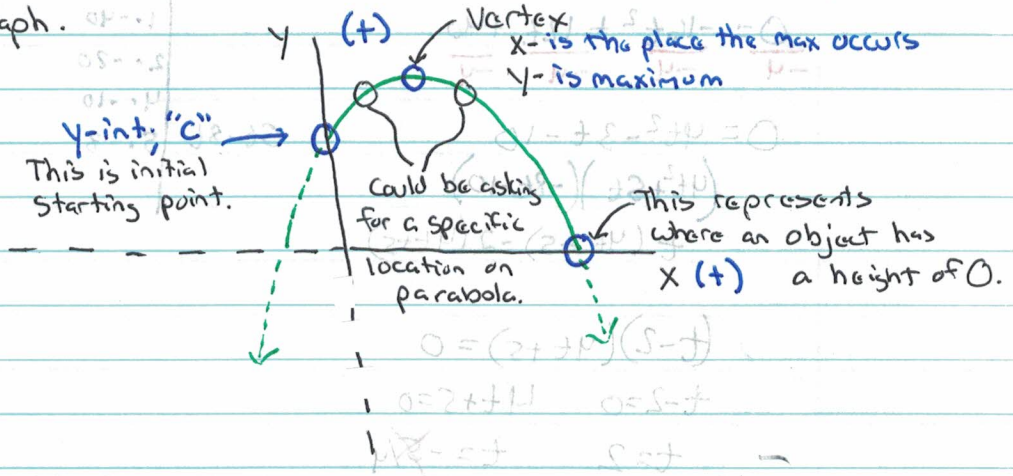
Math Unit 2.2 Quadratic Word Problems

Word Problems AKA Real-World Applications

Guides/Steps to Solving Word Problems:

1) READ the entire problem FIRST before trying to solve.
2) Identify what the problem is asking you to do/find.
3) Underline/highlight/circle key elements needed to solve the problem.
4) If needed DRAW a picture to represent the problem. It can HELP with understanding.
5) Ask yourself, "Does my answer make sense?"
6) Do not forget your units of measure!
7) Word problems will not have NO solutions or imaginary solutions.

Quadratic Functions and where answers can be found on its graph.

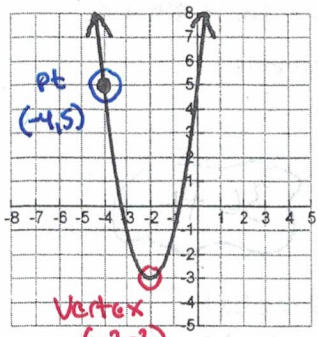


Math 2 Unit 2.2 Quadratic Word Problems Name: _____

Modeling a Quadratic Function When Given a Graph

Example 1: Write a quadratic function (in vertex form) that models each graph.

a.)



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

$y = a(x+2)^2-3$

Plug in a pt into y and x! Solve for a!

$5 = a(-4+2)^2-3$

$5 = a(-2)^2-3$

$5 = 4a-3$

$+3 \quad +3$

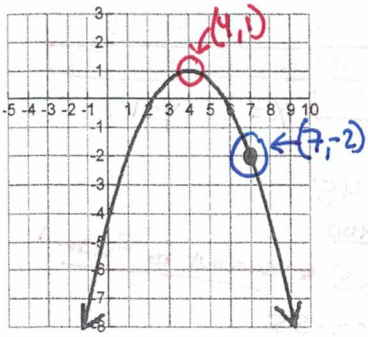
$8 = 4a \longrightarrow a = 2$

Rewrite using "a" and x, y

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

y

b.)



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

$y = a(x-4)^2+1$

$-2 = a(7-4)^2+1$

$-2 = a(3)^2+1$

$-2 = 9a+1$

$\frac{-3}{9} = \frac{9a}{9} \rightarrow a = -\frac{1}{3}$

$f(x) = -\frac{1}{3}(x-4)^2+1$

Modeling a Quadratic Function Using Various Word Problems

Example 2: Complete each word problem using techniques learned in previous concepts.

a.) Courtney is building a rectangular wading pool. She wants the area of the bottom to be 54 ft^2. She also wants the length of the pool to be 3 ft longer than twice its width. What are the dimensions of the pool?

length is 12 ft
width is 4.5 ft

b.) The formula for throwing a baseball in the air is represented by $h = -16t^2 + 12t + 40$ where *h* is the height of the ball. After how many seconds will the ball hit the ground? $h = 0$

2 seconds

c.) The function $h = -16t^2 + 1700$ gives an object's height h, in feet, at t seconds.

i.) What does the constant tell you about the height of the object? The constant is 1700 which means it is the initial height of the object. Time is 0!

ii.) What does the coefficient of t^2 tell you about the direction the object is moving?
$a = -16$, the function is a maximum. It starts up but goes down.

iii.) When will the object be 1000 feet above the ground? Let $h = 1000$, solve for t!

$1000 = -16t^2 + 1700$ b/c "bx" is missing solve using $\sqrt{}$ property!

$-1700 \quad -1700$

$-700 = -16t^2$

$\frac{-700}{-16} = \frac{-16t^2}{-16}$

$43.75 = t^2$

$\sqrt{43.75} = \sqrt{t^2}$

$t = 6.6$ seconds

6.6 seconds

iv.) What are a reasonable domain and range for the function h? For domain, let $h = 0$ solve for t!

Domain

x is t "time"

$0 \le x \le 10.3$

Let $h = 0$, solve for t!

$0 = -16t^2 + 1700$

$-1700 = -16t^2$

$106.25 = t^2$

Range

$0 \le y \le 1700$

$x = -\frac{b}{2a} \rightarrow x = -\frac{(0)}{2(-16)} \quad x = \frac{0}{-32}$

$x = 0$

$h = -16(0)^2 + 1700 \rightarrow h = 1700$

Example 2

a) 

$A = lw$

$A = 54\ ft^2$

$l = 2w + 3$

$w = w$

$54 = (2w+3)w$

$54 = 2w^2 + 3w$

$2w^2 + 3w - 54 = 0$

$(2w^2 - 9w)(12w - 54)$

$w(2w-9) + 6(2w-9)$

$(w+6)(2w-9) = 0$

$w+6 = 0 \quad 2w-9 = 0$

$w = \cancel{-}6 \quad w = 9/2$ or 4.5 ft

b/c length or width can not be negative

bx	a·c
3w	-108
	-1·108
	-2·54
	-3·36
	-4·27
	-6·18
-9w+12w	-9·12

width 4.5 ft

length 12 ft

$l = 2w + 3$

$l = 2(4.5) + 3$

$l = 12$ ft

b) $h = -16t^2 + 12t + 40$

$\frac{0}{-4} = \frac{-16t^2}{-4} + \frac{12t}{-4} + \frac{40}{-4}$

$0 = 4t^2 - 3t - 10$

$(4t^2 + 5t)(-8t - 10)$

$t(4t+5) - 2(4t+5)$

bx	a·c
-3t	-40
	1·-40
	2·-20
	4·-10
5t-8t	5·-8

$(t-2)(4t+5) = 0$

$t - 2 = 0 \quad 4t + 5 = 0$

$t = 2 \quad t = \cancel{-}5/4$

b/c time can not be negative

2 seconds

Example 2 Cont'd: Complete each word problem using techniques learned in previous concepts.

d.) The equation $y = x^2 - 12x + 45$ models the number of books y sold in a bookstore x days after an award-winning author appeared at an autograph-signing reception. What was the first day that at least 100 copies of the book were sold? $x = ?$ $y = 100$

$100 = x^2 - 12x + 45$

$-100 \quad -100$

$0 = x^2 - 12x - 55$ ← can not be factor!

$a = 1 \quad b = -12 \quad c = -55$

$$x = \frac{-(-12) \pm \sqrt{(-12)^2 - 4(1)(-55)}}{2(1)}$$

$$x = \frac{12 \pm \sqrt{364}}{2}$$

$\frac{12 + \sqrt{364}}{2} \approx 15.5$

$\frac{12 - \sqrt{364}}{2} \approx -3.5$

days can not be negative!

16 days

e.) A ball is thrown into the air with an initial upward velocity of 48 ft/s. It height *h* in feet after *t* seconds is given by the function $h(t) = -16t^2 + 48t + 4$.

i.) What height will the ball be when 2 seconds has passed?

$h = -16(2)^2 + 48(2) + 4$

$h = 36$

36 ft

ii.) In how many seconds will the ball reach its maximum height? Looking for the x-coordinate of vertex aka AOS.

$h(t) = -16t^2 + 48t + 4$

$a = -16 \quad b = 48$

$x = \frac{-(48)}{2(-16)} \Rightarrow x = \frac{-48}{-32}$

1.5 seconds

iii.) What is the ball's maximum height?

$h(t) = -16t^2 + 48t + 4$

$h(t) = -16(1.5)^2 + 48(1.5) + 4$

$h(t) = 40$ ft