Key

Common Core Regents Review

Functions

Quadratic Functions (Graphs)

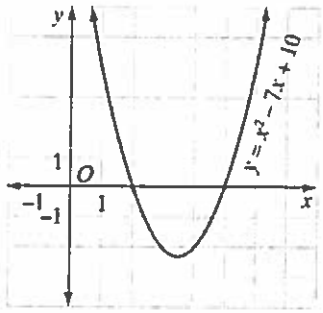
- A ***quadratic function*** has the form $y = ax^2 + bx + c$. It is an equation with a degree of two because its highest exponent is 2. The graph is *u*-shaped, and is also called a parabola. The graph turns up (***concave up***) and has a ***minimum*** value at the ***vertex*** (turning point) when the coefficient of x^2 ***is positive***. It increases on the interval $\left[x - coord \text{ of vertex}, \infty\right)$ and decreases on the interval $\left(-\infty, x - coord \text{ of vertex}\right]$. See graph 1 below. The graph turns down (***concave down***) and has a maximum value at its vertex when the coefficient of x^2 ***is negative.*** It increases on the interval $\left(-\infty, x - coord \text{ of vertex}\right]$ and decreases on the interval $\left[x - coord \text{ of vertex}, \infty\right)$. See graph 2 below.

- The ***axis of symmetry*** is the imaginary line that is drawn through the vertex that makes the graph symmetrical, and always has the equation, $x = c$. The ***parent function*** of a quadratic is $y = x^2$ and can be shifted up or down by adding a constant or stretching or inverting it by changing the coefficient of x^2. The ***roots*** or zeros of a quadratic function are the **x-intercepts**, where the graph crosses the *x*-axis. If the graph crosses in ***two places*** there are ***2 real roots***; if it touches only **once**, there is ***one real root***; if it ***does not cross*** the axis, there are ***no real roots***.

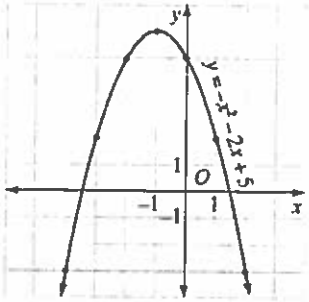
- To find the ***average rate of change, use the slope formula***, $m = \dfrac{f(x_2) - f(x_1)}{x_2 - x_1}$.

- The graphs of real world examples always start at $x = 0$; The solution to a quadratic-linear system is the point of intersection.

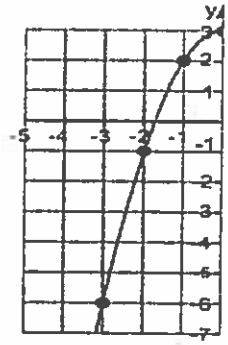
Graph 1



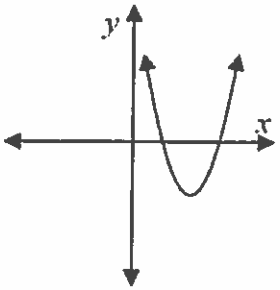
Graph 2

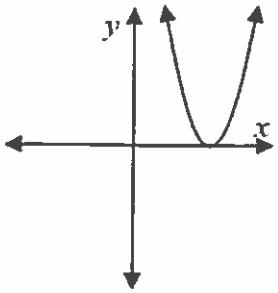


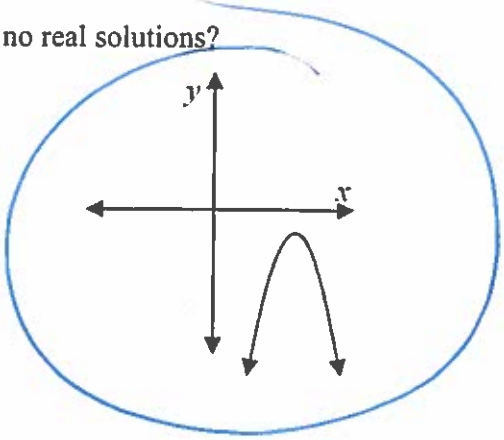
Find other points using symmetry



Look at the graphs below. Which one has no real solutions?

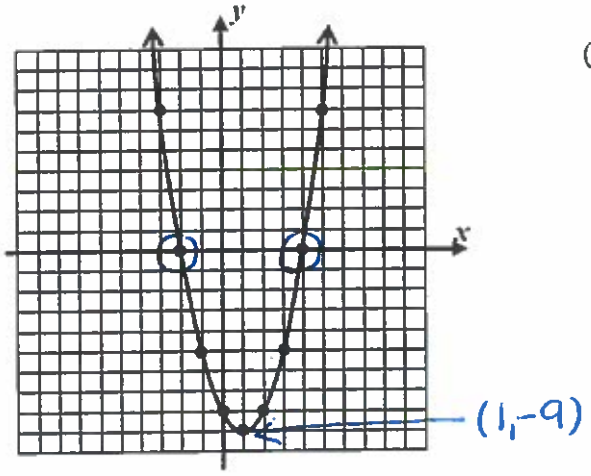






1) Each graph shown below represents a quadratic function of the form $y = x^2 + bx + c$. Use the graph to determine the zeros of the function. Then determine the binomial factors of the function and express the quadratic function in its $y = x^2 + bx + c$ form.

(a)

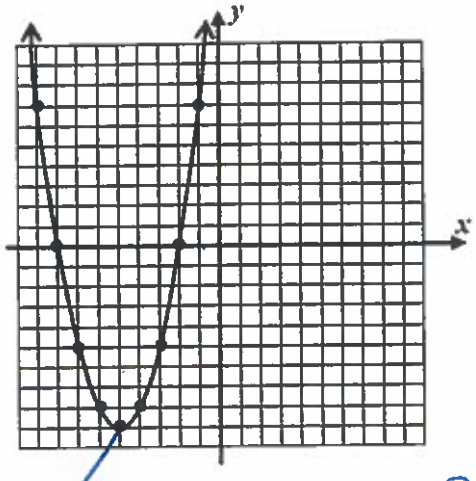


Zeros: $x = \{-2, 4\}$

Factors: $(x+2)(x-4)$

Equation: $y = (x-1)^2 - 9$

(b)



Zeros: $x = \{-8, -2\}$

Factors: $(x+8)(x+2)$

Equation: $y = (x+5)^2 - 9$

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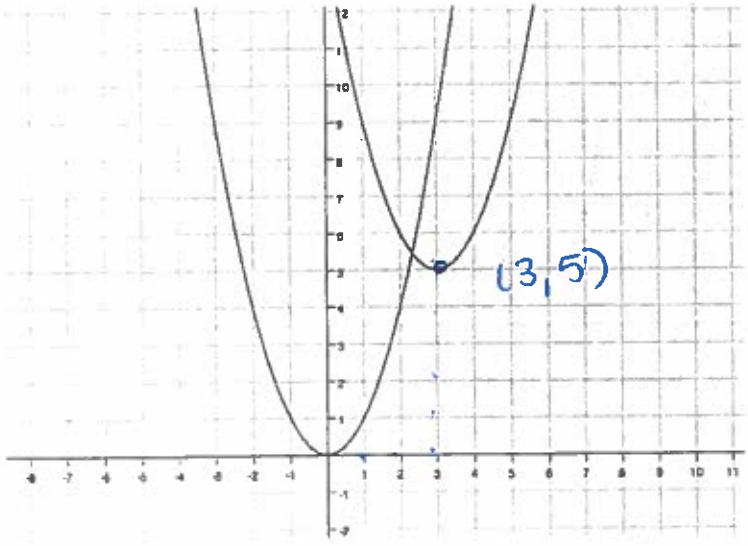
2) Study the graph below. Identify the parent function. Then write a description and equation for the transformed function.



Parent Function $y = x^2$

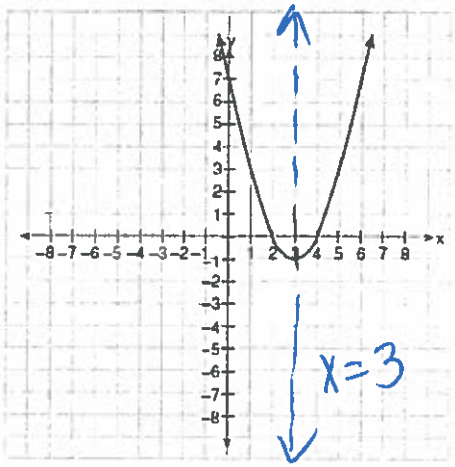
Transformed Equation $y = (x-3)^2 + 5$

Description of transformaion:

3 units right
5 units up

3) Which is an equation of the line of symmetry for the parabola in the accompanying diagram?

(1) $x=2$ (2) $x=4$ (3) $x=3$ (4) $y=3$



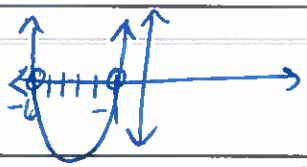
4) Which of the following sets of ordered pairs does not represent a function?

(1) $\{(1,2),(3,4),(4,5),(6,7)\}$ ✓ (3) $\{(-2,2),(-3,3),(-4,-4),(5,-5)\}$ ✓

(2) $\{(0,3),(1,5),(3,9),(1,13)\}$ × (4) $\{(1,2),(2,2),(3,5),(4,8)\}$ ✓

5) How many roots does $x^2+7x+6=0$ have?

(1) 1 (2) 2 (3) 3 (4) 0



6) Consider the graph of the function $f(x)=ax^2+bx+c$. If the coefficient of x^2 were 3, what would be true of the new function?

3

(1) The vertex would be 3 units above the vertex of the original parabola.
(2) The new parabola would be 3 units to the right of the original parabola.
(3) The new parabola would be wider than the original parabola.
(4) The new parabola would be narrower than the original parabola.

7) What is minimum point of the graph of the equation $y=2x^2+8x+9$?

(1) $(2,33)$ (2) $(2,17)$ (3) $(-2,-15)$ (4) $(-2,1)$

8) If the roots of a quadratic equation are -2 and 3, its equation can be written as

(1) $(x-2)(x+3)=0$ (2) $(x+2)(x-3)=0$ (3) $(x+2)(x+3)=0$ (4) $(x-2)(x-3)=0$

$x=-2$ $x=3$

9) Which describes the translation from $y=x^2$ to $y=(x+2)^2-1$?

(1) Up 2 units and right 1 unit. (3) Down 1 unit and left 2 units.
(2) Down 1 unit and right 2 units. (4) Up 1 unit and left 2 units

10) A ball is thrown in the air. Its height, h in meters, is given by $h = -4.9t^2 + 30t + 6$, where t is the time in seconds. What is the height of the ball at the instant it is thrown?
(1) 0 m (2) 4.9 m (3) 6 m (4) 30 m

11) The table contains values for x and y in a quadratic function. What are the roots of the function?
(1) -1 and 5 (2) -1 and 10 (3) -1, 0, and 5 (4) -1, 10, and 5

x	y
-1	0
0	10
1	16
2	18
3	16
4	10
5	0

12) Which ordered pair cannot be a solution of $h(t) = -16t^2 + 80t$, if h is the height of a ball above the ground after t seconds?
(1) $(1,64)$ (2) $(2,96)$ (3) $(-4,256)$ (4) $(5,0)$

13) A rocket is launched from the ground. The function $h(t) = -4.9t^2 + 180t$ models the height of the rocket. If all other factors remain the same, which of the following functions models the height of a rocket above the ground if it is launched from a platform 100 feet in the air?
(1) $h(t) = -4.9t^2 + 280t$
(2) $h(t) = -4.9t^2 + 180t - 100$
(3) $h(t) = -4.9t^2 + 180t + 100$
(4) $h(t) = -4.9t^2 + 180(t + 100)$

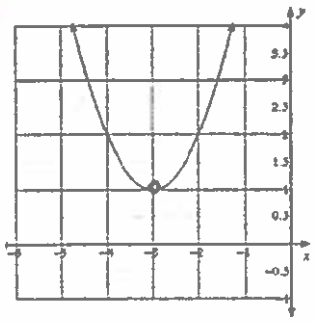
14) A bottle rocket that was made in science class had a trajectory path that followed the quadratic equation, $f(x) = -x^2 + 4x + 6$. What is the turning point of the rocket's path?
(1) $(1,5)$ (2) $(2,10)$ (3) $(-2,-10)$ (4) $(1,-5)$

15. What is the average rate of the function $f(x) = x^2 + 6x + 9$ on the interval $-1 \le x \le 3$?
(1) -4 (2) -8 (3) 8 (4) 4

x	y
-1	4
3	36

$$\frac{36-4}{3-(-1)} = \frac{32}{4} = 8$$

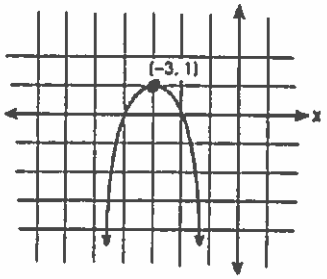
16. Which statement *is not* supported by the graph shown?
(1) The vertex is $(-3,1)$. ✓
(2) The roots are -4 and -2. ✗
(3) The coefficient of x^2 in the equation is positive. ✓
(4) The quadratic function has no real roots. ✓



17) Which equation represents the parabola shown in the accompanying graph?

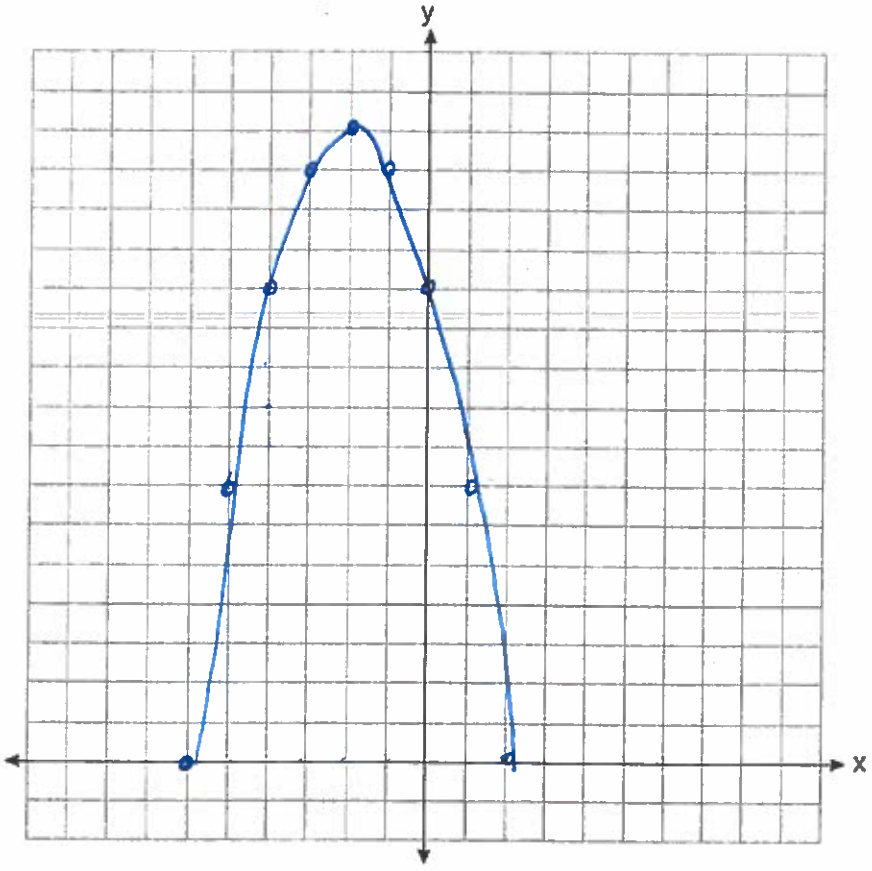
(1) $f(x)=(x+1)^2-3$ (3) $f(x)=-(x-3)^2+1$

(2) $f(x)=-(x+3)^2+1$ (4) $f(x)=-(x-3)^2-3$



18) On the set of axes below graph the following quadratic function, $f(x)=-x^2-4x+12$.

Use as the domain $\{x \mid -6 \le x \le 2\}$. Then answer the questions that follow. NO ARROWS



TABLE

x	f(x)
-6	0
-5	7
-4	12
-3	15
-2	16
-1	15
0	12
1	7
2	0

a. What are the x-intercepts? -6 and 2

b. What is the axis of symmetry? $x = -2$

c. What is the vertex of the graph? $(-2, 16)$

d. Is the this a maximum or minimum value max = 16

19) On the set of axes below, solve the following system of equations graphically for all values of x and y. Notice the quadratic is shown in vertex form.

$$y = (x-2)^2 + 4$$

$$4x + 2y = 14$$

$4x + 2y = 14$

$-4x \quad -4x$

$\frac{2y}{2} = \frac{-4x+14}{2}$

$y = -2x + 7$

$y = (x-2)^2 + 4$