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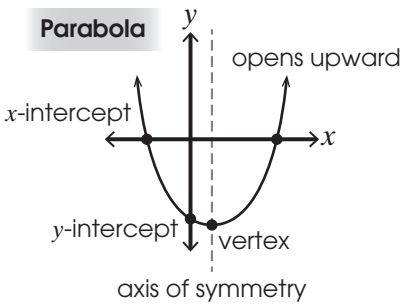
5 Graphs of Quadratic Relations

Words to Learn

Parabola: a graph of a quadratic relation that is shaped like the letter "U"

Axis of symmetry: a line that divides a parabola into two equal halves

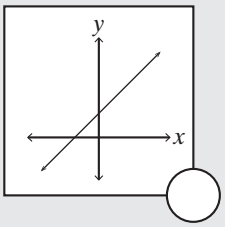
Vertex: the highest or lowest point of a parabola

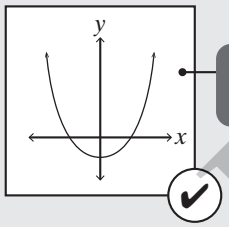


5.1 Properties of Quadratic Relations

Example

Identify and check the representations of quadratic relations.





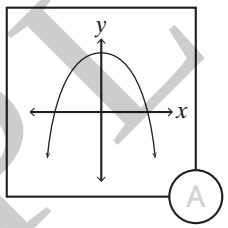
shows a parabola

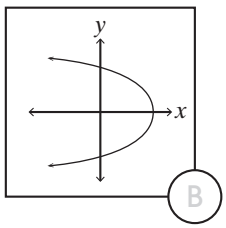
x	y		
-2	8	> -4	
-1	4	> -4	> 0
0	0	> 4	> 8
1	4	> 4	> 0
2	8		

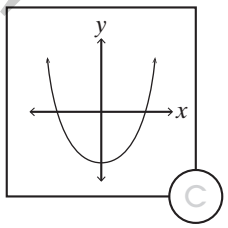
x	y		
-2	-3	> 3	
-1	0	> 5	> 2
0	5	> 7	> 2
1	12	> 9	> 2
2	21		

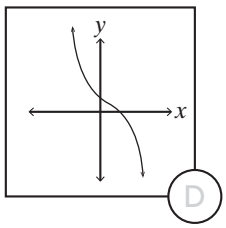
second differences are constant but not 0

Try This









x	y
-2	59
-1	11
0	-5
1	11
2	59

E

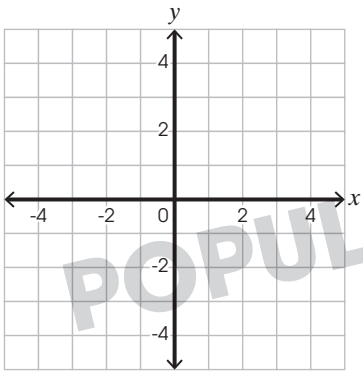
x	y
-2	-2
-1	1
0	-2
1	1
2	4

F

Graph the quadratic relations.

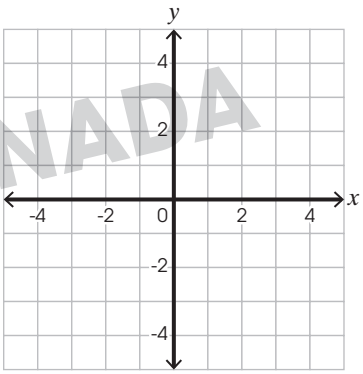
① $y = x^2$

x	y
-2	
-1	
0	
1	
2	



② $y = -2x^2 + 4$

x	y
-2	
-1	
0	
1	
2	



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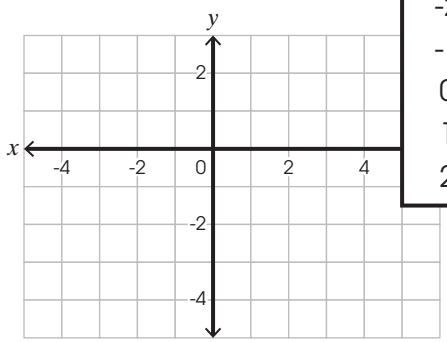
Graph the quadratic relations. Write the key characteristics of each in the table.

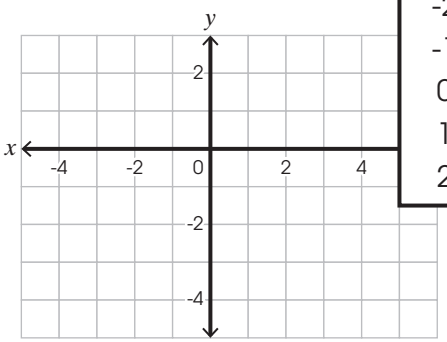
③ $y = x^2 - 4$

x	y
-2	
-1	
0	
1	
2	



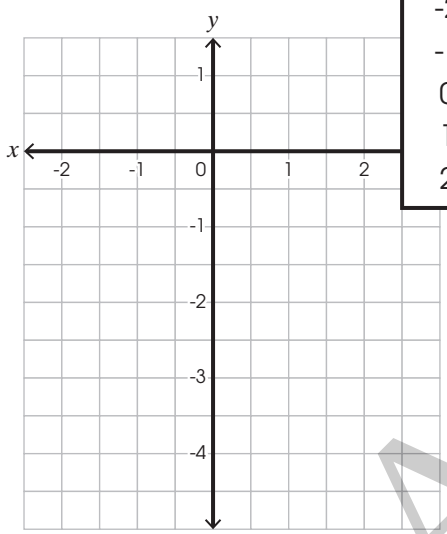
④ $y = -x^2 + x + 2$

x	y
-2	
-1	
0	
1	
2	



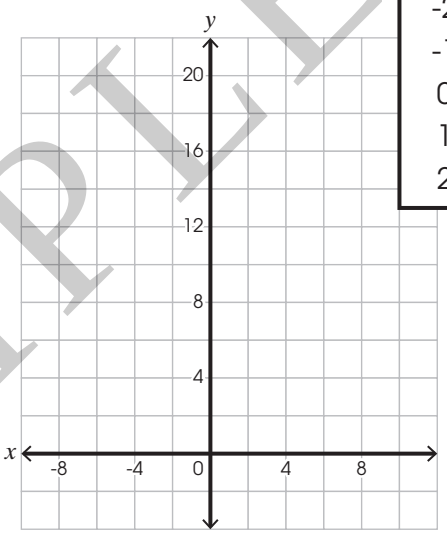
⑤ $y = -\frac{1}{2}(x - 1)^2$

x	y
-2	
-1	
0	
1	
2	



⑥ $y = 2(x + 1)^2 + 2$

x	y
-2	
-1	
0	
1	
2	



	$y = x^2 - 4$	$y = -x^2 + x + 2$	$y = -\frac{1}{2}(x - 1)^2$	$y = 2(x + 1)^2 + 2$
x-intercept(s)	(___, ___)(___, ___)			
y-intercept	(___, ___)			
Direction of Opening	_____			
Axis of Symmetry	$x =$ _____			
Vertex	(___, ___)			
Max./Min. Value	$y =$ _____			

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Sketch the parabolas with the given characteristics.

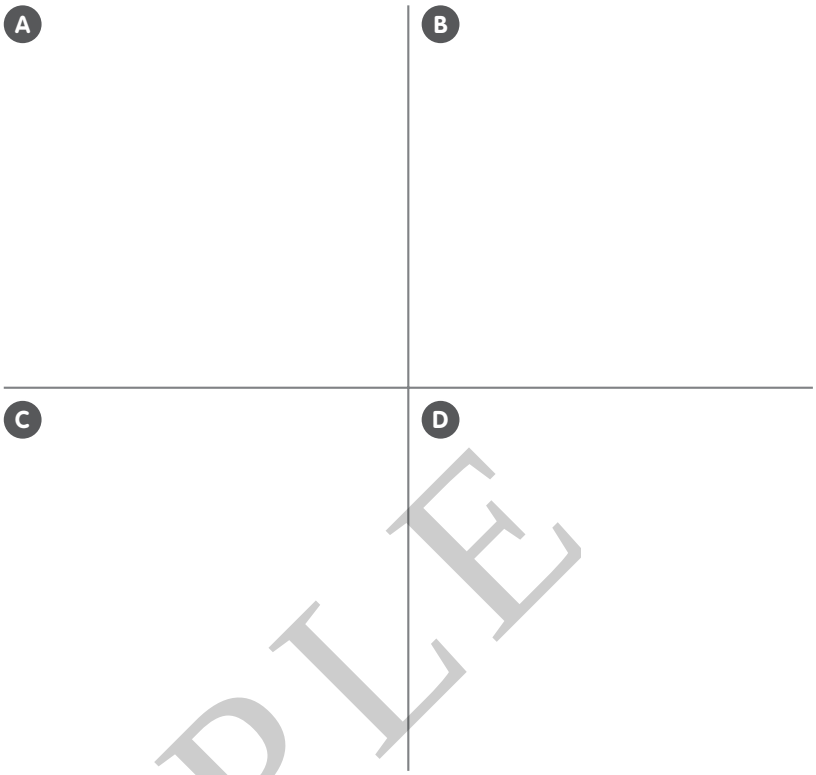
⑦

A. vertex: (-3,0)
y-intercept: (0,1)

B. x-intercept: (1.5,0)
y-intercept: (0,-6)

C. no x-intercepts
opens upward

D. x-intercepts: (2,0), (-2,0)
max. value: 3



Answer the questions without graphing.

⑧ $y = x^2 + 7$

a. What is the direction of opening?

_____

b. What is the y-intercept?

_____

⑨ $y = x^2 - 16x + 63$

a. What is the direction of opening?

_____

b. Will there be a maximum value or a minimum value?

_____

⑩ $y = -2(x - 1)^2$ ← Expand and rewrite in the form: $y = ax^2 + bx + c$.

a. What is the direction of opening? _____

b. What is the y-intercept? _____

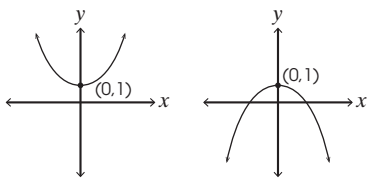
Standard Form of Quadratic Relations

$y = ax^2 + bx + c$

direction of opening — y-intercept

- $a > 0$, upward
- $a < 0$, downward

e.g. $y = x^2 + 1$ $y = -x^2 + 1$



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Circle T for true and F for false.

⑪ The axis of symmetry is always the y-axis. T / F

⑫ The vertex always lies on the axis of symmetry. T / F

⑬ A parabola with no x-intercepts and with a positive y-intercept always opens upward. T / F

⑭ All parabolas have y-intercepts. T / F

⑮ Consider $y = ax^2 + bx + c$.

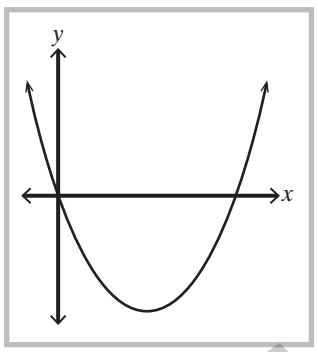
a. If it is an equation of a parabola, then a cannot be 0. T / F

b. If a is negative, the parabola will open downward. T / F

c. c is the y-intercept. T / F

Study each scenario and answer the questions.

⑯



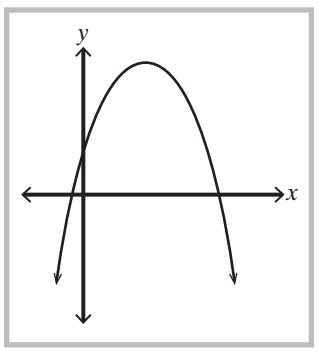
The graph shows the path made by Steven's dive.

a. Check the equation that represents the graph where x represents the horizontal distance and y represents the water depth.

(A) $y = 0.1x^2 + 8$ (B) $y = 0.1x^2 - 2x$ (C) $y = -0.2x^2 - x$

b. What was the maximum water depth Steven reached?

⑰



The graph shows the water arch Karen's garden hose made while she watered her plants.

a. Check the equation that represents the graph where x represents the horizontal distance and y represents the height.

(A) $y = 2x^2 + 5$ (B) $y = -0.5x^2 - 1$ (C) $y = -0.6x^2 + 2.7x + 1.5$

b. How far away was Karen from the plants?

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