Name: KEY Color: _____ Date: _____

NOTES: Section 3.3 – Complete the Square

Goals: #1 – I can solve quadratic equations using square roots.

#2 – I can solve quadratic equations by completing the square.

#3 – I can write quadratic functions in vertex form.

Homework: Section 3.3 Worksheet

EXPLORATION #1: Perfect Square Trinomials

Factor the following expressions:

1.) $x^2 - 6x + 9$

$(x-3)^2$

2.) $x^2 + 22x + 121$

$(x+11)^2$

What value of c would make the following a perfect square trinomial?

3.) $x^2 + 14x + c$

49

NOTES:

- Perfect Square Trinomials

$$a^2 + 2ab + b^2$$

Examples: $x^2 + 22x + 121 \rightarrow (x+11)^2$

$(x)^2 \quad 2(11)(x) \quad (11)^2$

$x^2 - 6x + 9 \rightarrow (x-3)^2$

$(x)^2 \quad 2(3)(x) \quad (3)^2$

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EXAMPLE #1: Solving a Quadratic Equation Using Square Roots

Solve each equation by using square roots.

1.) $x^2 - 16x + 64 = 100$

$(x-8)^2 = 100$

$\sqrt{(x-8)^2} = \pm\sqrt{100}$

$x - 8 = \pm 10$

$x = 8 \pm 10$

$\boxed{x = 18, -2}$

2.) $x^2 + 8x + 16 = 45$

$(x+4)^2 = 45$

$\sqrt{(x+4)^2} = \pm\sqrt{45}$

$\sqrt{9}\sqrt{5}$

$x + 4 = \pm 3\sqrt{5}$

$\boxed{x = -4 \pm 3\sqrt{5}}$

MONITORING PROGRESS: On Your Own

Solve each equation by using square roots.

1.) $x^2 + 18x + 81 = 5$

$(x+9)^2 = 5$

$\sqrt{(x+9)^2} = \pm\sqrt{5}$

$x + 9 = \pm\sqrt{5}$

$\boxed{x = -9 \pm \sqrt{5}}$

2.) $x^2 - 24x + 144 = -100$

$(x-12)^2 = -100$

$\sqrt{(x-12)^2} = \pm\sqrt{-100}$

$x - 12 = \pm 10i$

$\boxed{x = 12 \pm 10i}$

NOTES:

To complete the square, we adjust the left side of a quadratic equation so that it becomes a perfect square trinomial.

$1x^2 + bx + c \qquad c = \left(\frac{b}{2}\right)^2$

$\left(x + \frac{b}{2}\right)^2$

EXAMPLE #2: Making a Perfect Square Trinomial

Find the values of c that makes the expression a perfect square trinomial. Then write the expression as the square of a binomial.

1.) $x^2 + 14x + c$

$c = \left(\frac{14}{2}\right)^2 = (7)^2 = \boxed{49}$

$\boxed{(x+7)^2}$

2.) $x^2 - 2x + c$

$c = \left(\frac{-2}{2}\right)^2 = (-1)^2 = \boxed{1}$

$\boxed{(x-1)^2}$

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MONITORING PROGRESS: On Your Own

Find the values of c that makes the expression a perfect square trinomial. Then write the expression as the square of a binomial.

1.) $x^2 + 8x + c$

$c = \left(\frac{8}{2}\right)^2 = (4)^2 = \boxed{16}$

$\boxed{(x+4)^2}$

2.) $x^2 - 9x + c$

$c = \left(\frac{-9}{2}\right)^2 = \boxed{\frac{81}{4}}$

$\boxed{\left(x - \frac{9}{2}\right)^2}$

EXAMPLE #3: Solving by Completing the Square

Solve the equation by completing the square.

1.) $x^2 - 10x + 7 = 0$ $\left(\frac{-10}{2}\right)^2 = (-5)^2 = 25$

$x^2 - 10x + \boxed{25} = -7 + \boxed{25}$

$(x-5)^2 = 18$

$\sqrt{(x-5)^2} = \pm\sqrt{18}$

$\sqrt{9}\ \sqrt{2}$

$x - 5 = \pm 3\sqrt{2}$

$\boxed{x = 5 \pm 3\sqrt{2}}$

$\left(\frac{8}{2}\right)^2 = (4)^2 = 16$

2.) $x^2 + 8x = -20$

$x^2 + 8x + \boxed{16} = -20 + \boxed{16}$

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

$\sqrt{(x+4)^2} = \pm\sqrt{-4}$

$x + 4 = \pm 2i$

$\boxed{x = -4 \pm 2i}$

MONITORING PROGRESS: On Your Own

Solve the equation by completing the square.

1.) $x^2 - 18x + 5 = 0$ $\left(\frac{-18}{2}\right)^2 = (-9)^2 = 81$

$x^2 - 18x + \boxed{81} = -5 + \boxed{81}$

$(x-9)^2 = 76$

$\sqrt{(x-9)^2} = \pm\sqrt{76}$

$\sqrt{4}\ \sqrt{19}$

$x - 9 = \pm 2\sqrt{19}$

$\boxed{x = 9 \pm 2\sqrt{19}}$

$\left(\frac{14}{2}\right)^2 = (7)^2 = 49$

2.) $x^2 + 14x + 8 = 0$

$x^2 + 14x + \boxed{49} = -8 + \boxed{49}$

$(x+7)^2 = 41$

$\sqrt{(x+7)^2} = \pm\sqrt{41}$

$x + 7 = \pm\sqrt{41}$

$\boxed{x = -7 \pm \sqrt{41}}$

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EXAMPLE #4: Solving by Completing the Square

Solve the equation by completing the square.

1.) $\frac{3x^2+12x-18}{3}=\frac{0}{3}$ $(\frac{4}{2})^2=(2)^2=4$

$x^2+4x+\boxed{4}=6+\boxed{4}$

$(x+2)^2=10$

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

$x+2=\pm\sqrt{10}$

$\boxed{x=-2\pm\sqrt{10}}$

2.) $\frac{2x^2+8x+14}{2}=\frac{0}{2}$

$x^2+4x+\boxed{4}=-7+\boxed{4}$

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

$\sqrt{(x+2)^2}=\pm\sqrt{-3}$

$x+2=\pm i\sqrt{3}$

$\boxed{x=-2\pm i\sqrt{3}}$

EXAMPLE #5: Writing a Quadratic Function in Vertex Form

Write the quadratic function in vertex form. Then identify the vertex.

1.) $y=x^2-12x+18$ $(\frac{-12}{2})^2=(-6)^2=36$

$\boxed{36}+y=x^2-12x+\boxed{36}+18$

$36+y=(x-6)^2+18$

$-36 \qquad -36$

$\boxed{y=(x-6)^2-18}$

$\boxed{\text{Vertex: } (6,-18)}$

2.) $y=x^2+6x+4$ $(\frac{6}{2})^2=(3)^2=9$

$\boxed{9}+y=x^2+6x+\boxed{9}+4$

$9+y=(x+3)^2+4$

$-9 \qquad -9$

$\boxed{y=(x+3)^2-5}$

$\boxed{\text{Vertex: } (-3,-5)}$

MONITORING PROGRESS: On Your Own

Write the quadratic function in vertex form. Then identify the vertex.

1.) $y=x^2-8x+18$ $(\frac{-8}{2})^2=(-4)^2=16$

$\boxed{16}+y=x^2-8x+\boxed{16}+18$

$16+y=(x-4)^2+18$

$-16 \qquad -16$

$\boxed{y=(x-4)^2+2}$

$\boxed{\text{Vertex: } (4,2)}$

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