LESSON MAKER PRO

Factor to Solve

Solve polynomial equations over the real and complex numbers.

HIGH SCHOOL · MA.912.AR.6.1

MA.912.AR.6.1 "Given a mathematical or real-world context, when suitable factorization is possible, solve one-variable polynomial equations of degree 3 or higher over the real and complex number systems."

NAME _____ DATE _____

FACTOR FIRST

Factor the polynomial completely, then set each factor equal to 0. Linear factors give real solutions. For quadratic factors with no real zeros, use the quadratic formula or recognize complex roots.

WORKED EXAMPLE

The number line shows possible zero locations for $f(x) = x^3 - 9x$. Factor and solve $f(x) = 0$.



1. $x^3 - 9x = x(x^2 - 9)$
2. $x(x^2 - 9) = x(x - 3)(x + 3)$
3. Set each factor equal to 0.

Answer: x = -3, 0, 3

PRACTICE 4 problems

1 Solve: $x^3 - x^2 - 6x = 0$

ANSWER _____

2 Solve: $x^4 - 5x^2 + 4 = 0$

ANSWER _____

3 Solve over the complex numbers: $x^3 + 8 = 0$

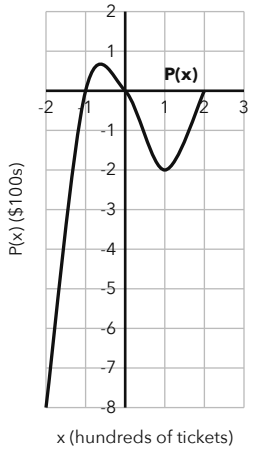
ANSWER _____

4 Solve over the complex numbers: $x^4 + 13x^2 + 36 = 0$

ANSWER _____

APPLY IT Show your work

1 A ticket club models profit by $P(x) = x^3 - x^2 - 2x$, where x is hundreds of tickets. The graph shows P. At what nonnegative ticket amounts does the club break even?



ANSWER _____

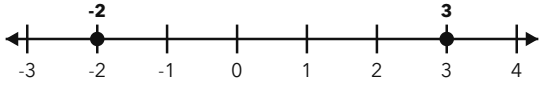
2 A music app tests a filter setting x with stability equation $x^4 + 5x^2 + 4 = 0$. Solve for all complex settings x.

WORK SPACE

ANSWER _____

CHALLENGE One step up

The number line shows the real zeros of $f(x) = x^4 - x^3 - 5x^2 - x - 6$. Find all four zeros. Explain why two zeros do not appear on the number line.



WORK SPACE AND ANSWER

ANSWER KEY

Factor to Solve

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve: $x^3 - x^2 - 6x = 0$	**x = -2, 0, 3**
2	Solve: $x^4 - 5x^2 + 4 = 0$	**x = -2, -1, 1, 2**
3	Solve over the complex numbers: $x^3 + 8 = 0$	**x = -2, 1 + i√3, 1 - i√3**
4	Solve over the complex numbers: $x^4 + 13x^2 + 36 = 0$	**x = 2i, -2i, 3i, -3i**

PART 2 · APPLY IT

1. **0 tickets or 200 tickets** Factor P(x) as x(x - 2)(x + 1). Its zeros are -1, 0, and 2, but only 0 and 2 are nonnegative ticket amounts.
2. **x = i, -i, 2i, -2i** Factor as $(x^2 + 1)(x^2 + 4) = 0$. Solve $x^2 = -1$ and $x^2 = -4$.

CHALLENGE

x = -2, 3, i, -i. Factoring gives $(x + 2)(x - 3)(x^2 + 1) = 0$. The number line shows only real numbers, so i and -i do not appear.

Accept solutions in any order. Accept i√3 and √3i as equivalent forms.