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?

b) When does the ball reach its maximum height?

c) What is the maximum height of the ball?

2) An ball fired vertically into the air it will be at a height (h) in feet, t seconds after launching, determined by the equation $h = – 16t^2 +96t$.

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

b) When does the ball reach its maximum height?

c) What is the maximum height of the ball?

3) A ball is shot into the air. 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?

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

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

4) A ball is shot into the air with a high-powered gun. It's height , h in meters after t seconds is modeled by

$h = -16t^2 +48t + 5$.

a) At what times will the ball have a height of 37m?

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

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

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?

6) A diver jumps off a cliff to water that is 144 feet below. The diver's height (h) in feet (t) seconds after diving is given by $h = -16t^2 + 144$. How long does the dive last?

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?

8) A chain store manager has been told by the main office that daily profit, P, is related to the number of clerks working that day, x, according to the equations $P(x) = -25x^2 + 300x$.

a) What number of clerks will maximize the profit?

b) What is the maximum possible profit?

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?

b) What is the maximum profit?

10) A factory produces lemon-scented widgets. You know that the more you produce the lower the unit cost is, to a point. As production levels increase so do the labor costs, storage costs, etc. An accountant has computed the cost for producing x units per day can be approximated by the formula

$C(x) = 0.04x^2 – 8x + 600$.

a) Find the daily production level that minimizes cost.

b) What is the minimum cost?

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?

b) What is the minimum cost?

12) In one study the efficiency of photosynthesis in an Antarctic species of grass was investigated. The table below lists results for various temperatures. The temperature *x* is in degrees Celsius and the efficiency *y* is given as a percent. The purpose of the research was to determine the temperature at which photosynthesis is most efficient.

x(°C)	-1.5	0	2.5	5	7	10	12	15	17	20	22	25	27	30
y(%)	33	46	55	80	87	93	95	91	89	77	72	54	46	34

a) Make a scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper.
b) Use a graphing calculator to find a linear function and a quadratic function to model the data. (round to 2 decimals)
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 determine the optimal temperature at which photosynthesis is most efficient. (round to 1-decimal)

13) A baseball player hits a ball. The following data represents the height in feet of the ball at different times.

Time (in seconds)	1	2	5
Height in feet	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.
b) Use a graphing calculator to find a linear function and a quadratic function to model the data. (round to 2 decimals)
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.

14) The following data represent the birth rate (per 1000 women) for women whose age is x, in 2018

age	12	17	22	27	32
Birth rate	1	42	106	117	100

a) Make a scatterplot of the data, on your calculator. You do not need to make a copy of this on your paper.
b) Use a graphing calculator to find a linear function and a quadratic function to model the data. (round to 2 decimals)
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) Predict the birth rate of 35-year-old women. (round to the nearest integer)

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.
b) Use a graphing calculator to find a linear function and a quadratic function to model the data. (round to 2 decimals)
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) What is the concentration of medicine after 1.75 hours? (round to 2-decimals)