LESSON MAKER PRO

Find Every Root

Use graphs, factoring, and division to solve polynomial equations.

HIGH SCHOOL · A2.A.1.4

A2.A.1.4 "Solve polynomial equations with real roots using various methods (e.g., polynomial division, synthetic division, using graphing calculators or other appropriate technology)."

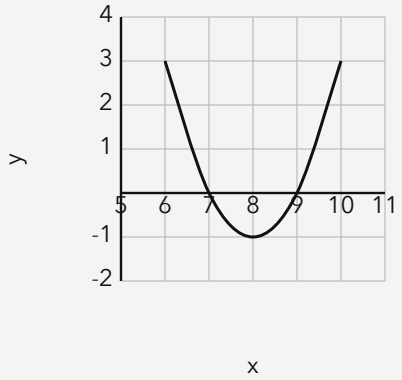
NAME _____ DATE _____

FROM GRAPH TO FACTORS

An x-intercept is a real root because the polynomial equals zero there. Divide by x minus a known root, then factor the quotient to find any other roots.

WORKED EXAMPLE

The graph shows $y = x^2 - 16x + 63$. Use an x-intercept and division to solve $x^2 - 16x + 63 = 0$.



1. The graph shows a root at $x = 7$.
2. Divide $x^2 - 16x + 63$ by $x - 7$ to get $x - 9$.
3. Set each factor in $(x - 7)(x - 9)$ equal to zero.

Answer: x = 7 or x = 9

PRACTICE 4 problems

1 Solve $x^2 + 2x - 8 = 0$.

ANSWER _____

2 Factor out x, then solve $x^3 - 2x^2 - 8x = 0$.

ANSWER _____

3 Use the known root $x = -2$ to divide and solve $x^3 + 2x^2 - 16x - 32 = 0$.

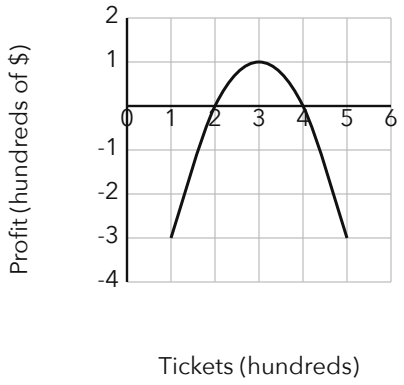
ANSWER _____

4 Use the known root $x = 1$ to divide and solve $x^3 + 6x^2 + 3x - 10 = 0$.

ANSWER _____

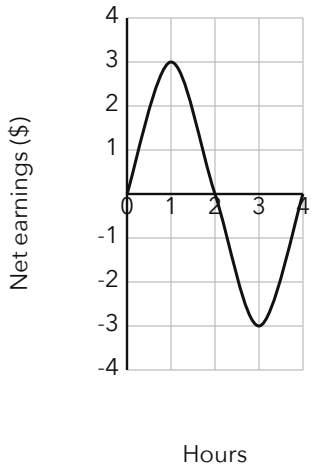
APPLY IT Show your work

1 A concert's profit P, in hundreds of dollars, depends on tickets sold x, in hundreds. The graph shows $P = -x^2 + 6x - 8$. At what ticket counts does the concert break even?



ANSWER _____

2 During a four-hour livestream, a creator's net earnings E, in dollars, follow $E = x(x - 2)(x - 4)$, where x is hours since the start. Use the graph to find one break-even time, then use the equation to find them all.



ANSWER _____

CHALLENGE One step up

A student divides $x^3 - 3x - 2$ by $x - 2$ and gets $x^2 + 2x + 1$. The student says $x = 2$ is the only real root. Explain the error and give every real root.

WORK SPACE AND ANSWER

ANSWER KEY

Find Every Root

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Solve $x^2 + 2x - 8 = 0$.	**x = -4 or x = 2**
2	Factor out x, then solve $x^3 - 2x^2 - 8x = 0$.	**x = -2, 0, or 4**
3	Use the known root x = -2 to divide and solve $x^3 + 2x^2 - 16x - 32 = 0$.	**x = -4, -2, or 4**
4	Use the known root x = 1 to divide and solve $x^3 + 6x^2 + 3x - 10 = 0$.	**x = -5, -2, or 1**

PART 2 · APPLY IT

1. **200 or 400 tickets** The graph crosses the x-axis at x = 2 and x = 4. Each x-unit represents 100 tickets.
2. **At 0, 2, and 4 hours** Any one of the three x-intercepts supplies a starting root. The factors show that earnings equal zero at x = 0, 2, and 4.

CHALLENGE

The quotient is $(x + 1)^2$, which is also zero when x = -1. The real roots are x = -1 and x = 2.

Accept roots in any order. In the challenge, students may note that -1 is a repeated root.