Solve for the zeros

1. $7x^2 - 32x - 60 = 0$

$(7x+10)(x-6)=0$

$x=-\frac{10}{7}$

$x=6$

2. $10n^2 - 35 = 65n$

$10n^2-65n-35=0$

$5(2n^2-13n-7)=0$

$5(2n+1)(n-7)=0$

-0.5

$2n+1$

$=0$

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Solving Quadratics with Perfect Square Trinomials

Completing the Square

Solve the equations below by factoring and using the square root property.

1. $x^2+14x+49=4$

$(x+7)(x+7)=4$

$\sqrt{(x+7)^2}=\sqrt{4}$

$x+7=\pm 2$

$x+7=2$ $\quad$ $x+7=-2$

$\boxed{x=-5}$ $\quad$ $\boxed{x=-9}$

2. $x^2-6x+9=20$

$\sqrt{20}$

$(x-3)^2=20$

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

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

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

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

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COMPLETING THE SQUARE

It is possible to take any quadratic equation, create a perfect square trinomial, and solve it in a similar way. This method is called **completing the square.**	
1	**REWRITE** as $ax^2+bx=c$
2	**DIVIDE** both sides by "a" so it becomes $x^2+bx=c$
3	**COMPLETE THE SQUARE** by taking half of b, square it, and **ADD IT TO BOTH SIDES** of the equation.
4	**FACTOR** the perfect square trinomial.
5	Take the **SQUARE ROOT** of both sides. This will create two cases because a square root has both a positive and negative value.
6	**SOLVE** both equations. **SIMPLIFY** all irrational and complex answers.

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Directions: Solve each quadratic equation below by completing the square. $ax^2+bx+c=0$

3. $x^2-18x+56=0$

4. $2x^2-16x=-30$

CTS

1 $\frac{2x^2}{2}-\frac{16x}{2}=\frac{-30}{2}$

2 $x^2-8x+16=-15+16$

3 $\frac{1}{2}(-4)^2$

$x^2-8x+16=1$

$(x-4)^2=1$

$\boxed{x=3}$ $\quad$ $\boxed{x=5}$

1 divide to make "a" term $=1$

2 move "c" to right side

3 take ½ of b, square it & add to both sides

4 Factor → $(x+\frac{b}{2})^2$

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5. $4x^2 - 8x = -3$

$\frac{4x^2}{4} - \frac{8x}{4} = \frac{-3}{4}$

$x^2 - 2x = -\frac{3}{4}$

$\frac{-2}{2}(-1)^2$

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

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

$x - 1 = \pm\frac{1}{2}$

$\boxed{x = \frac{3}{2}}$ $\boxed{x = \frac{1}{2}}$

6. $3x^2 + 10x + 8 = 0$

$\frac{3x^2}{3} + \frac{10x}{3} + \frac{8}{3} = 0$

$-\frac{b}{2a}$

$x^2 + \frac{10}{3}x + \frac{8}{3} = 0$

$x^2 + \frac{10}{3}x = -\frac{8}{3}$

$\frac{10}{3} \div 2$

$\frac{10}{3} \times \frac{1}{2} = \frac{10}{6}$

$(5/3)^2$

$x^2 + \frac{10}{3}x + \frac{25}{9} = -\frac{8 \cdot 3}{3 \cdot 3} + \frac{25}{9}$

$(x + \frac{5}{3})^2 = -\frac{24}{9} + \frac{25}{9}$

$\sqrt{(x+\frac{5}{3})^2} = \sqrt{\frac{1}{9}}$

$x + \frac{5}{3} = \pm\frac{1}{3}$

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

$\boxed{x = -\frac{4}{3}}$ $x = -\frac{6}{3} = \boxed{-2}$

7. $x^2 + 16x - 21 = -5$

$+21 \quad +21$

$x^2 + 16x = 16$

$(8)^2 = 64 \quad +64$

$x^2 + 16x + 64 = 80$

$(x + 8)^2 = 80$

$x + 8 = \pm 4\sqrt{5}$

$x = -8 + 4\sqrt{5}$

$x = -8 - 4\sqrt{5}$

$-\frac{b}{2a}$

$(x + 8)^2 - 80$

vertex form

8. $3x^2 - 30x = 69$

Warm-Up

9. $x^2 + 12x + 43 = 0$

10. $4x^2 + 76 = 16x$

Graph. What do you notice about the x-intercepts, zeroes, or roots?

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

2 roots

1 root

$(x-1)(x-1)$

$x=1$

no real roots

The Imaginary Numbers

- Equations such as $x^2 + 1 = 0$ have no real solution, so mathematicians defined the **imaginary numbers** to represent their solutions.
- The **imaginary unit**, i, is defined as $\sqrt{-1}$. This is useful when working with square roots of negative numbers.
- A **pure imaginary number** is written in the form $a+bi$ where a is the real number and bi is the imaginary part.

complex #

Simplifying Negative Square Roots

Step 1: Rewrite $\sqrt{-a}$ as $\sqrt{-1 \cdot a}$

Step 2: Break a down if it is not a perfect square.

Step 3: Simplify the radical, recalling that $\sqrt{-1} = i$.

1. $\sqrt{-9}$ $\boxed{\pm 3i}$ $\sqrt{9 \cdot -1}$ $3\sqrt{-1} = \pm 3i$	**2.** $\sqrt{-196}$ $\sqrt{196 \cdot -1}$ $\sqrt{196}\ \sqrt{-1}$ $\pm 14i$	**3.** $\sqrt{-5}$ $\sqrt{5 \cdot -1}$ $\sqrt{5} \cdot \sqrt{-1}$ $\pm i\sqrt{5}$
4. $\sqrt{-80}$ $\sqrt{-1 \cdot 80}$ $i\ \sqrt{16}\ \sqrt{5}$ $\boxed{4i\sqrt{5}}$	**5.** $\sqrt{-32}$ $\sqrt{-1 \cdot 32}$ $i\ \sqrt{16}\ \sqrt{2}$ $\boxed{4i\sqrt{2}}$	**6.** $\sqrt{-192}$ $\sqrt{-1 \cdot 192}$ $i\ \sqrt{64}\ \sqrt{3}$ $\boxed{8i\sqrt{3}}$

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Solving Equations

7. $x^2 + 81 = 0$

$-81\ \ -81$

$\sqrt{x^2} = \sqrt{-81}$

$x = \pm 9i$

8. $2x^2 + 9 = 1$

$2x^2 = -8$

$\sqrt{x^2} = \sqrt{-4}$

$\pm 2i$

9. $4x^2 + 15 = -9$

$-15\ \ -15$

$4x^2 = -24$

$\sqrt{x^2} = \sqrt{-6}$

$\sqrt{-1}\sqrt{6}$

$\sqrt{-1}$

$x = \pm i\sqrt{6}$

10. $x^2 + 13 = 1$

11. $3x^2 - 5 = -446$

12. $-\frac{2}{3}x^2 - 1 = 17$

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$i^{-1} = -i$

$i^0 = 1$

i^{29}

$i^1 = \sqrt{-1} = i$

$i^2 = (\sqrt{-1})(\sqrt{-1}) = (\sqrt{-1})^2 = -1$

$i^3 = (\sqrt{-1})(\sqrt{-1})(\sqrt{-1}) = (-1)(\sqrt{-1}) = -i$

$i^4 = (\sqrt{-1})(\sqrt{-1})(\sqrt{-1})(\sqrt{-1}) = 1$

$i^5 = i \quad -1$

$i^6 = -1$

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$$\frac{5}{(5-i)} \cdot \frac{(5+i)}{(5+i)} = \frac{25+5i}{25+\cancel{5i}-\cancel{5i}-i^2}$$

Conjugate

$$\frac{25+5i}{25-(-1)}$$

$$\frac{25+5i}{26}$$

$$\frac{5}{3+\sqrt{2}}\ (3-\sqrt{2})$$

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8. $2x^2+9=1$

$2x^2=-8$

$x^2=-4$

$\sqrt{x^2}=\sqrt{-4}$

$x=\sqrt{-1\cdot 4}$

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

10. $x^2+13=1$

$x^2=-12$

$\sqrt{x^2}=\sqrt{-12}$

$x=\sqrt{-1\cdot 12}$

$x=i\sqrt{4}\sqrt{3}$

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

12. $-\frac{2}{3}x^2-1=17$

$-\frac{2}{3}x^2=18$

$\sqrt{x^2}=\sqrt{-27}$

$x=\sqrt{-1\cdot 9\cdot 3}$

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

9. $4x^2+15=-9$

$4x^2=-24$

$x^2=-6$

$\sqrt{x^2}=\sqrt{-6}$

$x=\sqrt{-1\cdot 6}$

$\boxed{x=\pm i\sqrt{6}}$

11. $3x^2-5=-446$

$\frac{3x^2}{3}=\frac{-441}{3}$

$\sqrt{x^2}=\sqrt{-147}$

$x=\sqrt{-1\cdot 49\cdot 3}$

$\boxed{x=\pm 7i\sqrt{3}}$

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Complex number scavenger for 20 minutes

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