LESSON MAKER PRO

Beyond Real Roots

Use i to solve quadratics with negative discriminants.

HIGH SCHOOL · HSN-CN.C.7

CCSS.Math.Content.HSN-CN.C.7 "Solve quadratic equations with real coefficients that have complex solutions."

NAME ______________________ DATE ____________

WHEN ROOTS TURN COMPLEX

For $ax^2 + bx + c = 0$, calculate the discriminant, $b^2 - 4ac$. If it is negative, use $\sqrt{-n} = i\sqrt{n}$ in the quadratic formula, and write the two conjugate complex solutions.

WORKED EXAMPLE

Solve $x^2 - 10x + 29 = 0$.

1. $a = 1$, $b = -10$, and $c = 29$, so $b^2 - 4ac = 100 - 116 = -16$.
2. $x = (10 \pm \sqrt{-16})/2$.
3. $x = (10 \pm 4i)/2 = 5 \pm 2i$.

Answer: $x = 5 + 2i$ or $x = 5 - 2i$

PRACTICE

6 problems

1. Solve $x^2 + 9 = 0$.

   ANSWER ______________________

2. Solve $x^2 - 6x + 18 = 0$.

   ANSWER ______________________

3. Solve $2x^2 + 4x + 10 = 0$.

   ANSWER ______________________

4. Solve $(x - 5)^2 + 7 = 0$.

   ANSWER ______________________

5. Solve $3x^2 - 6x + 11 = 0$.

   ANSWER ______________________

6. Solve $4x^2 + 4x + 9 = 0$.

   ANSWER ______________________

APPLY IT
Show your work

1 A student council models the profit from a concert fundraiser by $P(x) = x^2 - 12x + 40$, where x is a real change in ticket price, in dollars. Find the values of x that make $P(x) = 0$. What does your result mean for real ticket prices?

WORK SPACE

ANSWER ____________________

2 A student is tuning a game controller. Its error score is modeled by $E(x) = 2x^2 + 8x + 17$, where x is a real sensitivity adjustment. Find the adjustments that would make $E(x) = 0$. What does your result mean?

WORK SPACE

ANSWER ____________________

CHALLENGE
One step up

CHALLENGE

Solve $12x^2 + 12x + 7 = 0$. Then, in one sentence, explain why neither solution is real.

____

____

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve x^2 + 9 = 0.	**x = 3i or x = -3i**
2	Solve x^2 - 6x + 18 = 0.	**x = 3 + 3i or x = 3 - 3i**
3	Solve 2x^2 + 4x + 10 = 0.	**x = -1 + 2i or x = -1 - 2i**
4	Solve (x - 5)^2 + 7 = 0.	**x = 5 + sqrt(7)i or x = 5 - sqrt(7)i**
5	Solve 3x^2 - 6x + 11 = 0.	**x = 1 + (2sqrt(6)/3)i or x = 1 - (2sqrt(6)/3)i**
6	Solve 4x^2 + 4x + 9 = 0.	**x = -1/2 + sqrt(2)i or x = -1/2 - sqrt(2)i**

PART 2 · APPLY IT

1. **x = 6 + 2i or x = 6 - 2i. There is no real ticket-price change that makes the profit equal to 0.** Set x^2 - 12x + 40 equal to 0. The discriminant is -16, so the roots are 6 ± 2i and there are no real break-even ticket prices.
2. **x = -2 + (3sqrt(2)/2)i or x = -2 - (3sqrt(2)/2)i. No real sensitivity adjustment makes the error score equal to 0.** Set 2x^2 + 8x + 17 equal to 0. The discriminant is -72, giving roots -2 ± (3sqrt(2)/2)i, so zero error is not reached for a real adjustment.

CHALLENGE

x = -1/2 + (sqrt(3)/3)i or x = -1/2 - (sqrt(3)/3)i. Neither solution is real because the discriminant is -192, which is negative.

Accept either order for each pair of conjugate solutions and algebraically equivalent simplified forms. For the context problems, accept a clear statement that no real input makes the modeled quantity equal to zero.