

## Precalculus

**Use polynomial division with remainder 0 to  
factor a polynomial**

Todor Milev

2019

## Example

Demonstrate that  $6x^3 - 19x^2 + 17x - 3$  is divisible by  $2x - 3$  using polynomial long division. Use your work to factor the cubic. Solve the equation  $6x^3 - 19x^2 + 17x - 3 = 0$ .

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$$(\text{Dividend}) = (\text{Quotient}) \cdot (\text{Divisor}) + (\text{Remainder})$$

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No easy factorization of quadratic, so use formula:

$$x_1, x_2 = ?$$

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$$\begin{aligned}(6x^3 - 19x^2 + 17x - 3) &= (3x^2 - 5x + 1) \cdot (2x - 3) \\ &= 3 \left( x - \left( \frac{5+\sqrt{13}}{6} \right) \right) \left( x - \left( \frac{5-\sqrt{13}}{6} \right) \right) (2x - 3)\end{aligned}$$

No easy factorization of quadratic, so use formula:

$$x_1, x_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-(-5) \pm \sqrt{(-5)^2 - 4 \cdot 3 \cdot 1}}{2 \cdot 3} = \frac{5 \pm \sqrt{13}}{6}$$

We are ready to solve the equation.

$$\begin{aligned}6x^3 - 19x^2 + 17x - 3 &= 0 \\ 3 \left( x - \left( \frac{5+\sqrt{13}}{6} \right) \right) \left( x - \left( \frac{5-\sqrt{13}}{6} \right) \right) (2x - 3) &= 0 \\ 2x - 3 = 0 \quad \text{or} \quad x = \left( \frac{5+\sqrt{13}}{6} \right) \quad \text{or} \quad x = \left( \frac{5-\sqrt{13}}{6} \right)\end{aligned}$$

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