

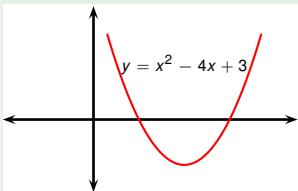
Precalculus

Solve a quadratic equation

Todor Milev

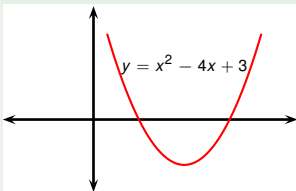
2019

Example



Find the x -intercepts of $x^2 - 4x + 3$.

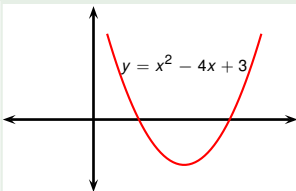
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$x_1, x_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

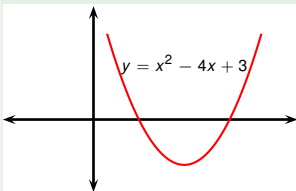
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1}
 \end{aligned}$$

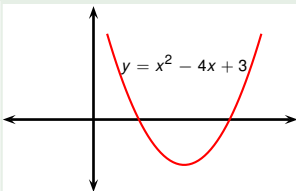
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1}
 \end{aligned}$$

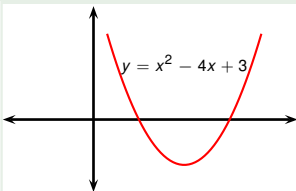
Example



Find the x -intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1}
 \end{aligned}$$

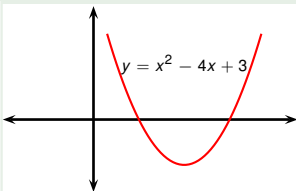
Example



Find the x -intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2}
 \end{aligned}$$

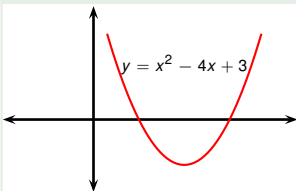
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2}
 \end{aligned}$$

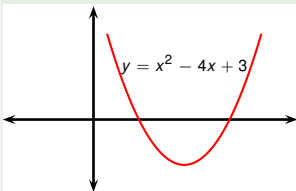
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2}
 \end{aligned}$$

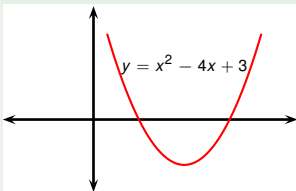
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \left\{ \begin{array}{l} \frac{4 + 2}{2} \\ \frac{4 - 2}{2} \end{array} \right.
 \end{aligned}$$

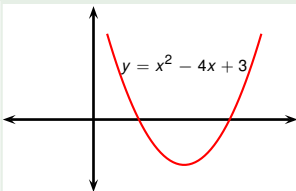
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \begin{cases} \frac{4+2}{2} = \frac{6}{2} \\ \frac{4-2}{2} \end{cases}
 \end{aligned}$$

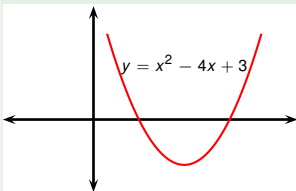
Example



Find the x -intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \begin{cases} \frac{4+2}{2} = \frac{6}{2} = 3 \\ \frac{4-2}{2} \end{cases}
 \end{aligned}$$

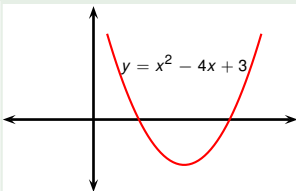
Example



Find the x -intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \begin{cases} \frac{4+2}{2} = \frac{6}{2} = 3 \\ \frac{4-2}{2} = \frac{2}{2} = 1 \end{cases}
 \end{aligned}$$

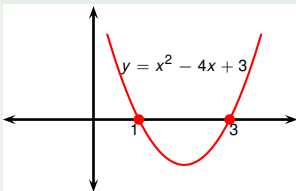
Example



Find the x-intercepts of $x^2 - 4x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \begin{cases} \frac{4+2}{2} = \frac{6}{2} = 3 \\ \frac{4-2}{2} = \frac{2}{2} = 1 \end{cases}
 \end{aligned}$$

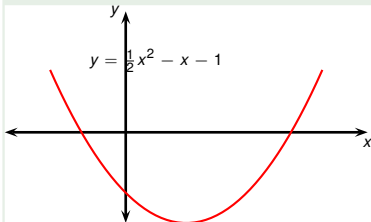
Example



Find the x -intercepts of $x^2 - 4x + 3$.

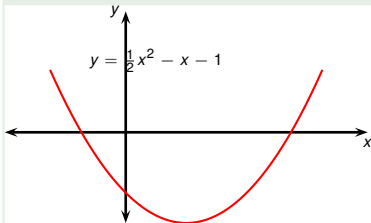
$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-4) \pm \sqrt{(-4)^2 - 4 \cdot 1 \cdot 3}}{2 \cdot 1} \\
 &= \frac{4 \pm \sqrt{4}}{2} \\
 &= \frac{4 \pm 2}{2} \\
 &= \begin{cases} \frac{4+2}{2} = \frac{6}{2} = 3 \\ \frac{4-2}{2} = \frac{2}{2} = 1 \end{cases}
 \end{aligned}$$

Example



Find the x -intercepts of $\frac{x^2}{2} - x - 1$.

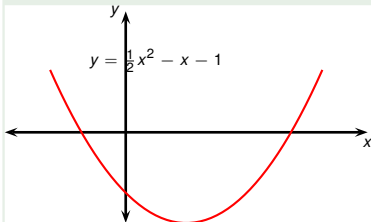
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$x_1, x_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

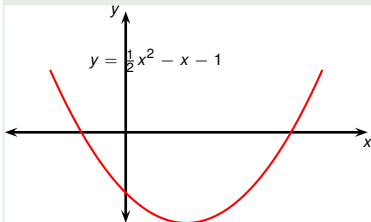
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}}
 \end{aligned}$$

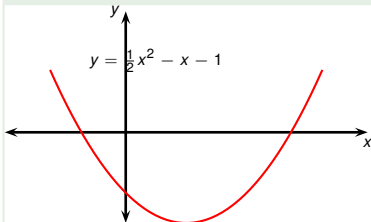
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}}
 \end{aligned}$$

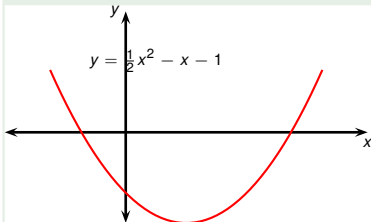
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}}
 \end{aligned}$$

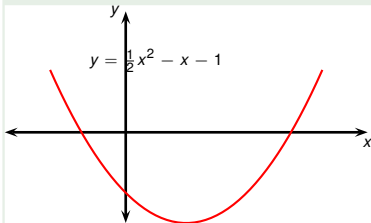
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}}
 \end{aligned}$$

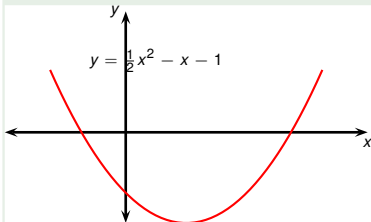
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}} \\
 &= 1 \pm \sqrt{3}
 \end{aligned}$$

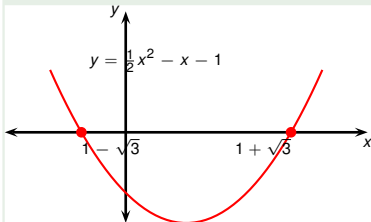
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}} \\
 &= 1 \pm \sqrt{3}
 \end{aligned}$$

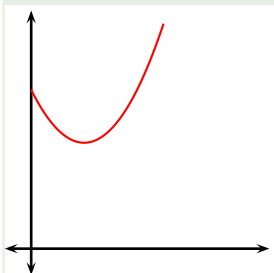
Example



Find the x-intercepts of $\frac{x^2}{2} - x - 1$.

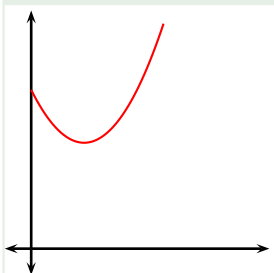
$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \cdot \frac{1}{2} \cdot (-1)}}{2 \cdot \frac{1}{2}} \\
 &= 1 \pm \sqrt{3}
 \end{aligned}$$

Example



Find the x -intercepts of $x^2 - 2x + 3$.

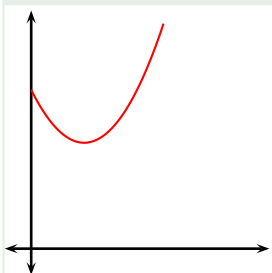
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$x_1, x_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

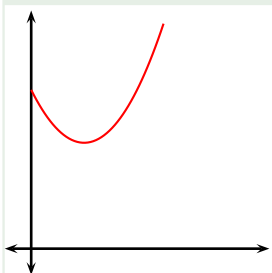
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1}
 \end{aligned}$$

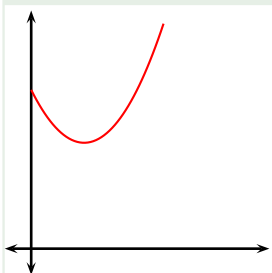
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1}
 \end{aligned}$$

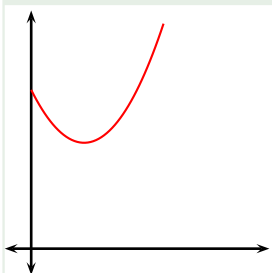
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\&= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1}\end{aligned}$$

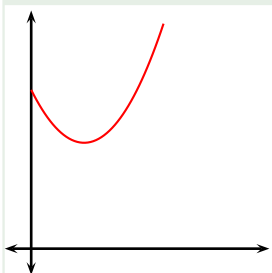
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1} \\
 &= \frac{2 \pm \sqrt{-8}}{2}
 \end{aligned}$$

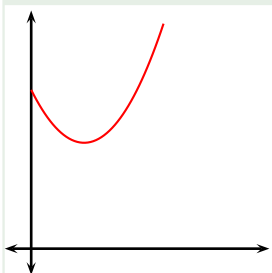
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\&= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1} \\&= \frac{2 \pm \sqrt{-8}}{2}\end{aligned}$$

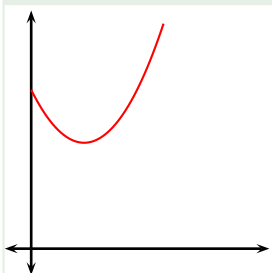
Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1} \\
 &= \frac{2 \pm \sqrt{-8}}{2} \\
 &\text{no real solutions}
 \end{aligned}$$

Example



Find the x-intercepts of $x^2 - 2x + 3$.

$$\begin{aligned}
 x_1, x_2 &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
 &= \frac{-(-2) \pm \sqrt{(-2)^2 - 4 \cdot 1 \cdot (3)}}{2 \cdot 1} \\
 &= \frac{2 \pm \sqrt{-8}}{2}
 \end{aligned}$$

no real solutions

no x - intercepts