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Lxx – Worksheet – 3.2 Investigating Quadratic Functions in Standard Form

Pg 174 #1abd: Which functions are quadratic? Explain.

$f(x) = 2x^2 + 3x$	$f(x) = 5 - 3x$	$f(x) = (2x - 5)(3x - 2)$
2nd degree polynomial. Yes, it is a quadratic.	1st degree polynomial (linear). Not a quadratic.	$= 6x^2 - 4x - 15x + 10$ $= 6x^2 - 19x + 10$ 2nd degree polynomial (factored form) Yes, it is a quadratic.

Pg 174 #2: Complete the table for each graph:

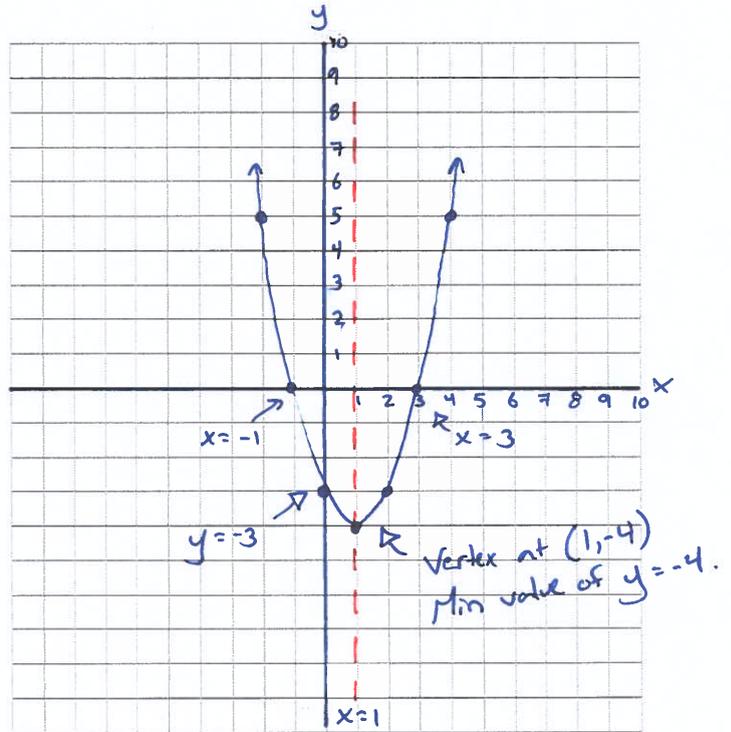| Graph:	Coordinates of the vertex	Equation of the axis of symmetry	x- and y-intercepts	Maximum or minimum value	Domain and Range
	$(-2, 2)$	$x = -2$	$x = -3, -1$ ("zeroes") $y = -6$ $(-3,0), (-1,0)$ $(0,-6)$	Max at $(-2,2)$ Max value is $y = 2$.	Domain: $\{x \mid -\infty < x < \infty, x \in \mathbb{R}\}$ or $\{x \in \mathbb{R}\}$ Range: $\{y \mid -\infty < y \leq 2, y \in \mathbb{R}\}$ or $\{y \mid y \leq 2, y \in \mathbb{R}\}$
	$(6, -4)$	$x = 6$	$x = 2, 10$ ("zeroes") $y = 5$ $(2,0), (10,0)$ $(0,5)$	Min at $(6,-4)$ Min value is $y = -4$.	Domain: $(-\infty, \infty)$ Range: $[-4, \infty)$ using Interval Notation
	$(3, 0)$	$x = 3$	$x = 3$ ("zeroes") $y = 8$ $(3,0)$ $(0,8)$	Min at $(3,0)$ Min value is $y = 0$.	Domain: $\{x \in \mathbb{R}\}$ Range: $\{y \mid y \geq 0, y \in \mathbb{R}\}$

Pg 174 #4ab: Create a table of values and then sketch the graph of each function. Determine thee vertex, the axis of symmetry, the direction of opening, the maximum or minimum value, the domain and range, and any intercepts.

a. $f(x) = x^2 - 2x - 3$

x	y
-4	21
-3	12
-2	5
-1	0
0	-3
1	-4
2	-3
3	0
4	5

Domain: $\{x \mid -\infty < x < \infty, x \in \mathbb{R}\}$
or $\{x \in \mathbb{R}\}$

Range: $\{y \mid -4 \le y < \infty, y \in \mathbb{R}\}$
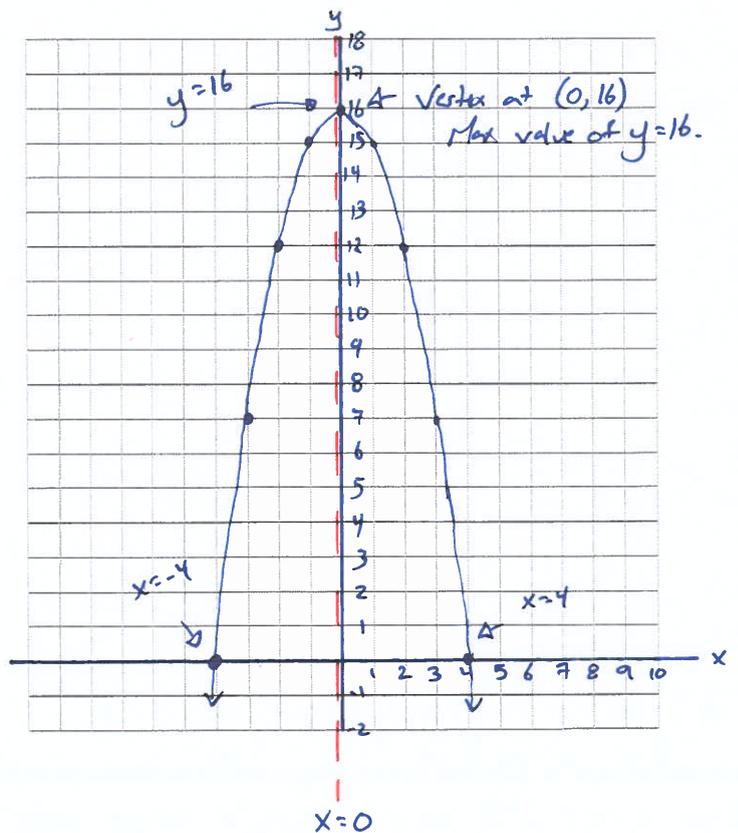or $\{y \mid y \ge -4, y \in \mathbb{R}\}$

x = -1
x = 3
y = -3
Vertex at (1, -4)
Min value of y = -4.
x = 1

b. $f(x) = -x^2 + 16$

x	y
-5	-9
-4	0
-3	7
-2	12
-1	15
0	16
1	15
2	12
3	7
4	0
5	-9

Domain: $\{x \in \mathbb{R}\}$

Range: $\{y \mid y \le 16, y \in \mathbb{R}\}$

y = 16
Vertex at (0, 16)
Max value of y = 16.
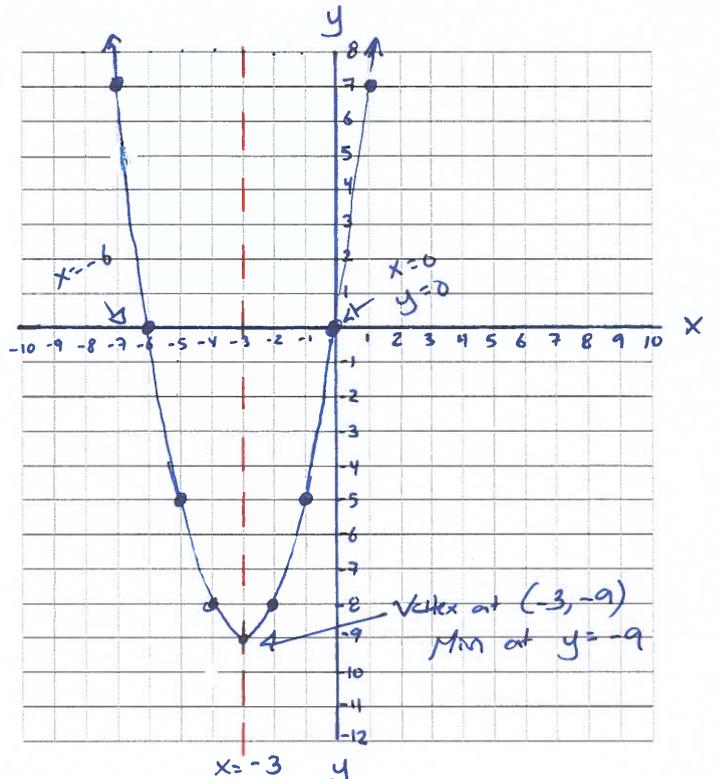x = -4
x = 4
X = 0

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Pg 174 #4cd: Create a table of values and then sketch the graph of each function. Determine thee vertex, the axis of symmetry, the direction of opening, the maximum or minimum value, the domain and range, and any intercepts.

c. $p(x) = x^2 + 6x$

x	y
-7	7
-6	0
-5	-5
-4	-8
-3	-9
-2	-8
-1	-5
0	0
1	7

Domain: $\{x \in \mathbb{R}\}$

Range: $\{y \mid y \geq -9, y \in \mathbb{R}\}$

Vertex at $(-3, -9)$

Min at $y = -9$

$x = -3$

d. $g(x) = -2x^2 + 8x - 10$

x	y
-1	-20
0	-10
1	-4
2	-2
3	-4
4	-10
5	-20

Domain: $\{x \in \mathbb{R}\}$

Range: $\{y \mid y \leq -2, y \in \mathbb{R}\}$

Vertex at $(2, -2)$

$x = 2$
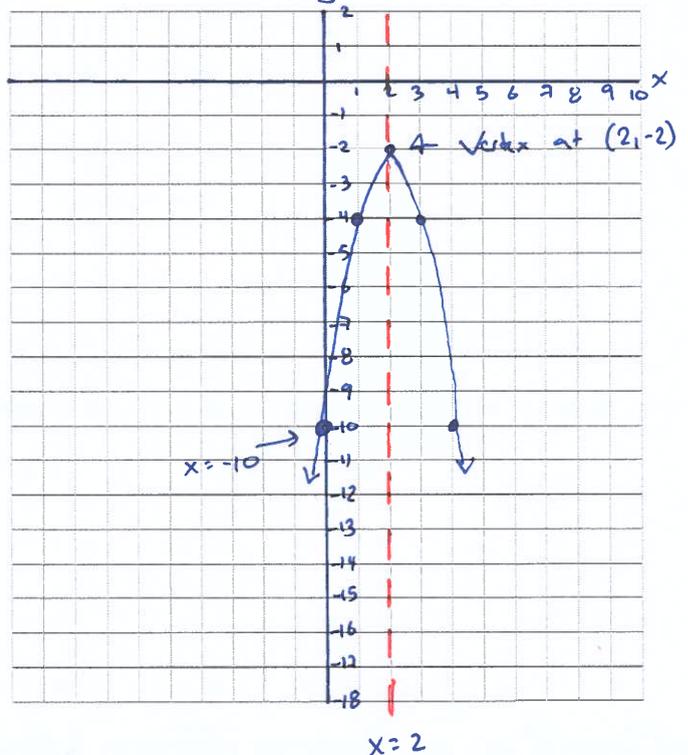
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Pg 174 #5: Use technology to graph each function. Identify the vertex, ~~the axis of symmetry~~, ~~the direction of opening~~, ~~the maximum or minimum value~~, ~~the domain and range~~, and any intercepts. Round values to the nearest tenth, if necessary.
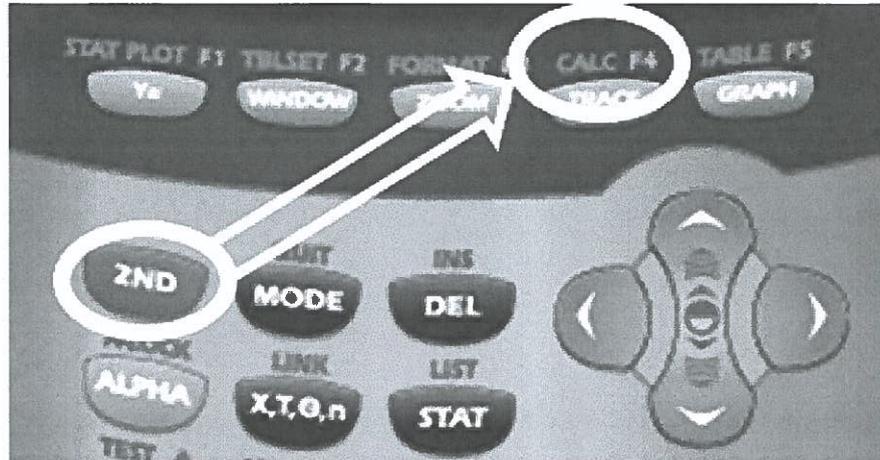
To find the vertex:

- *2ND, CALC*
- *Min (3) or Max (4)*
- *Set left/right bounds*

To find the Zeroes:

- *2ND, CALC*
- *Zero (2)*
- *Set left/right bounds*

To find the y-intercept:

- *2ND, CALC*
- *Value (1)*
- *X=0*

	Sketch	Vertex	Zeroes	Y-Intercept
$f(x) = 3x^2 + 7x - 6$		$(-1.1\overline{6}, -10.083)$	$x = -3$ $x = 0.\overline{6}$	$y = -6$
$f(x) = -2x^2 + 5x + 3$		$(1.25, 6.125)$	$x = -0.5$ $x = 3$	$y = 3$
$f(x) = 50x - 4x^2$		$(6.25, 156.25)$	$x = 0$ $x = 12.5$	$y = 0$
$f(x) = 1.2x^2 + 7.7x + 24.3$		$(-3.21, 11.95)$	None (never crosses x-axis... y is never zero).	$y = 24.3$

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Pg 174 #7: A siksik, and Arctic ground squirrel, jumps from a rock, travels through the air, and then lands on the tundra. The graph shows the height of its jump as a function of time. Use the graph to answer each of the following, and identify which characteristic(s) of the graph you used in each case.
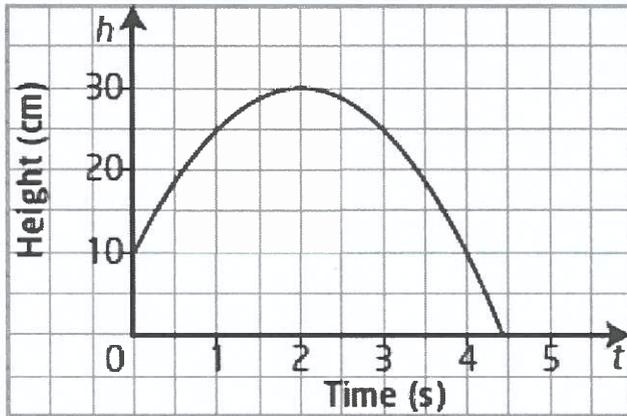
	Answer	Graph Characteristics
a. What is the height of the rock that the siksik jumped from?	10cm	y-intercept (0,10)
b. What is the maximum height of the siksik? When did it reach that height?	30cm above ground at 2 seconds	Vertex (2,30)
c. How long was the siksik in the air?	~ 4.5 seconds	x-intercept (0,4.5)
d. What are the domain and range in this situation?	Domain: [0,4.5] Range: [0,30]	x-values y-values
e. Would this type of motion be possible for a siksik in real life? Use your answers to parts (a) and (d) to answer why or why not.	Probably not. Probably doesn't take 4.5 seconds to land.	

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■ KEY ■

Pg 174 #11: Satellite dish antennas have the shape of a parabola. Consider a satellite dish that is 80 cm across. Its cross-sectional shape can be described by the function $d(x) = 0.0125x^2 - x$, where d is the depth, in centimeters, of the dish at a horizontal distance of x centimeters from one edge of the dish.

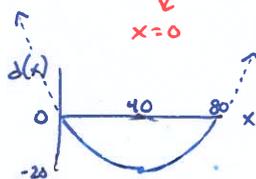a. What is the domain of this function?

$d(x) = 0.0125x^2 - x$

$d(x) = (x)(0.0125x - 1)$
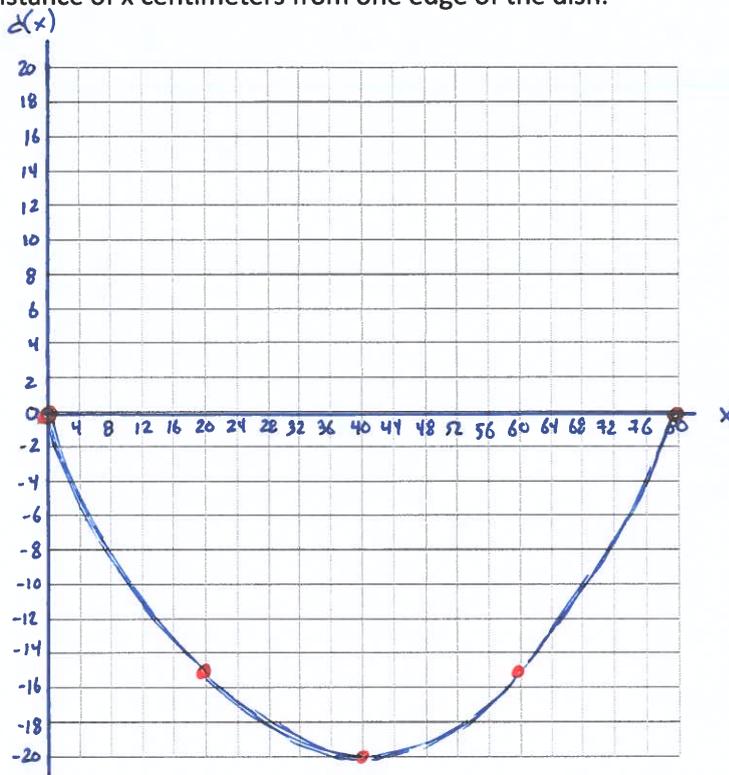
Depth of zero at what values?

$0 = (x)(0.0125x - 1)$

$x = 0$

$0.0125x - 1 = 0$
$x = 80$

Domain: $[0, 80]$

b. Graph the function to show the cross-sectional shape of the satellite dish.

x	d(x)
0	0
2	-15
40	-20
60	-15
80	0

c. What is the maximum depth of the dish? Does this correspond to the maximum value of the function? Explain.

"Maximum depth" occurs at the minimum value of the dish. At vertex, which is (40, -20). "Maximum depth" of dish is 20 cm.

d. What is the range of the function?

Range: $\{d \mid -20 \le d \le 0, d \in \mathbb{R}\}$

e. How deep is the dish at a point 25 cm from the edge of the dish?

$d(x) = 0.0125(x)^2 - (x)$
$d(25) = 0.0125(25)^2 - (25)$
$= -17.1875$ cm

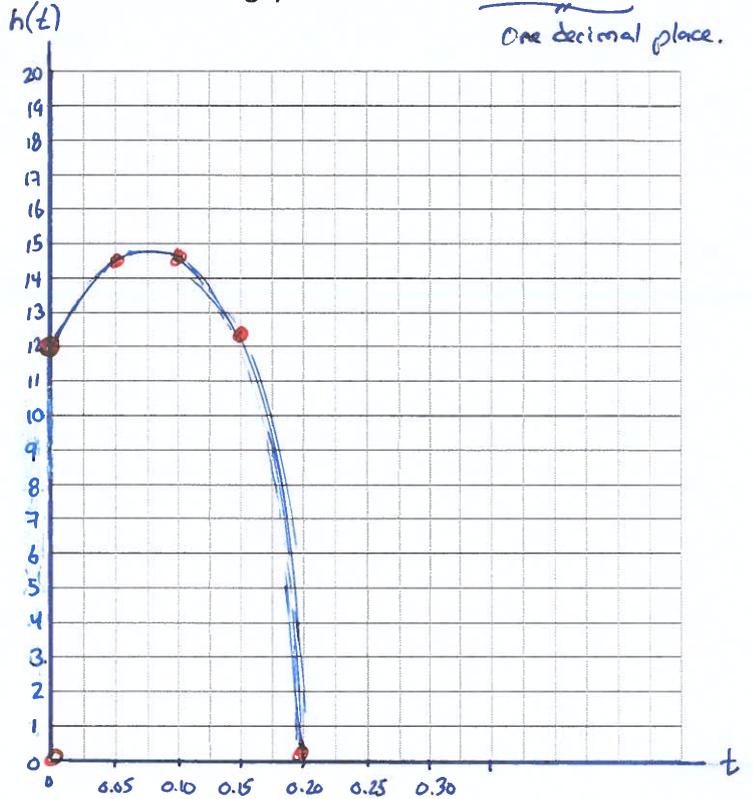Dish is ≈ 17.2 cm deep.

■ KEY ■

Pg 174 #12: A jumping spider jumps from a log onto the ground below. Its height, h, in centimeters, as a function of time, t, in seconds, since it jumped can be modelled by the function $h(t) = -490t^2 + 75t + 12$. Where appropriate, answer the following questions to the nearest tenth.

One decimal place.

a. Graph the function.

t (x)	$h(t)$ (y)
0	12
0.05	14.525
0.10	14.6
0.15	12.225
0.20	7.4
0.25	0.125
0.30	-9.6

NOTE: Graphed first using technology to get an idea of Domain + Range.

b. What does the h-intercept represent?

The starting h-value.
In this case, the height of the log.

c. When does the spider reach its maximum height? What is its maximum height?

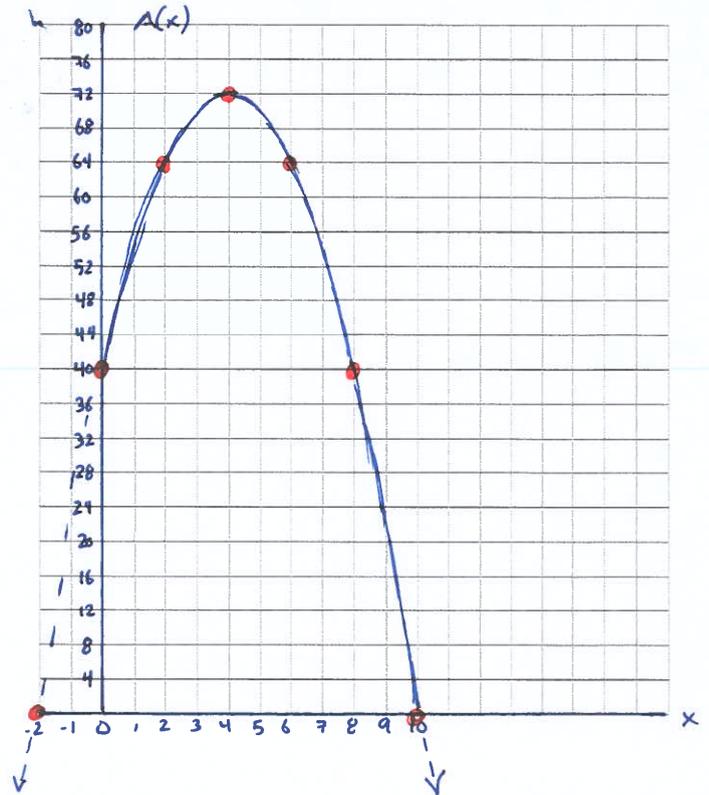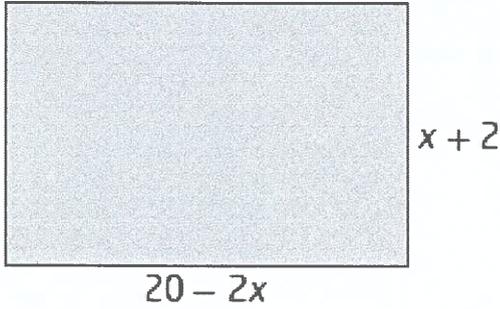Per the hand-drawn graph, at approximately 0.075 seconds.
Using technology, 2nd → Max → Set Bounds, at exactly (0.07652..., 14.8698...)
or 0.07652 seconds.
To the nearest tenth, this is 0.1 seconds.

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Pg 174 #15: a. Write a function to represent the area of the rectangle. Show that the function fits the definition of a quadratic function.

$$A = (x+2)(20-2x) = 20x - 2x^2 + 40 - 4x$$
$$A = -2x^2 + 16x + 40$$

$x + 2$

$20 - 2x$

b. Graph the function.

x	$A(x)$
-2	0
0	40
2	64
4	72
6	64
8	40
10	0

c. What do the x-intercepts represent in this situation? How do they relate to the dimensions of the rectangle?   The x-values that make the area "zero".

d. What information does the vertex give about this situation?

The maximum value.   when $x = 4$, $A(x) = 72$.

e. What are the domain and range? What do they represent in this situation?

Domain: $\{x \mid 0 \le x \le 10, x \in \mathbb{R}\}$ → Possible x-values

Range: $\{A \mid 0 \le A \le 72, A \in \mathbb{R}\}$ → Possible areas.