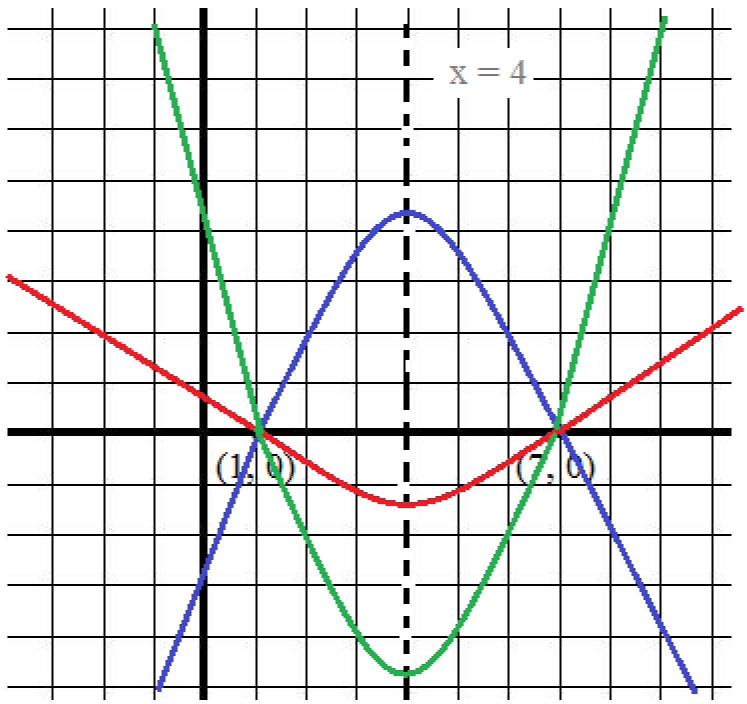
Algebra II: Identifying Quadratic Equation from Points

Notes, Examples, and Practice Test (w/solutions)



Topics include Factored form, Vertex form, and Standard form, solving systems, interpreting graphs, and more.

Finding the equation of a quadratic from points

I. Introduction

If three coplanar points are known, the equation of the parabola (quadratic) going through them can be determined.

If the vertex and one point are known, the quadratic equation can be identified.

What if you know the 2 x-intercepts? This is not enough information!

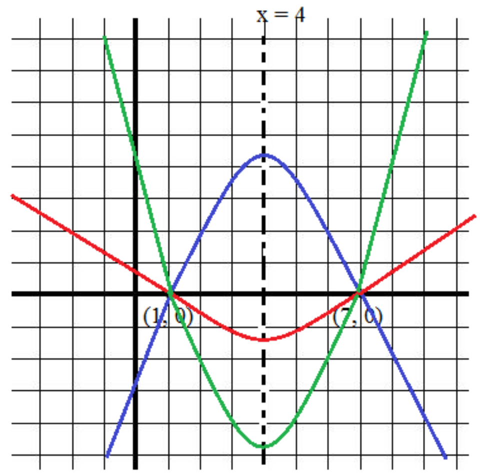
Example: (1, 0) and (7, 0)

Although we know the axis of symmetry is x = 4, we cannot specify the exact curve...

The diagram displays three possible parabolas that go through (1, 0) and (7, 0)..

(There are an infinite number of parabolas that go through (1, 0) and (7, 0)

We must know a *third point* to determine the precise quadratic equation.



II. Using *intercept form* and x-intercepts

Example: Determine the equation of a parabola that passes through (3, 0) and the vertex (1, 5)

Solution: If the vertex is (1, 5), then the axis of symmetry is x = 1..
Since the axis of symmetry is x = 1 and one x-intercept is (3, 0),
then the other x-intercept must be (-1, 0) (to maintain symmetry)

Step 1: Write general formula of quadratic

$y = a(x - p)(x - q)$ where p and q are the x- intercepts

Step 2: Substitute given values (to determine "a")

(1, 5)
p = -1
q = 3

$5 = a(1 - -1)(1 - 3)$

$5 = -4a$

$a = \frac{-5}{4}$

Step 3: Write equation of the quadratic

$y = \frac{-5}{4}(x + 1)(x - 3)$

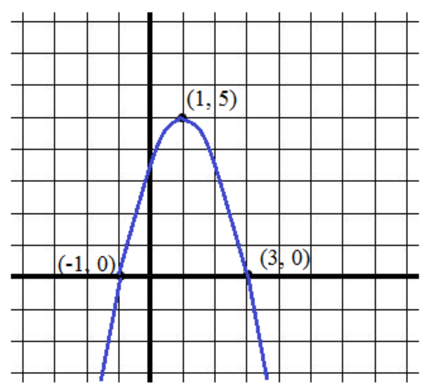
Step 4: Check answer (test the 3 points)

(-1, 0): $0 = \frac{-5}{4}(-1 + 1)(-1 - 3)$ ✓

(3, 0): $0 = \frac{-5}{4}(3 + 1)(3 - 3)$ ✓

(1, 5): $5 = \frac{-5}{4}(1 + 1)(1 - 3)$

$5 = \frac{-5}{4}(-4)$ ✓



(Note: Intercept form may be called *Factored Form*)

Finding the equation of a quadratic from points

What if we know the vertex and one point? We don't have a 3rd point. However, since one of the 2 points is a vertex, the equation can be determined.

III. Using *vertex form* and the vertex & point

Example: What is the equation of a parabola with vertex (3, 1) that passes through (-1, 9)?

Solution: Since we are given the vertex and a point, it is rather straightforward.

Step 1: Write the general formula for a parabola

$y = a(x - h)^2 + k$ where (h, k) is the vertex (and (x, y) are points on the parabola)

Step 2: Use substitution to find "a"

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

(h, k) = (3, 1)

(x, y) = (-1, 9)

$9 = a(-1 - 3)^2 + 1$

$8 = 16a$

$a = \frac{1}{2}$

Step 3: Write equation of the quadratic

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

Step 4: Check answer

test points: (3, 1) $1 = \frac{1}{2}(3 - 3)^2 + 1$ ✓

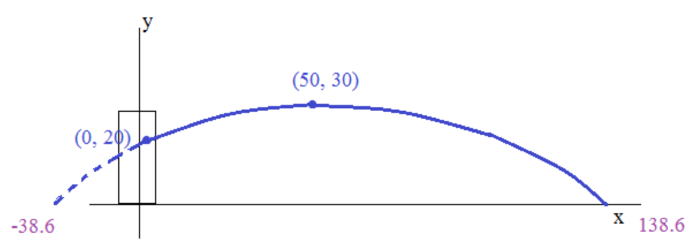
(-1, 9) $9 = \frac{1}{2}(-1 - 3)^2 + 1$ ✓

Example: A kid throws a ball out of a 2nd floor window. The window is 20 feet above the ground. If the ball reaches a *maximum height* of 30 feet when it is 50 feet from the building. How far from the building will the ball hit the ground?

Solution: The maximum height is the vertex. So, we need another point to find the equation.

Step 1: Draw a picture, identify variables, and map points

x = distance from building
y = height above ground



Step 2: Write general form of a parabola (quadratic)

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

Step 3: Substitute to find "a"

(h, k) = (50, 30)
(x, y) = (0, 20)

$20 = a(0 - 50)^2 + 30$

$-10 = 2500a$

$a = \frac{-1}{250}$

Step 4: Write the equation of the parabola (path of the projectile)

$y = \frac{-1}{250}(x - 50)^2 + 30$

Step 5: Answer the question!

When the ball hits the ground, its height will be 0..
Therefore, we need to find the coordinate (x, 0)

$0 = \frac{-1}{250}(x - 50)^2 + 30$

$7500 = (x - 50)^2$

$x = 50 \pm 88.6$

x = ~~-38.6~~ or 138.6

(cannot be negative; that point is behind the building!)

approximately 138.6 feet from the building

Finding the equation of a quadratic from points

Suppose we are given 3 points -- and neither is a vertex -- how can we find the equation of the quadratic that includes all of them?

Again, we'll use general equations and substitution....

IV: Using *standard form* and solving simultaneous equations

Example: The following are 3 points on a parabola: (-1, -6) (2, 15) (-3, 0)
Find the quadratic expression that represents the parabola.

Solution: We have 3 points, so we'll need to figure out which quadratic equation they have in common.

Step 1: Write standard from of a quadratic

$ax^2 + bx + c = y$

Step 2: Substitute each point into the equation

(-1, -6): $a(-1)^2 + b(-1) + c = -6$ $\quad a - b + c = -6$

(2, 15): $a(2)^2 + b(2) + c = 15$ $\quad 4a + 2b + c = 15$

(-3, 0): $a(-3)^2 + b(-3) + c = 0$ $\quad 9a - 3b + c = 0$

Step 3: Solve the system of 3 equations and 3 unknowns

(calculator/using an augmented matrix)

$$\left[\begin{array}{ccc|c} 1 & -1 & 1 & -6 \\ 4 & 2 & 1 & 15 \\ 9 & -3 & 1 & 0 \end{array}\right]$$

(coefficients) a b c y

Casio fx-9750GII

Button	Operation
Menu	(main)
Equa	(solving equations)
EXE	
F1	(simultaneous equations)
F2	Number of unknowns? 3
Enter the above matrix	
F1	(solve)

Calculator Output: x, y, z $\begin{bmatrix} 2 \\ 5 \\ -3 \end{bmatrix}$

$a = 2 \quad b = 5 \quad c = -3$

(Algebra/elimination method)

equation 1: $a - b + c = -6$
2: $4a + 2b + c = 15$
3: $9a - 3b + c = 0$

1: $2a - 2b + 2c = -12$
2: $4a + 2b + c = 15$
4: $6a + 3c = 3$

1: $-3a + 3b - 3c = 18$
2: $9a - 3b + c = 0$
$6a - 2c = 18$

$6a + 3c = 3$
$-6a + 2c = -18$
$5c = -15$
$c = -3$

4: $6a + 3c = 3$
$6a + 3(-3) = 3$
$6a = 12$
$a = 2$

1: $a - b + c = -6$
$(2) - b + (-3) = -6$
$-b = -5$
$b = 5$

Step 4: Write standard form of the equation

→ $y = 2x^2 + 5x - 3$

Step 5: Check solutions!

(-1, -6): $(-6) = 2(-1)^2 + 5(-1) - 3 = 2 - 5 - 3 = -6$ ✓

(2, 15): $(15) = 2(2)^2 + 5(2) - 3 = 8 + 10 - 3 = 15$ ✓

(-3, 0): $(0) = 2(-3)^2 + 5(-3) - 3 = 18 - 15 - 3 = 0$ ✓

Finding the equation of a quadratic from points

Example: A swimmer steps up to a diving board. When he dives off, his height above the water is
24 feet @ 1 second,
18 feet @ 2 seconds, and
2 feet @ 3 seconds.

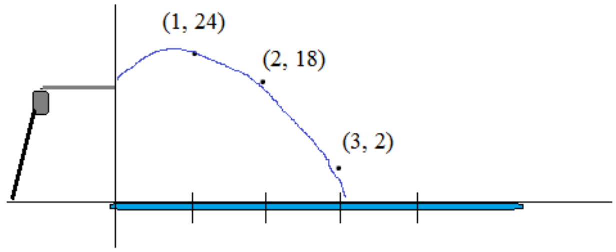
a) How high is the diving board?

b) What is the peak height of the jump? When does it occur?

c) When does he hit the water?

Step 1: Sketch a graph of the dive.

The trajectory is shows
an upside down parabola.



Step 2: Determine the equation that models the diver.

Standard form of a quadratic: $y = ax^2 + bx + c$

(1, 24): $24 = a(1)^2 + b(1) + c$

(2, 18): $18 = a(2)^2 + b(2) + c$

(3, 2): $2 = a(3)^2 + b(3) + c$

$a + b + c = 24$

$4a + 2b + c = 18$

$9a + 3b + c = 2$

Linear system:
3 equations and 3 unknowns

Using a TI nspire CX CAS:
menu
3: Algebra
7: Solve System of Equations
2: Solve System of Linear Equations
('number of equations': enter 3)
When the *linSolve* function and template appear, enter the equations.
$x + y + z = 24$
$4x + 2y + z = 18$
$9x + 3y + z = 2$
Enter
Output: {-5, 9, 20}

The model of the diver is

$h(t) = -5t^2 + 9t + 20$

where t is the time of the dive
and $h(t)$ is the height of the diver over the water.

Step 3: Answer the questions

a) height of the diving board: This occurs when the diver starts -- at time (t) = 0. $h(0) = 20$

b) Peak of he dive: This would occur at the vertex -- $\frac{-b}{2a} = \frac{-9}{2(-5)} = .9$ seconds

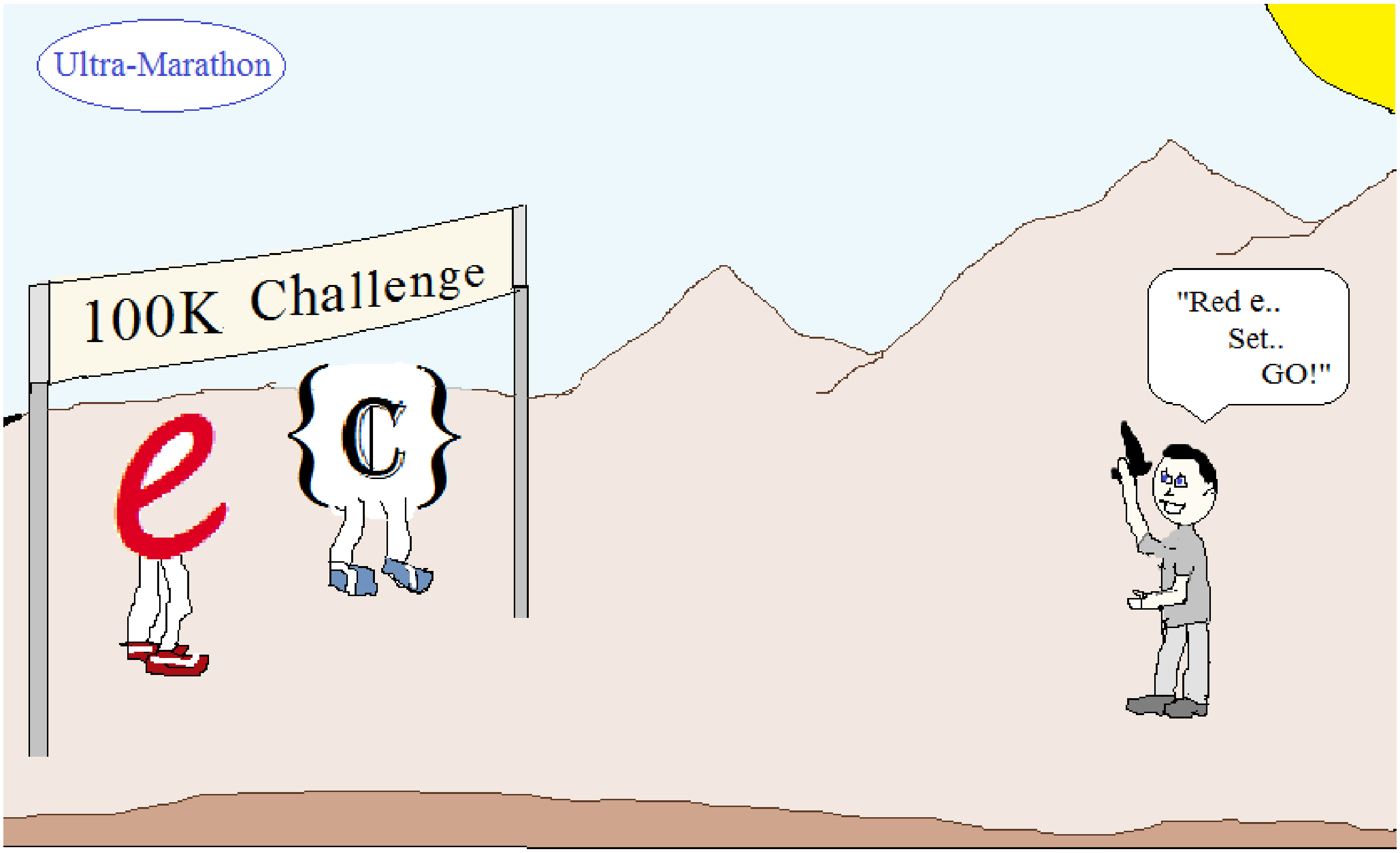
$h(.9) = -5(.9)^2 + 9(.9) + 20 =$ 24.05 feet

c) Diver hits water: This occurs when the height is 0 -- $0 = -5t^2 + 9t + 20$

Since time cannot be negative,

there is only one answer: 3.09 seconds

Using the TI nspire Calculator:
menu
3: algebra
1: solve
Enter the quadratic equation.
$-5t^2 + 9t + 20 = 0$, t
control enter
Output: t = -1.29 and t = 3.09



Testing the limits of endurance,
these math figures will run on and on...

LanceAF #87 5-24-13
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Practice Test-→

Finding Quadratic Equations Quiz

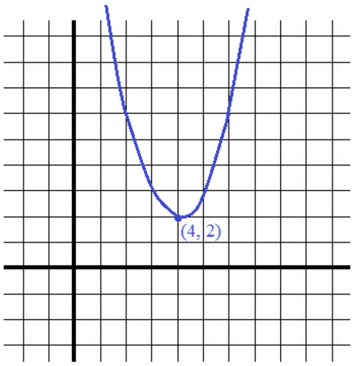
I. Vertex Form -- Express the following parabolas in *vertex form*

A. vertex: (2, 5)
through the point (5, 14)

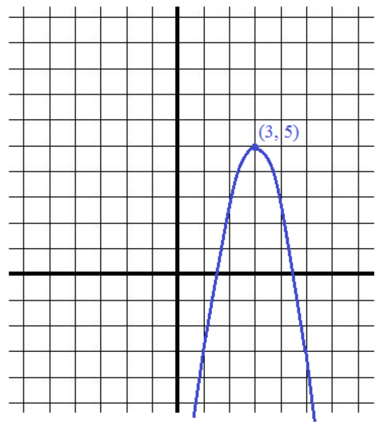
B. vertex: (-2, -5)
through the point (1, 22)

C. vertex: (3, 3)
y-intercept: (0, -15)

D.



E.



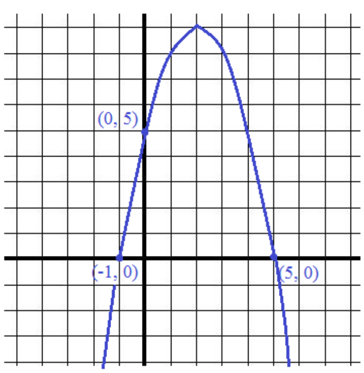
II. Intercept Form -- Express the following quadratics in *intercept form*

A. x-intercepts: (1, 0) (5, 0)
vertex: (3, 8)

B. x-intercepts: (-3, 0) (5, 0)
another point on the curve: (7, 4)

C. vertex: $\left(\frac{-3}{2}, \frac{-25}{2}\right)$
y-intercept: (0, -8)

D.



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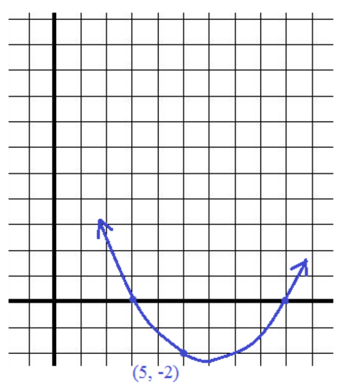


Finding Quadratic Equations Quiz

III. Standard Form -- Express the following quadratics in *standard form*

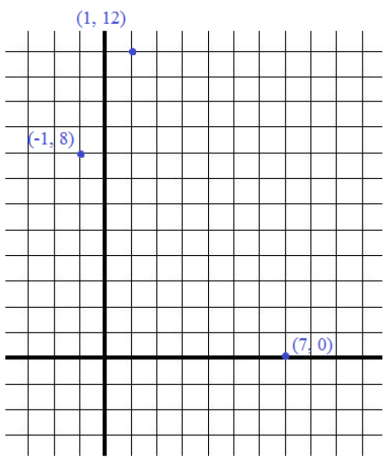
A. x-intercepts: (1, 0) (7, 0)
y-intercept: (0, 21)

B. Includes the following points:
(1, 0) (2, 11) (-4, 5)

C: Vertex: (1, -8)
through (-3, 0) and (9, 24)

Find and sketch the parabola through the points

D.



E. Use a system of 3 equations to find the parabola that goes through the following points:

(Calculator)

(1, 7)
(0, 10)
(-1/2, 29/2)

F. Use a system of 3 equations to find the parabola that goes through the following points:

(Use an Augmented Matrix)

(3, -54)
(7, -26)
(10, 16)

Finding Quadratics Equations Quiz

IV: Word Problems and Models

A) A cannon sits in a castle 50 feet above the ground.
After it is fired, the cannon ball reaches a maximum height of 80 feet when it is 40 feet from the castle.

Where does it hit its target on the ground? (How far from the castle?)

B) A series of photo images show a long jumper's position during a jump.
The following are the distances and height depicted in each image:

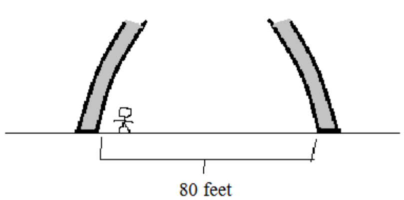
0 feet long, 0 feet high (his inital jumping point)
3' long, 1' 9" high
15' long, 3' 9" high
18' long, 3' high

How *far* did he jump?

How *high* did he peak during his jump?

C) A construction crew is building an arch with an 80 foot space between the bases.
If you stand 10 feet from one base, the arch extends 25 feet above the spot you're standing on.

How high will the arch be?



Brilliant mathematicians see things differently...

Test Answers-→

Finding Quadratic Equations Quiz

SOLUTIONS

$y = a(x-h)^2 + k$
where (h, k) is vertex

I. Vertex Form -- Express the following parabolas in *vertex form*

A. vertex: (2, 5)
through the point (5, 14)

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

$(14) = a((5) - 2)^2 + 5$

$14 = 9a + 5$

$a = 1$

$y = (x-2)^2 + 5$

B. vertex: (-2, -5)
through the point (1, 22)

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

$(22) = a((1) - -2)^2 + -5$

$22 = 9a - 5$

$a = 3$

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

Check:
test point (1, 22)

$22 = 3(1+2)^2 - 5$
$22 = 27 - 5$
$22 = 22$ ✓

C. vertex: (3, 3)
y-intercept: (0, -15)

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

$(-15) = a((0) - 3)^2 + 3$

$-15 = 9a + 3$

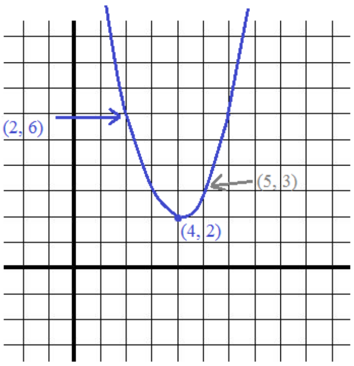
$a = -2$

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

Check:
test point (0, -15)

$-15 = -2(0-3)^2 + 3$
$-15 = -18 + 3$
$-15 = -15$ ✓

D.



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

Vertex: (4, 2)
through point (2, 6)

$(6) = a((2) - 4)^2 + 2$

$6 = 4a + 2$

$a = 1$

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

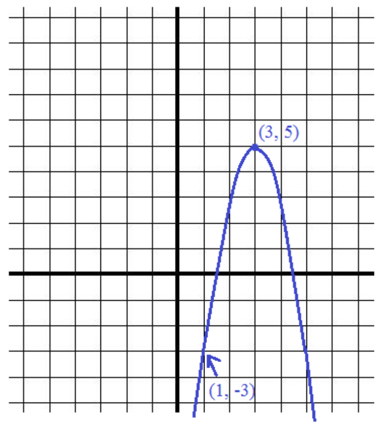
Check answer: (plug in 3 different points)

1) (2, 6): $6 = (2-4)^2 + 2$
$6 = 6$ ✓

2) (4, 2): $2 = (4-4)^2 + 2$
$2 = 2$ ✓

3) (5, 3): $3 = (5-4)^2 + 2$
$3 = 3$ ✓

E.



$y = a(x-h)^2 + k$ (Substitute vertex and point to find "a")

$-3 = a(1-3)^2 + 5$

$-3 = 4a + 5$
$a = -2$

(write general equation) $y = -2(x-3)^2 + 5$

II. Intercept Form -- Express the following quadratics in *intercept form*

A. x-intercepts: (1, 0) (5, 0)
vertex: (3, 8)

$y = a(x-p)(x-q)$
where p and q are x-intercepts ("zeros")

$y = -2(x-1)(x-5)$

$y = a(x-1)(x-5)$

$(8) = a((3) - 1)((3) - 5)$

$8 = -4a$

$a = -2$

B. x-intercepts: (-3, 0) (5, 0)
another point on the curve: (7, 4)

$y = a(x-p)(x-q)$ (substitute to find "a")

$(4) = a((7) - -3)((7) - 5)$
$4 = a(10)(2)$
$a = 1/5$

$y = \frac{1}{5}(x+3)(x-5)$

C. vertex: $\left(\frac{-3}{2}, \frac{-25}{2}\right)$

y-intercept: (0, -8)

(write in vertex form)

$(-8) = a\left((0) - \frac{-3}{2}\right)^2 + \frac{-25}{2}$

$-8 = \frac{9}{4}a - \frac{25}{2}$

$\frac{9}{2} = \frac{9}{4}a \quad a = 2$

$y = 2\left(x + \frac{3}{2}\right)^2 - \frac{25}{2}$

(expand)

$y = 2x^2 + 6x + \frac{9}{2} - \frac{25}{2}$

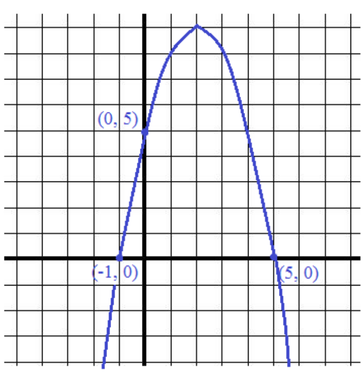
$y = 2x^2 + 6x - 8$

(factor)

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

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

D.



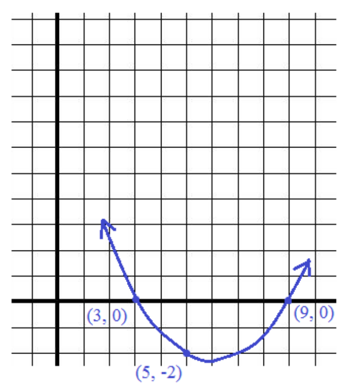
$y = a(x-p)(x-q)$

$p = -1$
$q = 5$
$x = 0 \quad y = 5$

$5 = a(0 - -1)(0 - 5)$
$5 = -5a$
$a = -1$

$y = -(x+1)(x-5)$

E.



$y = a(x-p)(x-q)$

$p = 3 \quad q = 9$
$x = 5 \quad y = -2$

$-2 = a(5-3)(5-9)$

$-2 = -8a$

$a = \frac{1}{4}$

$y = \frac{1}{4}(x-3)(x-9)$

Note: test all 3 points to check your answer...

Finding Quadratic Equations Quiz

SOLUTIONS

$y = ax^2 + bx + c$

III. Standard Form -- Express the following quadratics in *standard form*

A. x-intercepts: (1, 0) (7, 0)
y-intercept: (0, 21)

$ax^2 + bx + c = y$ (set up 3 equations, 3 unknowns)

$a(1)^2 + b(1) + c = 0$
$a(7)^2 + b(7) + c = 0$
$a(0)^2 + b(0) + c = 21$ (solve)

$a + b + c = 0$
$49a + 7b + c = 0$
$c = 21$

$y = 3x^2 - 24x + 21$

$a + b = -21$
$49a + 7b = -21$
$-7a - 7b = 147$
$42a = 126$

$a = 3$
$b = -24$

(note: to check, just try all 3 points in your equation)

B. Includes the following points:
(1, 0) (2, 11) (-4, 5)

$ax^2 + bx + c = y$

$a(1)^2 + b(1) + c = 0$
$a(2)^2 + b(2) + c = 11$
$a(-4)^2 + b(-4) + c = 5$ (set up 3 equations with 3 unknowns)

$$\left[\begin{array}{ccc|c} 1 & 1 & 1 & 0 \\ 4 & 2 & 1 & 11 \\ 16 & -4 & 1 & 5 \end{array}\right]$$ (use coefficients and solution in a matrix)

solution: $\begin{bmatrix} 2 \\ 5 \\ -7 \end{bmatrix} \begin{matrix} a \\ b \\ c \end{matrix}$ $2x^2 + 5x - 7 = y$

check: (1, 0) --- $2 + 5 - 7 = 0$ ✓
(2, 11) --- $8 + 10 - 7 = 11$ ✓
(-4, 5) --- $32 - 20 - 7 = 5$ ✓

C: Vertex: (1, -8)
through (-3, 0) and (9, 24)

(express in vertex form)

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

$0 = a(-3 - 1)^2 + -8$ (insert vertex and 1st point to find "a")
$0 = 16a - 8$
$a = 1/2$

$y = \frac{1}{2}(x - 1)^2 + (-8)$ (use algebra to change to standard form)

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

$y = \frac{1}{2}x^2 - x - \frac{15}{2}$

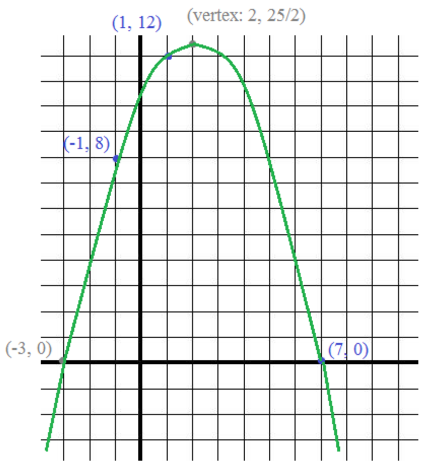
check 3 points:
(1, -8):
$-8 = \frac{1}{2} - 1 - \frac{15}{2}$
$-8 = -8$ ✓

(-3, 0):
$0 = 9/2 + 3 - 15/2$
$0 = 0$ ✓

(9, 24):
$24 = 81/2 - 9 - 15/2$
$33 = 66/2$ ✓

Find and sketch the parabola through the points

D.



$ax^2 + bx + c = y$

(1, 12): $a(1)^2 + b(1) + c = 12$
(-1, 8): $a(-1)^2 + b(-1) + c = 8$
(7, 0): $a(7)^2 + b(7) + c = 0$

$a + b + c = 12$
$a - b + c = 8$
$49a + 7b + c = 0$

(solve with matrix, substitution, or elimination; by hand or with calculator)

$a = -1/2$
$b = 2$
$c = 10\ 1/2$

$-\frac{1}{2}x^2 + 2x + \frac{21}{2}$

axis of symmetry: $x = -b/2a = 2$
vertex: (2, 25/2)

TEST 3 points to check!

(-1, 8): $-1/2 - 2 + 21/2 = 8$
(1, 12): $-1/2 + 2 + 21/2 = 12$
(7, 0) : $-49/2 + 14 + 21/2 = 0$
✓

E. Use a system of 3 equations to find the parabola that goes through the following points:
(1, 7)
(0, 10)
(-1/2, 29/2)

(Calculator)

$ax^2 + bx + c = y$ (set up 3 equations, 3 unknowns)

$a(1)^2 + b(1) + c = 7$
$a(0)^2 + b(0) + c = 10$
$a(-1/2)^2 + b(-1/2) + c = 29/2$

$4x^2 - 7x + 10$

$1a + 1b + 1c = 7$
$0a + 0b + 1c = 10$
$\frac{1}{4}a + \frac{-1}{2}b + 1c = \frac{29}{2}$

(Input the coefficients into the calculator to solve)

$a = 4$
$b = -7$
$c = 10$

F. Use a system of 3 equations to find the parabola that goes through the following points:
(3, -54)
(7, -26)
(10, 16)

(Use an Augmented Matrix)

$x^2 - 3x - 54$

$ax^2 + bx + c = y$

$a(3)^2 + b(3) + c = -54$
$a(7)^2 + b(7) + c = -26$
$a(10)^2 + b(10) + c = 16$

Place coefficients into the matrix:

$$\left[\begin{array}{ccc|c} 9 & 3 & 1 & -54 \\ 49 & 7 & 1 & -26 \\ 100 & 10 & 1 & 16 \end{array}\right]$$ $\frac{1}{9}$R1

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 1/9 & -6 \\ 49 & 7 & 1 & -26 \\ 100 & 10 & 1 & 16 \end{array}\right]$$ -49R1 + R2 (replace R2)
-100R1 + R3 (replace R3)

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 1/9 & -6 \\ 0 & -28/3 & -40/9 & 268 \\ 0 & -70/3 & -91/9 & 616 \end{array}\right]$$ (-3/28)R2
(-3/70)R3

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 1/9 & -6 \\ 0 & 1 & 10/21 & -201/7 \\ 0 & 1 & 91/210 & -132/5 \end{array}\right]$$ -1R2 + R3 (replace R3)

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 1/9 & -6 \\ 0 & 1 & 10/21 & -201/7 \\ 0 & 0 & -9/210 & 81/35 \end{array}\right]$$ (-210/9)R3

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 1/9 & -6 \\ 0 & 1 & 10/21 & -201/7 \\ 0 & 0 & 1 & -54 \end{array}\right]$$ (-10/21)R3 + R2 (replace R2)
(-1/9)R3 + R1 (replace R1)

$$\left[\begin{array}{ccc|c} 1 & 1/3 & 0 & 0 \\ 0 & 1 & 0 & -21/7 \\ 0 & 0 & 1 & -54 \end{array}\right]$$ (-1/3)R2 + R1 (replace R1)

$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & -3 \\ 0 & 0 & 1 & -54 \end{array}\right]$$

Finding Quadratics Equations Quiz

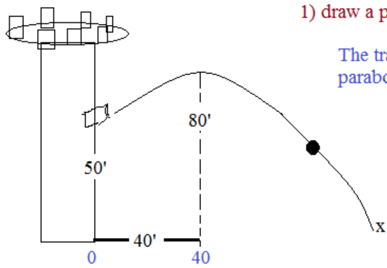
SOLUTIONS

IV: Word Problems and Models

A) A cannon sits in a castle 50 feet above the ground.
After it is fired, the cannon ball reaches a maximum height of 80 feet when it is 40 feet from the castle.

Where does it hit its target on the ground? (How far from the castle?)

1) draw a picture and label



The trajectory of the cannonball is a parabolic arc...

vertex: (40, 80)
point: (0, 50)

x = distance from castle
y = height above the ground

2) Identify the quadratic equation

vertex form: $y = a(x - h)^2 + k$
(substitute to find "a")

$50 = a(0 - 40)^2 + 80$

$50 = 1600a + 80$

$a = \frac{-3}{160}$

Equation of the cannon ball:

$y = \frac{-3}{160}(x - 40)^2 + 80$

3) Answer the question

The cannonball hits the ground when the height y = 0

$0 = \frac{-3}{160}(x - 40)^2 + 80$

$-80 = \frac{-3}{160}(x - 40)^2$

$4266.67 = (x - 40)^2$

$\pm 65.32 = x - 40$

x = -25.32 or 105.32

since -25.32 is behind the castle, we eliminate that possibility!

The cannonball lands approximately 105.32 feet from the castle.

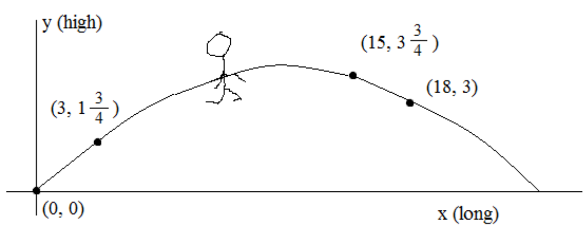
B) A series of photo images show a long jumper's position during a jump.
The following are the distances and height depicted in each image:

0 feet long, 0 feet high (his inital jumping point)
3' long, 1' 9" high
15' long, 3' 9" high
18' long, 3' high

How *far* did he jump?

How *high* did he peak during his jump?

1) Draw a picture and label (map the points)



2) Determine the quadratic equation

Choose 3 points: (0, 0) (3, 1.75) (18, 3)

$y = ax^2 + bx + c$

construct 3 equations/3 unknowns

$a(0)^2 + b(0) + c = 0$

$a(3)^2 + b(3) + c = 1.75$

$a(18)^2 + b(18) + c = 3$

solve: $\left[\begin{array}{ccc|c} 0 & 0 & 1 & 0 \\ 9 & 3 & 1 & 1.75 \\ 324 & 18 & 1 & 3 \end{array}\right]$ $\begin{bmatrix} -1/36 \\ 2/3 \\ 0 \end{bmatrix}$ $\begin{matrix} a \\ b \\ c \end{matrix}$

$y = -\frac{1}{36}x^2 + \frac{2}{3}x$

(note: you can test the points to check the equation)

3) Answer the questions

How far? Find where he lands: (x, 0)

$0 = -\frac{1}{36}x^2 + \frac{2}{3}x$ (mult. by -36)

$0 = x^2 - 24x$

x = 0 or 24

0 is the beginning of his jump;
24 feet is where he lands!

How high? Find the vertex!

axis of symmetry is x = 12

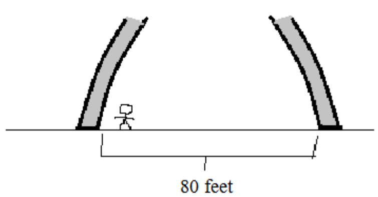
$y = -\frac{1}{36}(12)^2 + \frac{2}{3}(12) = 4$

so, vertex is (12, 4)

Therefore, he reaches 4 feet high!

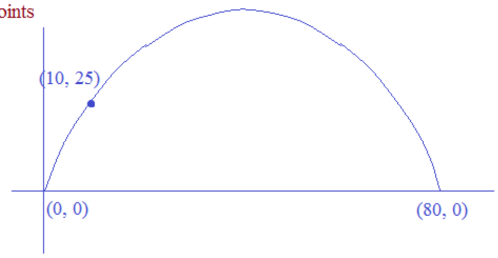
C) A construction crew is building an arch with an 80 foot space between the bases.
If you stand 10 feet from one base, the arch extends 25 feet above the spot you're standing on.

How high will the arch be?



The arch's height will be the vertex of the parabola...

1) Map the points



Given: 2-intercepts: (0, 0) (80, 0)
one point: (10, 25)

$y = a(x - p)(x - q)$
intercept form

2) find the quadratic equation

$25 = a(10 - 0)(10 - 80)$
substitute to find "a"

$25 = -700a$

$a = \frac{-1}{28}$

$y = \frac{-1}{28}(x - 0)(x - 80)$

3) answer the question

The height of the arch will be at the vertex (where x = 40)

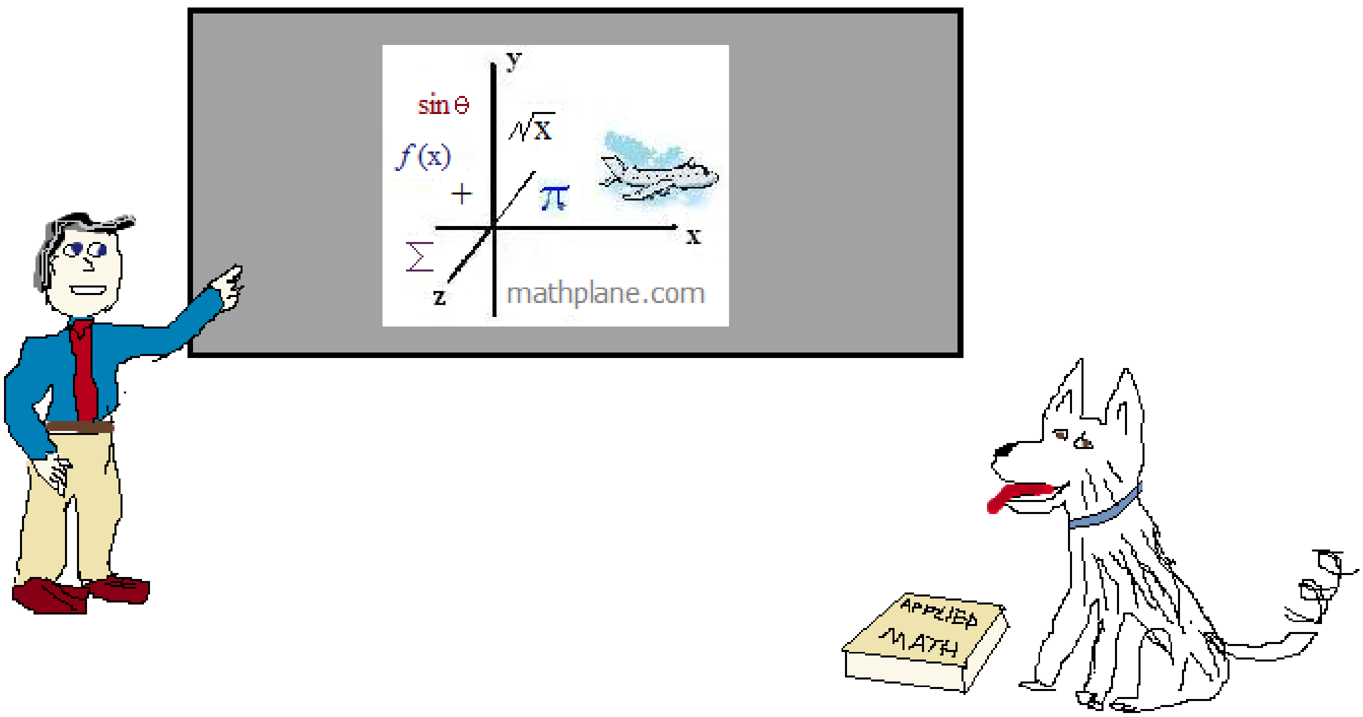
$y = \frac{-1}{28}(40 - 0)(40 - 80)$

y = 57.14 feet

Thanks for visiting. (Hope it helped!)

If you have questions, suggestions, or requests, let us know.

Enjoy



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