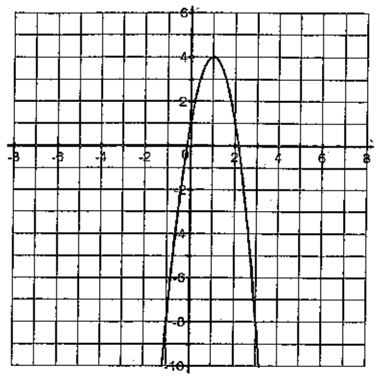
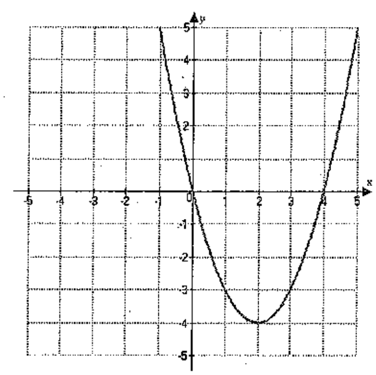
GSE Algebra I | Unit 3A: Modeling and Analyzing Quadratic Functions | Name:

Study Guide

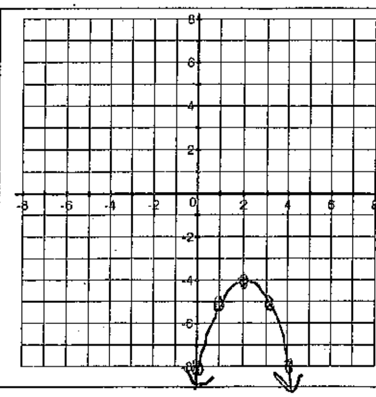
What you need to know and be able to do	Things to remember	Problem	Problem
Describe Characteristics of Quadratics Functions	• *Vertex* • *Axis of Symmetry* • *Interval of Inc/Dec* • *Domain* • *Range* • *Extrema* • *Min/Max Value* • *Zeros* • *Y-int* • *Rate of Change* $\frac{y_2 - y_1}{x_2 - x_1}$	1. 	Vertex: $(1,4)$ Axis of Symmetry: $x=1$ Interval of Inc/Dec: I: $-\infty<x<1$ D: $1<x<\infty$ Domain: $\mathbb{R}$ Range: $-\infty<y\le 4$ Extrema: max Min/Max Value: 4 Zeros: $-0.2, 2.2$ Y-int: $(0,1)$ Rate of Change from $-1 < x < 1$ $(-1,-8)\ (1,4)$ $RoC = \frac{4--8}{1--1} = \boxed{6}$
		2. 	Vertex: $(2,-4)$ Axis of Symmetry: $x=2$ Interval of Inc/Dec: I: $2<x<\infty$ D: $-\infty<x<2$ Domain: $\mathbb{R}$ Range: $-4\le y<\infty$ Extrema: min Min/Max Value: -4 Zeros: $0, 4$ Y-int: $(0,0)$ Rate of Change from $0 < x < 3$ $(0,0)\ (3,-3)$ $RoC = \frac{-3-0}{3-0} = \boxed{-1}$
Identify Transformations of Quadratic Functions	• *Describe the transformations on the function $y = x^2$*	3. $y = -2(x+3)^2 - 4$ reflect over x-axis stretch by 2 move left 3 move down 4	4. $y = \frac{1}{2}x^2 + 9$ shrink by $\frac{1}{2}$ move up 9
	• *Write the equation for the function $y = x^2$ with given transformations*	5. Vertically compress by a factor of 1/3, shift right 3, and shift down 8 $y = \frac{1}{2}(x-3)^2 - 8$	6. Reflect across the x-axis, vertically stretch by a factor 5, and shift up 7 $y = -5x^2 + 7$

Graph Quadratics Functions

- *Graphing in vertex form*

7. $f(x) = -(x-2)^2 - 4$

x	f(x)
0	-8
1	-5
2	-4
3	-5
4	-8



- *Graphing in standard form*

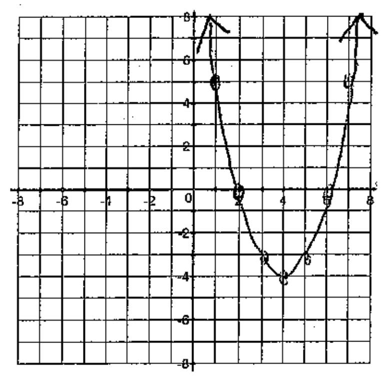
8. $f(x) = x^2 - 8x + 12$

$h: \frac{-b}{2a} = \frac{8}{2(1)} = 4$

$k: (4)^2 - 8(4) + 12 = -4$

vertex: $(4, -4)$

x	f(x)
2	0
3	-3
4	-4
5	-3
6	0



Converting between Vertex and Standard Forms

- *Convert from vertex form to standard form*

9. $y = \frac{1}{2}(x-8)^2 + 5$

$\frac{1}{2}(x-8)(x-8)+5$

	x	-8
x	x^2	-8x
-8	-8x	64

$\frac{1}{2}(x^2 - 16x + 64) + 5$

$\frac{1}{2}x^2 - 8x + 32 + 5$

$\boxed{y = \frac{1}{2}x^2 - 8x + 37}$

10. $y = -(x+1)^2 - 9$

$-(x+1)(x+1) - 9$

	x	+1
x	x^2	1x
+1	1x	1

$-(x^2 + 2x + 1) - 9$

$-x^2 - 2x - 1 - 9$

$\boxed{y = -x^2 - 2x - 10}$

- *Convert from standard form to vertex form*

$y = a(x-h)^2 + k$

11. $y = 2x^2 - 4x + 9$

$a = 2 \quad b = -4 \quad c = 9$

$h: \frac{4}{2(2)} = 1$

$k = 2(1)^2 - 4(1) + 9 = 7$

$\boxed{y = 2(x-1)^2 + 7}$

12. $y = -x^2 - 9x + 2$

$a = -1 \quad b = -9 \quad c = 2$

$h: \frac{9}{2(-1)} = -4.5$

$k: -(-4.5)^2 - 9(-4.5) + 2 = 22.25$

$\boxed{y = -1(x+4.5)^2 + 22.25}$

Understand Applications of Quadratics

- *Vertex will be the highest or the lowest point*

Abigail tosses a coin off a bridge into a stream below. The distance, in feet, the coin is above the water is modeled by the equation $y = -16x^2 + 96x + 112$, where x represents time in seconds.

$h: \frac{-96}{2(-16)} = 3$

$k: -16(3)^2 + 96(3) + 112$

$= 256$

13. At what time, in seconds, will the coin be at the highest point of the toss?

3 seconds

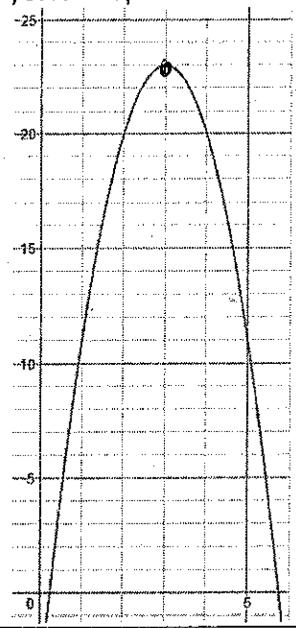
14. What is the highest point the coin reached?

256 feet

15. How high was Abigail from the stream before she tosses her coin? y-intercept

112 ft.

Study Guide

	• *Find the correct coordinate pair from the graph.* • *If you know the y-value, there might be multiple x-values*	The profits of Mr. Unlucky's company can be respresnted by the equation $y = -3x^2 + 18x - 4$, where y is the amount of profit in *hundreds of thousands* of dollars and x is the number of years of operation. 	16. When will Unlucky's business show the maximum profit? vertex: 3 years 17. What is the maximum profit? vertex: $2,300,000 (23 hundred thousand) 18. How much money did the business make after 1 year? $y = -3(1)^2 + 18(1) - 4 = 11$ $1,100,000 19. When did the business reach $2,000,000? 2 years and 4 years 20. What is the average rate of change for 1 < x < 3? (1,11) (3, 23) RoC $= \frac{23-11}{3-1} =$ $6,00,000/year
Compare Quadratic Equations	• *Compare vertex values* • *Compare y-intercepts* • *Compare rates of change* • *Compare vertex and standard forms* Roger vertex: (1, 4) y-int: (0, 3) (1.5, 3.75) (2, 3) RoC $= \frac{3-3.75}{2-1.5} = -\frac{3}{2}$ or -1.5	Two baseball players, Steve and Roger, hit homeruns. The path of Steve's ball can be modeled by the function $f(x) = -3x^2 + 6x + 5$, where f(x) is the height in hundreds of feet and x is the number of seconds the ball is in the air. The path of Roger's ball can be modeled by the function $g(x) = -(x-1)^2 + 4$, where g(x) is the height in hundreds of feet and x is the number of seconds the ball is in the air. Steve $\frac{-6}{2(-3)} = 1$; $-3(1)^2 + 6(1) + 5 = 8$ vertex: (1, 8) y-int: (0, 5) (1.5, 7.25) (2, 5) RoC $= \frac{5-7.25}{2-1.5} = -\frac{9}{2}$ or -4.5	21. Which player's baseball had the **greatest** height? (vertex) Steve's, 8 ft vs. 4 ft 22. Which player had the **lowest** y-intercept? Roger, (0,3) vs. (0,5) 23. What player had the **largest rate of decrease** from 1.5 < x < 2 Steve, −4.5 vs −1.5 24. What height is each player's baseball after 0.5 seconds? Steve: $f(0.5) = -3(0.5)^2 + 6(0.5) + 5$ $= 7.25$ feet Roger: ~~[illegible]~~ $g(.5) = -(.5-1)^2 + 4$ $= 3.75$ feet