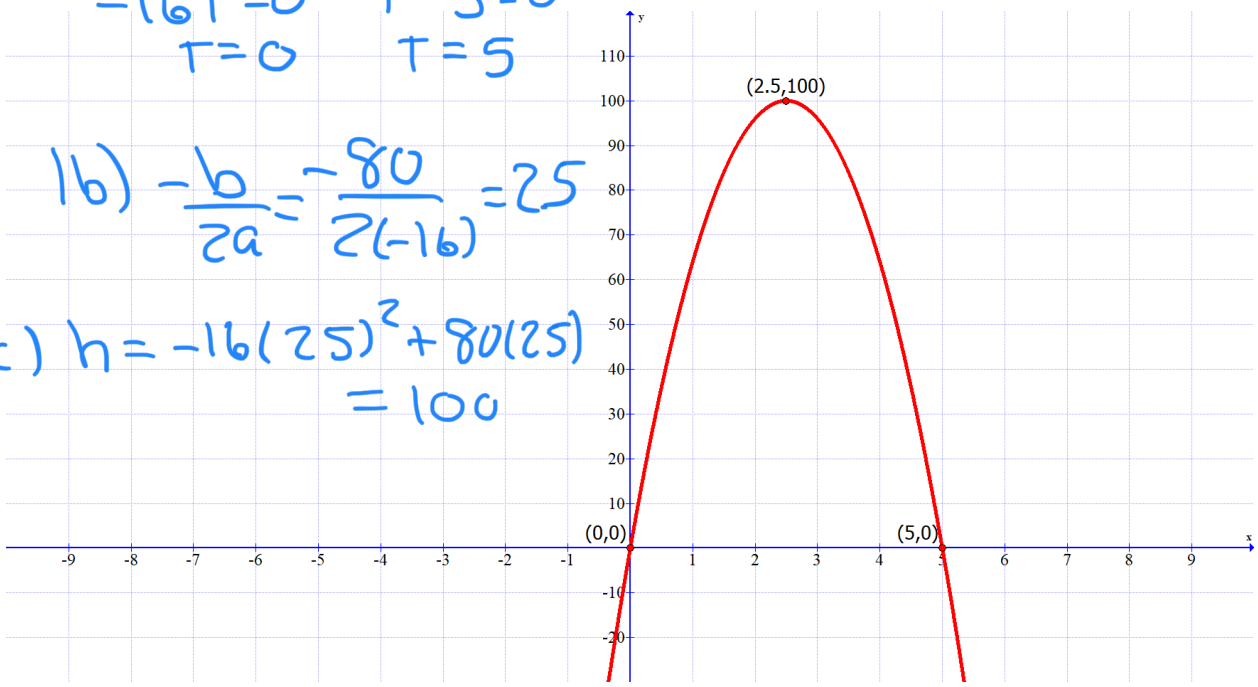
$-16T = 0 \quad T-5 = 0$

$T = 0 \quad T = 5$

1b) $-\frac{b}{2a} = \frac{-80}{2(-16)} = 25$

1c) $h = -16(25)^2 + 80(25)$

$= 100$



3) A ball is shot into the air with a high-powered gun. It's height , h in meters after t seconds is modeled by $h=-16t^2 + 128t +6$.

a) At what times will the ball have a height of 118m? 1 & 7 seconds

b) How long will it take to land (round to 2 decimals)? 8.04 seconds

c) Determine the maximum height it reaches (round to 2 decimals). 262 meters

3a)

$-16T^2+128T+6=118$

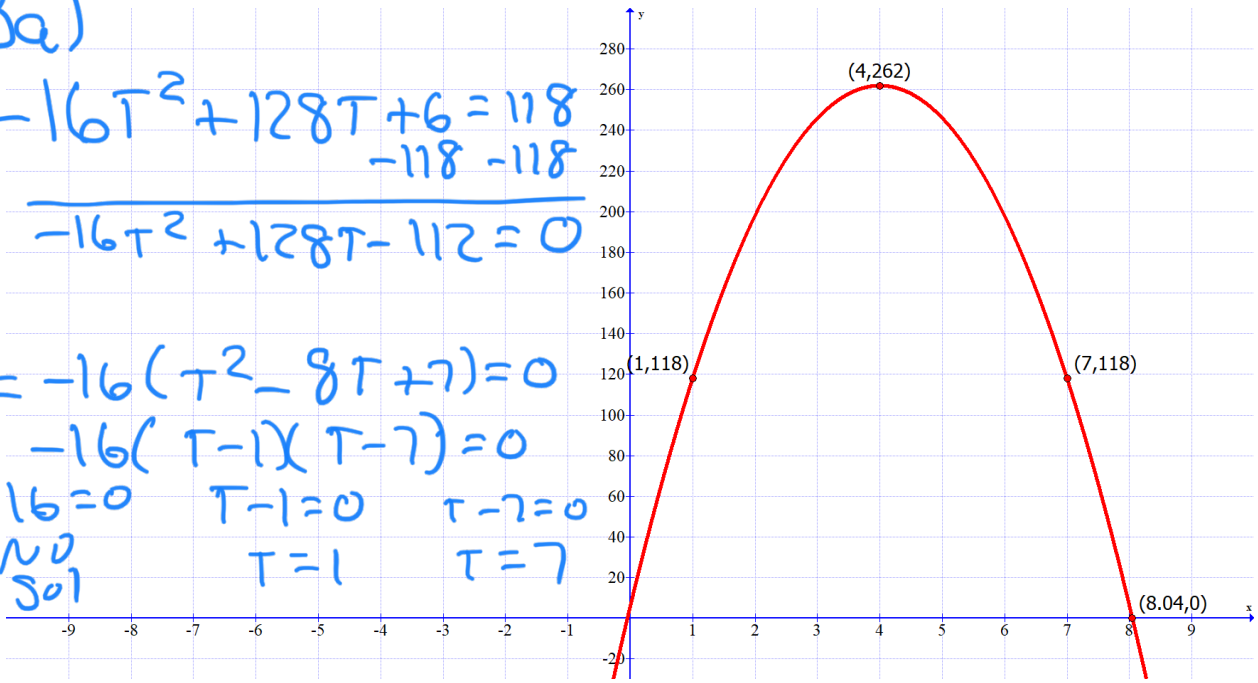
$-118\ \ -118$

$-16T^2+128T-112=0$

$=-16(T^2-8T+7)=0$

$-16(T-1)(T-7)=0$

$-16=0$ NO Sol $\quad T-1=0,\ T=1 \quad T-7=0,\ T=7$



3b) $-16T^2+128T+6=0$

$a=-16 \quad b=128 \quad c=6$

$$T=\frac{-128\pm\sqrt{(128)^2-4(-16)(6)}}{2(-16)}$$

$$T=\frac{-128\pm\sqrt{16768}}{-32}$$

$$T=\frac{-128+129.49}{-32} \qquad T=\frac{-128-129.49}{-32}$$

$T=-0.05 \qquad T\approx 8.04$

5) A baby drops his bottle at the peak of a Ferris wheel. The height (h) in feet of the bottle, t seconds after the baby drops the bottle is given by

$h=-16t^2 + 64$.

After how many seconds will the bottle hit the ground? 2 Seconds

$-16t^2 + 64 = 0$

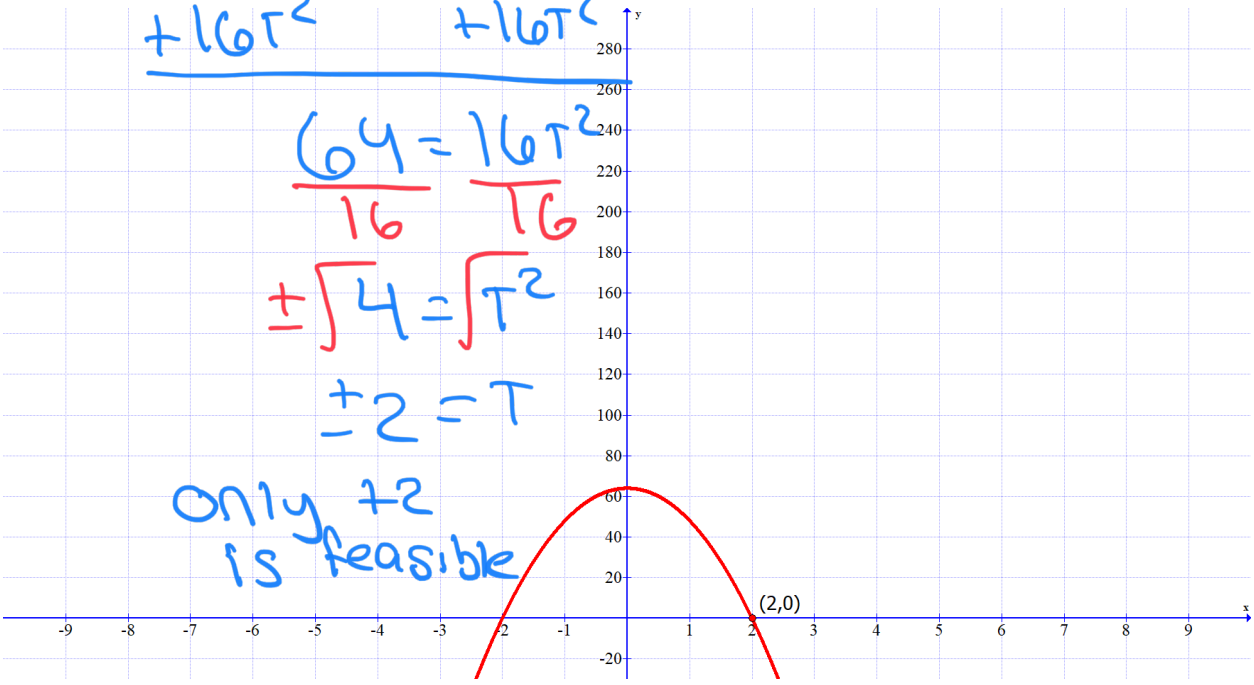
$+16t^2 \quad +16t^2$

$\frac{64}{16} = \frac{16t^2}{16}$

$\pm\sqrt{4} = \sqrt{t^2}$

$\pm 2 = t$

only +2 is feasible



7) A diver jumps off a cliff to water that is 100 feet below. The diver's height (h) in feet (t) seconds after diving is given by

$h = -16t^2 + 100.$

How long does the dive last? 2.5 seconds

$-16T^2 + 100 = 0$

$+16T^2 \quad +16T^2$

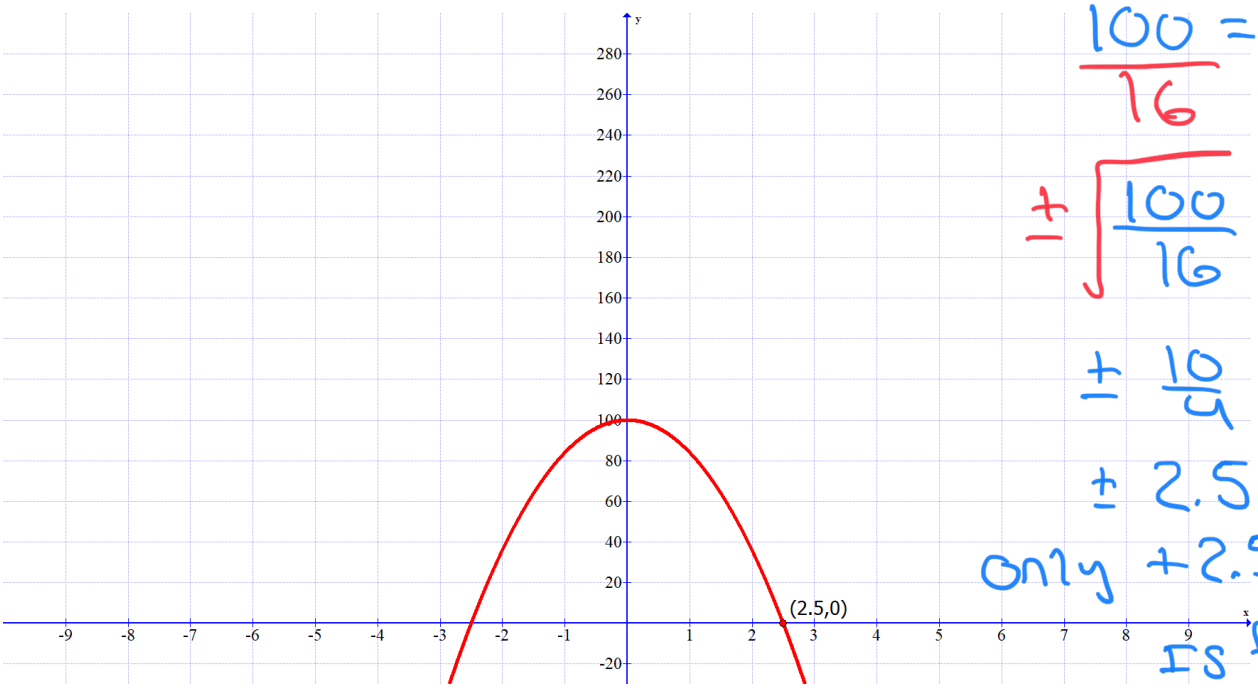
$\frac{100}{16} = \frac{16T^2}{16}$

$\pm\sqrt{\frac{100}{16}} = \sqrt{T^2}$

$\pm \frac{10}{4} = T$

$\pm 2.5 = T$

only +2.5 is feasible



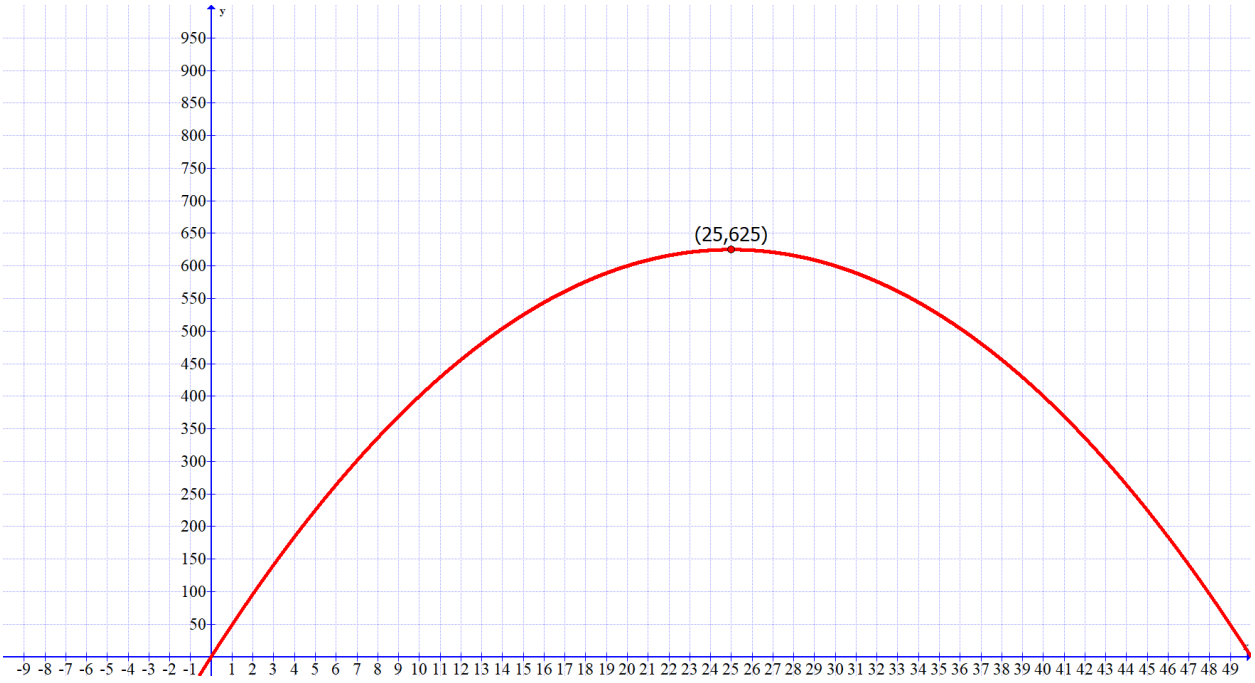
9) The total profit (p(x)) in dollars for a company to manufacture and sell x items per week is given by the function

$p(x) = - x^2 + 50x.$

a) What number of units will maximize profit? $\frac{-b}{2a} = \frac{-50}{2(-1)} = 25 \text{ units}$

b) What is the maximum profit? $P(25) = -1(25)^2 + 50(25)$

$= \$625$

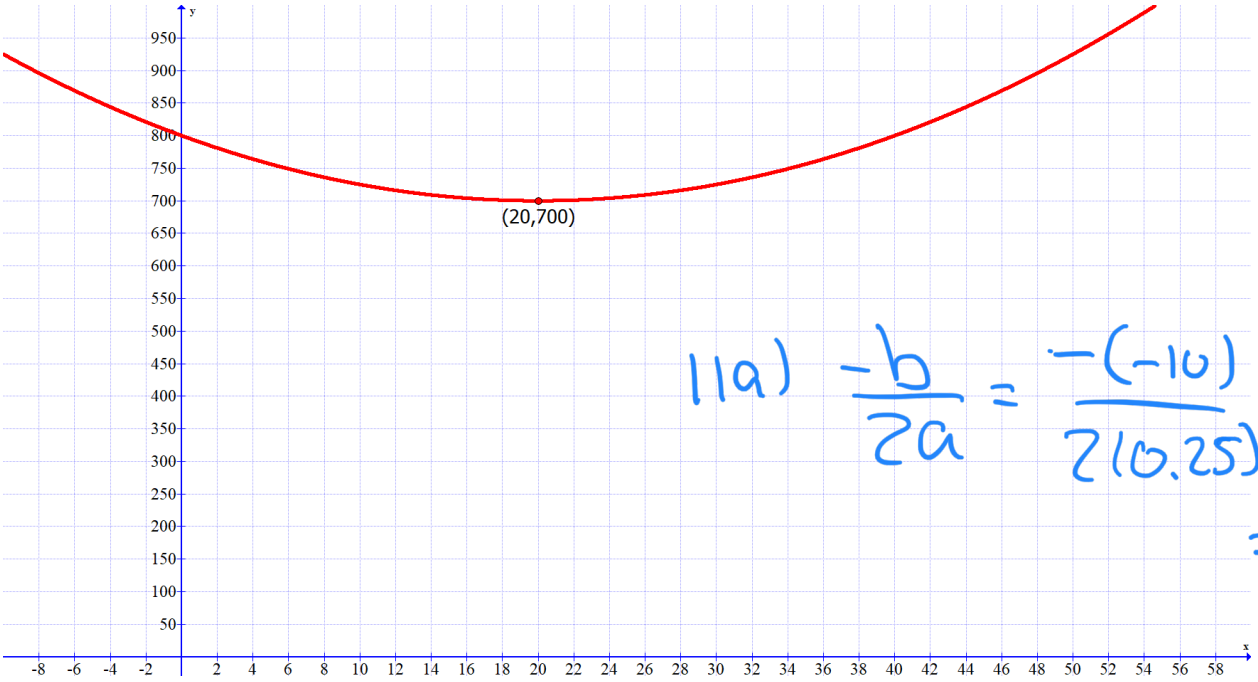


11) A manufacturer of lighting fixtures has a daily production cost of

$C(x) = 0.25x^2 - 10x + 800$. Where x is the number of units produced.

a) How many fixtures should be produced each day to minimize cost? 20 fixtures

b) What is the minimum cost?



11a) $\frac{-b}{2a} = \frac{-(-10)}{2(0.25)} = \frac{10}{0.50}$

$= 20$

13) A baseball player hits a low line drive. The following data represents the height of the ball at different times.

Time (in seconds)	1	2	5
height	13	19	13

a) Make a scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper. See below

b) Use a graphing calculator to fit a linear function and a quadratic function to the data.

c) Decide which equation is the best to represent this data.

d) Graph the function of best fit with the scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper.

e) Use the equation to find the maximum height of the ball.

b) Linear: $y = -0.46x + 16.23$ or $h = -0.46T + 1623$

Quadratic: $y = -2x^2 + 12x + 3$ or $h = -2T^2 + 12T + 3$

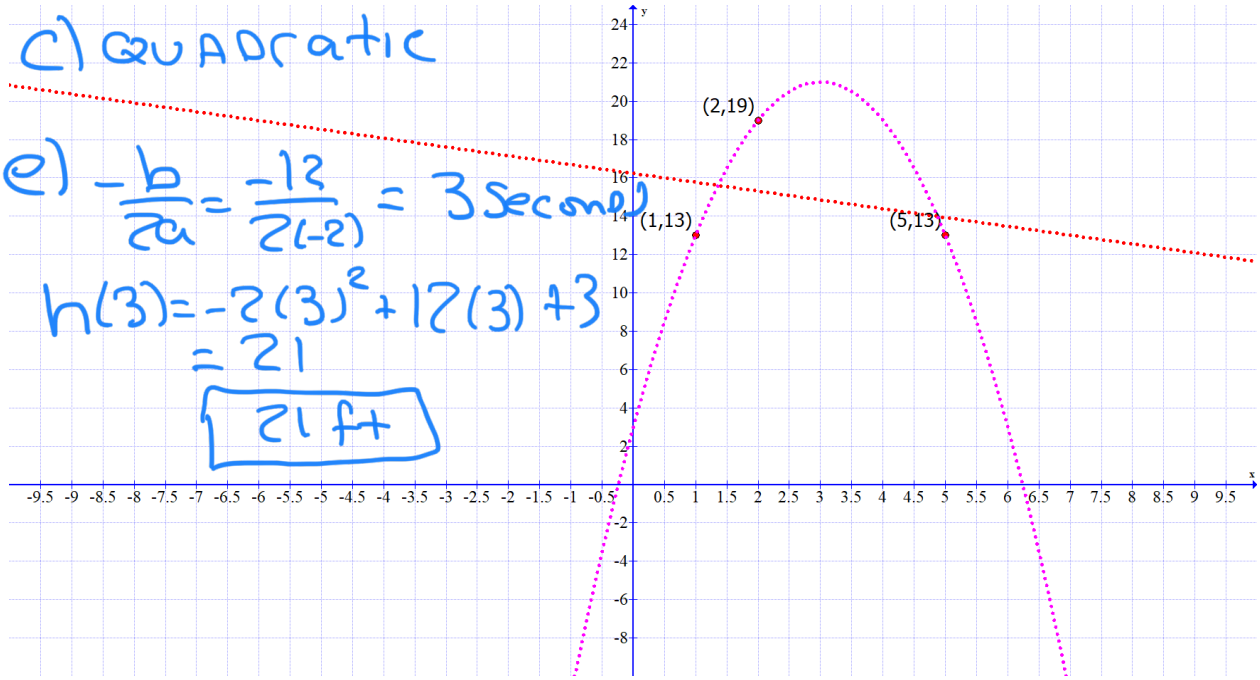
c) Quadratic

e) $-\frac{b}{2a} = \frac{-12}{2(-2)} = 3$ seconds

$h(3) = -2(3)^2 + 12(3) + 3$

$= 21$

21 ft



15) The concentration (in milligrams per liter) of a medication in a patient's blood as time passes is given by the data in the following table:

Time (Hours)	Concentration (mg/l)
0	0
0.5	78.1
1	99.8
1.5	84.4
2	50.1
2.5	15.6

a) Make a scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper. See below

b) Use a graphing calculator to fit a linear function and a quadratic function to the data. Linear $C(t) = -1.22t + 56.20$ Quad $C(t) = -56.21t^2 + 139.31t + 9.35$

c) Decide which equation is the best to represent this data. Quadratic

d) Graph the function of best fit with the scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper. See below

e) What is the concentration of medicine after 1.75 hours?

$$C(1.75) = -56.21(1.75)^2 + 139.31(1.75) + 9.35$$

81 mg/L