

Completing the Square

Review -- Identify the MIN/MAX of the following quadratic functions --

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

2. $y = -(x + 5)^2 - 11$

3. $y = \frac{3}{4}(x - 4)^2 + 2$

Min 3

MAX = -11

MIN = 2.

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Review the Process....

How do we change standard form to vertex form?

Factor
↓
Zeros
↓
Axis
↓
Vertex
↓
Vertex Form

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$y = x^2 + 4x + 4$ is a perfect square trinomial $\rightarrow y = x^2 + 4x + 4 = (x + 2)^2$

Trinomial, Binomial²

- What value for c makes $y = x^2 + 6x + c$ a perfect square trinomial?
- Name 2 other perfect square trinomials.

$$x^2 + 8x + \underline{16} = (x + 4)^2 \quad x^2 + 6x + 9 = (x + 3)^2$$

What is a **perfect square trinomial**?

A Trinomial that when factored is a binomial squared

$$x^2 + 9x + \sqrt{2025} = (x + 4.5)^2$$

$$x^2 + 20x + \sqrt{100} = (x + 10)^2$$

$$x^2 + 12x + \sqrt{36} = (x + 6)^2$$

$$x^2 - 14x + \sqrt{49} = (x - 7)^2$$

1/2 middle number squared = c

p.115 # 1

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Example 1: What is the minimum value of $y = x^2 + 4x + 4$?

- Need to put the equation in the form $y = a(x-p)^2 + q$, (p,q) gives the vertex of the quadratic equation

$y = x^2 + 4x + 4$ is a perfect square tri.

Factored: $y = (x + 2)^2$ to Vertex Form

Vertex: $(-2, 0)$

\therefore min value = 0

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Example 2: What is the minimum value of $y = x^2 + 12x - 7$?

- The function is not a perfect square.
- We need to use another method to put it in the form $y = a(x-h)^2 + k$
- **Completing the Square**

$$y = ax^2 + bx + c$$

Group x terms $y = (x^2 + 12x) - 7$

Find c to make a perfect square trinomial $= (x^2 + 12x + \underline{36} - 36) - 7$

Add and subtract c $= (x+6)^2 - 36 - 7$

Factor perfect square trinomial

Simplify $= (x+6)^2 - 43$ $V(-6, -43)$
 Min Value = -43

standard and vertex form have common a values

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$$y = -x^2 - 4x + 5$$

Factor -1

$$= -1(x^2 + 4x + 4 - 4) + 5 \quad c = 4$$

$$= -1((x+2)^2 - 4) + 5$$

get rid of outside bracket

$$= -(x+2)^2 + 4 + 5$$

$$= -(x+2)^2 + 9 \quad (-2, 9)$$

p.99#8 p.116#5

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Example 3: Find the maximum value of $y = -4x^2 + 4x - 9$?

- How do we know we're looking for a maximum value?

a is negative

- What is the "a" value of this parabola? (This value goes in front of the bracket....)

$$\begin{aligned}
 y &= (-4x^2 + 4x) - 9 \\
 &= -4(x^2 - x) - 9 && \text{Factor a value} \\
 &= -4(x^2 - x + 0.25 - 0.25) - 9 && \text{Find c +/-} \\
 &= -4((x - 0.5)^2 - 0.25) - 9 && \text{Factor Perfect Square Tri} \\
 &= -4(x - 0.5)^2 + 1 - 9 && \text{Multiply a value} \\
 &= -4(x - 0.5)^2 - 8 && \text{MAX} = -8
 \end{aligned}$$

p. 1

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p. 116 #5

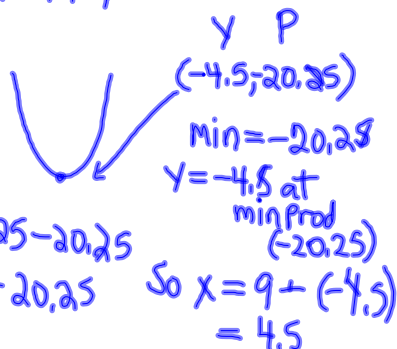
Find the minimum product of two numbers whose difference is 9

$$\begin{aligned}
 x - y &= 9 && \text{Solve for x} \\
 x &= 9 + y
 \end{aligned}$$

MIN $P = xy$

$$\begin{aligned}
 &= (9 + y)y \\
 &= (9y + y^2) \\
 &= y^2 + 9y + 20.25 - 20.25 \\
 &= (y + 4.5)^2 - 20.25
 \end{aligned}$$

So the values are 4.5 and -4.5



$$\begin{aligned}
 x + y &= 9 && P = x(9 - x) \\
 y &= 9 - x && = 9x - x^2 \\
 &&& = -x^2 + 9x
 \end{aligned}$$

- p. 99 # 9

- p. 116 # 6, 9, 11

Radicals Handout

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