

Properties of Quadratic Functions Part 2

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PRE-CALCULUS 11 QUADRATIC FUNCTIONS PROPERTIES OF QUADRATIC FUNCTIONS PART 2

A. Definitions

1. **quadratic function:** any function that can be written in the form:
 $y = ax^2 + bx + c$ or $f(x) = ax^2 + bx + c$. Where a, b and c are constants and $a \neq 0$.
2. **x-intercept:** the place where the curve crosses the x-axis. These are also referred to as the roots or zeros of the function.
3. **y-intercept:** the place where the curve crosses the y-axis. In the form of the quadratic function the c value represents the y-intercept.
4. **vertex:** the highest or lowest point of a quadratic function.
5. **axis of symmetry:** the imaginary line, through the vertex, that divides the quadratic function into two perfect halves.
6. **maximum/minimum:** the highest or lowest point of a quadratic function.

B. Identifying Quadratic Functions Using First Differences

Determine whether each table represents a linear function or quadratic function.

x	y
0	-4
1	-2
2	0
3	2

$$\left. \begin{array}{l} -2 - -4 = 2 \\ 0 - -2 = 2 \\ 2 - 0 = 2 \end{array} \right\} \text{Constant difference} \\ \text{indicates a} \\ \text{Linear function}$$

x	y
0	1
1	-4
2	-11
3	-20

$$\left. \begin{array}{l} -4 - 1 = -5 \\ -11 - -4 = -7 \\ -20 - -11 = -9 \end{array} \right\} \text{Consistent difference} \\ \text{decrease indicates} \\ \text{a Quadratic function}$$

C. Use a table of values to graph the following function, for the x values indicated. Then determine:

- 1) the intercepts
- 2) coordinates of the vertex
- 3) equation of the axis of symmetry
- 4) the domain of the function
- 5) the range of the function

$$y = -2x^2 - 8x - 6$$

x	y
-4	-6
-3	0
-2	2
-1	0
0	-6

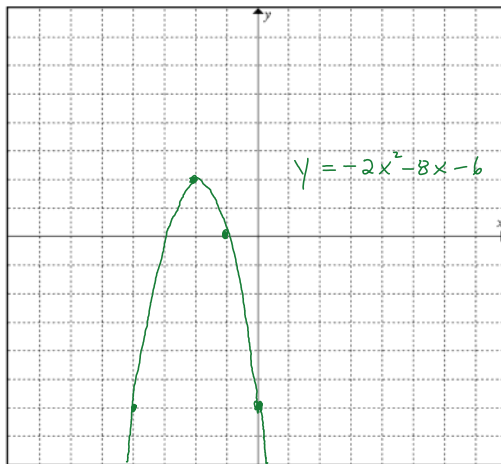
$$y = -2(-4)^2 - 8(-4) - 6$$

$$y = -2(-3)^2 - 8(-3) - 6$$

$$y = -2(-2)^2 - 8(-2) - 6$$

$$y = -2(-1)^2 - 8(-1) - 6$$

$$y = -2(0)^2 - 8(0) - 6$$



1) x-int $(-3, 0)$ & $(-1, 0)$ y-int $(0, -6)$

2) vertex $(-2, 2)$

3) Axis of Symmetry $x = -2$

4) Domain $x \in \mathbb{R}$

5) Range $y \leq 2$

Assignment : Properties of Quadratic Functions Assignment #4 – 8 only

Discuss the Ideas

OBJECTIVE

1. How do you know if a given equation represents a quadratic function?

0

2. How do you know if a given table of values represents a quadratic function?

0

3. Which characteristics of a quadratic function can be identified from the equation $y = ax^2 + bx + c$?

0

Exercises

When approximating answers, round to the nearest tenth.

A

4. Identify the y -intercept of the graph of each quadratic function.

a) $y = -\frac{1}{2}x^2 + 5x - 1$

b) $y = 3 - 14x + 5x^2$

c) $y = -x^2 + 8x - 5$

d) $y = -4x + 3x^2$

e) $y = \frac{4}{3}x^2$

f) $y = 16x^2 - \frac{9}{4}$

5. State whether the vertex of the graph of each quadratic function is a maximum point or a minimum point.

a) $y = 2x^2 + 5x - 4$

b) $y = 5 - 3x^2$

c) $y = 3x^2 - 3x - \frac{5}{4}$

d) $y = 2x - 5x^2$

e) $y = 4 + \frac{1}{2}x^2$

f) $y = -3 + 4x + 2x^2$

6. For the graph of each quadratic function:

i) Identify the vertical intercept.

ii) State whether the vertex is a maximum point or a minimum point.

a) $y = \frac{1}{2}x^2 + 3x + 2$

b) $y = -\frac{1}{3}x^2 + 9x - \frac{7}{4}$

c) $V = 12 - 9t + 2t^2$

d) $h = -5t^2 + 15t + 40$

B

7. Identify whether each table of values represents a linear function, a quadratic function, or neither. Explain how you know.

a)

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

b)

x	0	2	4	6	8
y	5	0	-7	-16	-27

8. Use a table of values to graph each quadratic function below, for the values of x indicated. Determine:

i) the intercepts

ii) the coordinates of the vertex

iii) the equation of the axis of symmetry

iv) the domain of the function

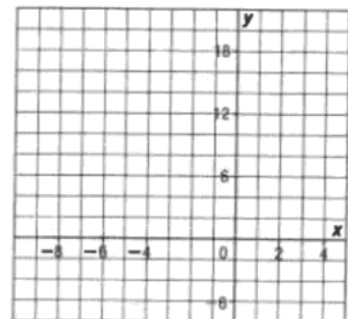
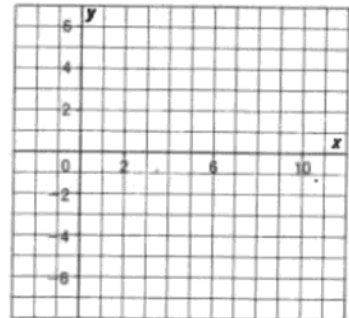
v) the range of the function

a) $y = -x^2 + 12x - 32$

x	3	4	5	6	7	8	9
y							

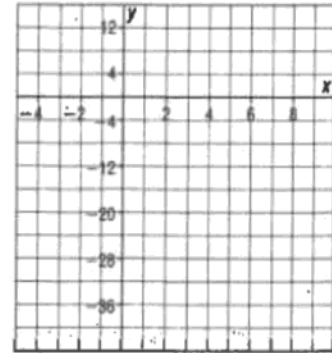
b) $y = 2x^2 + 8x + 6$

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



c) $y = -3x^2 + 24x - 45$

x	1	2	3	4	5	6	7
y							



9. a) Use graphing technology to graph each set of quadratic functions.

i) $y = x^2 + 2x$

ii) $y = -x^2 - 2x$

$y = x^2 + 2x + 1$

$y = -x^2 - 2x - 1$

$y = x^2 + 2x + 2$

$y = -x^2 - 2x - 2$

b) How many x -intercepts may a parabola have?

c) How many y -intercepts may a parabola have?

10. Use graphing technology to graph each quadratic function below.

Determine:

i) the intercepts

ii) the coordinates of the vertex

iii) the equation of the axis of symmetry

iv) the domain of the function v) the range of the function

a) $y = 0.5x^2 - 2x + 5$

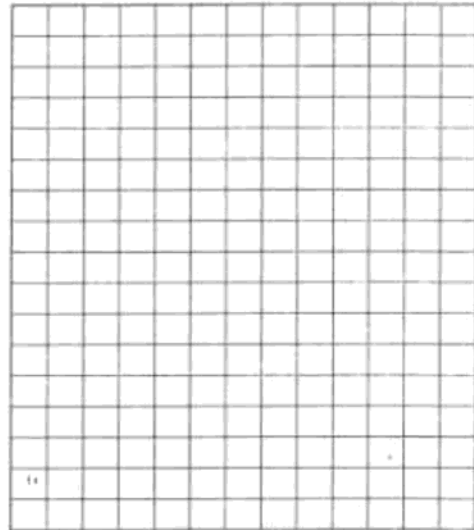
b) $y = -0.75x^2 - 6x + 15$

c) $y = \frac{1}{2}x^2 - \frac{3}{2}x - 5$

Study Note

CR1, CR2

Write an equation of a quadratic function. Determine the characteristics of the function and show the strategies you used. Sketch a graph of the function and label the vertex, the axis of symmetry, and the intercepts.



ANSWERS

4. a) -1 b) 3 c) -5 d) 0 e) 0 f) $-\frac{9}{4}$ 5. a) minimum b) maximum
c) maximum d) maximum e) minimum f) minimum 6. a) i) 2 ii) minimum
b) i) $-\frac{7}{4}$ ii) maximum c) i) 12 ii) minimum d) i) 40 ii) maximum 7. a) neither
b) quadratic 8. a) i) $x: 4, 8; y: -32$ ii) (6, 4) iii) $x = 6$ iv) $x \in \mathbb{R}$ v) $y \leq 4, y \in \mathbb{R}$
b) i) $x: -3, -1; y: 6$ ii) (-2, -2) iii) $x = -2$ iv) $x \in \mathbb{R}$ v) $y \geq -2, y \in \mathbb{R}$
c) i) $x: 3, 5; y: -45$ ii) (4, 3) iii) $x = 4$ iv) $x \in \mathbb{R}$ v) $y \leq 3, y \in \mathbb{R}$ 9. b) 0, 1, or 2
c) 1 10. a) i) no x -intercepts; $y: 5$ ii) (2, 3) iii) $x = 2$ iv) $x \in \mathbb{R}$ v) $y \geq 3, y \in \mathbb{R}$
b) i) no x -intercepts; $y: -15$ ii) (4, -3) iii) $x = 4$ iv) $x \in \mathbb{R}$ v) $y \leq -3, y \in \mathbb{R}$
c) i) $x: -2, 5, y: -5$ ii) (1.5, -6.125) iii) $x = 1.5$ iv) $x \in \mathbb{R}$ v) $y \geq -6.125, y \in \mathbb{R}$
d) i) x : approximately -0.7, 2.2; $y: -2.875$ ii) (0.75, -4) iii) $x = 0.75$
iv) $x \in \mathbb{R}$ v) $y \geq -4, y \in \mathbb{R}$ e) i) x : approximately 1.2, 2.3; $y: -8.1875$
ii) (1.75, 1) iii) $x = 1.75$ iv) $x \in \mathbb{R}$ v) $y \leq 1, y \in \mathbb{R}$ f) i) no x -intercepts, $y: -4$
ii) (3, -1) iii) $x = 3$ iv) $x \in \mathbb{R}$ v) $y \leq -1, y \in \mathbb{R}$ 11. b) after about 2 s
c) approximately $0 \leq t \leq 2.0$, the time the stone was in the air 12. a) same signs
b) $a \neq 0, c = 0$ c) opposite signs 13. a) approximately -0.03

Multiple Choice

1. C 2. D