

# Finding Polynomial Roots w/1

$$\begin{array}{r|rrrrr} \textcircled{1} & 2 & 1 & -5 & 7 & -5 & 6 \\ & & 2 & -6 & 2 & -6 & \\ \hline & 3 & 1 & -3 & 1 & -3 & 0 \\ & & 3 & 0 & 3 & & \\ \hline & & 1 & 0 & 1 & & 0 \end{array}$$

$$x^2 + 1 = 0$$

$$x = \pm i$$

$$x = 2, 3, \pm i$$

$$\begin{array}{r|rrrr} \textcircled{2} & 4 & 1 & -4 & 1 & -4 \\ & & 4 & 0 & 4 & \\ \hline & & 1 & 0 & 1 & 0 \end{array}$$

$$x^2 + 1 = 0$$

$$x = 4, \pm i$$

$$\begin{array}{r|rrrrrr} \textcircled{3} & 2 & 1 & 0 & 0 & 0 & -16 \\ & & 2 & 4 & 8 & 16 & \\ \hline & -2 & 1 & 2 & 4 & 8 & 0 \\ & & -2 & 0 & -8 & & \\ \hline & & 1 & 0 & 4 & & 0 \end{array}$$

$$x^2 + 4 = 0$$

$$x^2 = -4$$

$$x = \pm 2i$$

$$x = \pm 2, \pm 2i$$

$$\begin{array}{r|rrrrr} \textcircled{4} & 1 & 1 & 0 & 0 & 0 & -1 \\ & & 1 & 1 & 1 & 1 & \\ \hline & -1 & 1 & 1 & 1 & 1 & 0 \\ & & -1 & 0 & -1 & & \\ \hline & & 1 & 0 & 1 & & 0 \end{array}$$

$$x^2 + 1 = 0$$

$$x^2 = -1$$

$$x = \pm i$$

$$x = \pm 1, \pm i$$

$$\begin{array}{r|rrrr} \textcircled{5} & -3 & 1 & -1 & -7 & 15 \\ & & -3 & 12 & -15 & \\ \hline & & 1 & -4 & 5 & 0 \end{array}$$

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

$$x = \frac{4 \pm \sqrt{-4}}{2} = \frac{4 \pm 2i}{2}$$

$$x = -3, 2 \pm i$$

$$\textcircled{6} \quad \underline{4} \mid 1 \quad -6 \quad 13 \quad -20$$

$$\quad \quad \quad 4 \quad -8 \quad 20$$

$$\hline 1 \quad -2 \quad 5 \mid 0$$

$$x^2 - 2x + 5 = 0$$

$$x = \frac{2 \pm \sqrt{-16}}{2} = \frac{2 \pm 4i}{2}$$

$$x = 1 \pm 2i$$

$$\textcircled{7} \quad \underline{2} \mid 1 \quad 0 \quad 0 \quad -8$$

$$\quad \quad \quad 2 \quad 4 \quad 8$$

$$\hline 1 \quad 2 \quad 4 \mid 0$$

$$x^2 + 2x + 4 = 0$$

$$x = \frac{-2 \pm \sqrt{-12}}{2} = \frac{-2 \pm 2i\sqrt{3}}{2}$$

$$x = -1 \pm i\sqrt{3}$$

$$\textcircled{8} \quad \underline{-2} \mid 1 \quad 0 \quad 0 \quad 8$$

$$\quad \quad \quad -2 \quad 4 \quad -8$$

$$\hline 1 \quad -2 \quad 4 \mid 0$$

$$x^2 - 2x + 4 = 0$$

$$x = \frac{2 \pm \sqrt{-12}}{2} = \frac{2 \pm 2i\sqrt{3}}{2}$$

$$x = 1 \pm i\sqrt{3}$$

$$\textcircled{9} \quad \underline{-3} \mid 1 \quad 3 \quad -2 \quad -6$$

$$\quad \quad \quad -3 \quad 0 \quad 6$$

$$\hline 1 \quad 0 \quad -2 \mid 0$$

$$x^2 - 2 = 0$$

$$x^2 = 2$$

$$x = \pm \sqrt{2}$$

$$\textcircled{10} \quad \underline{1} \mid 1 \quad -1 \quad -3 \quad 3$$

$$\quad \quad \quad 1 \quad 0 \quad -3$$

$$\hline 1 \quad 0 \quad -3 \mid 0$$

$$x^2 - 3 = 0$$

$$x^2 = 3$$

$$x = \pm \sqrt{3}$$

$$\begin{array}{r}
 \textcircled{11} \quad \underline{11} \quad 5 \quad -4 \quad 19 \quad -16 \quad -4 \\
 \quad \quad \quad 5 \quad 1 \quad 20 \quad 4 \\
 \hline
 -\frac{1}{5} \mid 5 \quad 1 \quad 20 \quad 4 \mid 0 \\
 \quad \quad \quad -1 \quad 0 \quad -4 \\
 \hline
 \quad \quad \quad 5 \quad 0 \quad 20 \mid 0
 \end{array}$$

$$\begin{aligned}
 &\rightarrow x^2 + 4 = 0 \\
 &\quad x^2 = -4
 \end{aligned}$$

$$x = 1, -\frac{1}{5}, \pm 2i$$

$$\begin{array}{r}
 \textcircled{12} \quad \underline{-1} \mid 3 \quad -4 \quad 1 \quad 6 \quad -2 \\
 \quad \quad \quad -3 \quad 7 \quad -8 \quad 2 \\
 \hline
 \frac{1}{3} \mid 3 \quad -7 \quad 8 \quad -2 \mid 0 \\
 \quad \quad \quad 1 \quad -2 \quad 2 \\
 \hline
 \quad \quad \quad 3 \quad -6 \quad 6 \mid 0
 \end{array}$$

$$\rightarrow x^2 - 2x + 2 = 0$$

$$x = \frac{2 \pm \sqrt{-4}}{2} = \frac{2 \pm 2i}{2}$$

$$x = -1, \frac{1}{3}, 1 \pm i$$

$$\begin{array}{r}
 \textcircled{13} \quad \underline{-2} \mid 1 \quad -3 \quad -20 \quad -24 \quad -8 \\
 \quad \quad \quad -2 \quad 10 \quad 20 \quad 8 \\
 \hline
 -1 \mid 1 \quad -5 \quad -10 \quad -4 \mid 0 \\
 \quad \quad \quad -1 \quad 6 \quad 4 \\
 \hline
 \quad \quad \quad 1 \quad -6 \quad -4 \mid 0
 \end{array}$$

$$\rightarrow x^2 - 6x - 4 = 0$$

$$x = \frac{6 \pm \sqrt{52}}{2} = \frac{6 \pm 2\sqrt{13}}{2}$$

$$x = -2, -1, 3 \pm \sqrt{13}$$

$$\begin{array}{r}
 \textcircled{14} \quad \underline{1} \mid 1 \quad 3 \quad -1 \quad -3 \\
 \quad \quad \quad 1 \quad 4 \quad 3 \\
 \hline
 \quad \quad \quad 1 \quad 4 \quad 3 \mid 0
 \end{array}$$

$$x^2 + 4x + 3 = 0$$

$$(x+3)(x+1) = 0$$

$$x = 1, -3, -1$$

$$\begin{array}{r}
 \textcircled{15} \quad \underline{1} \mid 1 \quad 5 \quad -27 \quad 31 \quad -10 \\
 \quad \quad \quad 1 \quad 6 \quad -21 \quad 10 \\
 \hline
 2 \mid 1 \quad 6 \quad -21 \quad 10 \mid 0 \\
 \quad \quad \quad 2 \quad 16 \quad -10 \\
 \hline
 \quad \quad \quad 1 \quad 8 \quad -5 \mid 0
 \end{array}$$

$$\rightarrow x^2 + 8x - 5 = 0$$

$$x = \frac{-8 \pm \sqrt{64}}{2} = \frac{-8 \pm 2\sqrt{21}}{2}$$

$$x = 1, 2, -4 \pm \sqrt{21}$$

$$\textcircled{16} \begin{array}{r|rrrr} 1 & 1 & 5 & -1 & -5 \\ & & 1 & 6 & 5 \\ \hline & 1 & 6 & 5 & 0 \end{array} \rightarrow \begin{array}{l} x^2 + 6x + 5 = 0 \\ (x+5)(x+1) = 0 \\ x = 1, -1, -5 \end{array}$$

$$\textcircled{17} \begin{array}{r|rrrr} 3/4 & 4 & -3 & 4 & -3 \\ & & 3 & 0 & 3 \\ \hline & 4 & 0 & 4 & 0 \end{array} \rightarrow \begin{array}{l} x^2 + 1 = 0 \\ x^2 = -1 \\ x = 3/4, \pm i \end{array}$$

$$\textcircled{18} \begin{array}{r|rrrrr} 1/2 & 2 & -3 & -1 & 1 \\ & & 1 & -1 & -1 \\ \hline & 2 & -2 & -2 & 0 \end{array} \rightarrow \begin{array}{l} x^2 - x - 1 = 0 \\ x = \frac{1 \pm \sqrt{5}}{2}, 1/2 \end{array}$$

$$\textcircled{19} \begin{array}{r|rrrrrr} -2 & 1 & -5 & 5 & 15 & -36 & 20 \\ & & -2 & 14 & -38 & 46 & -20 \\ \hline 11 & 1 & -7 & 19 & -23 & 10 & 0 \\ & & 1 & -6 & 13 & 10 \\ \hline 27 & 1 & -6 & 13 & -10 & 0 \\ & & 2 & -2 & 10 \\ \hline & 1 & -4 & 5 & 0 \end{array} \rightarrow \begin{array}{l} x^2 - 4x + 5 = 0 \\ x = \frac{4 \pm \sqrt{-4}}{2} = \frac{4 \pm 2i}{2} \\ x = -2, 1, 2, 2 \pm i \end{array}$$

$$\textcircled{20} \begin{array}{r|rrrrr} -2 & 1 & -3 & -3 & 9 & -4 & 12 \\ & & -2 & 10 & -14 & 10 & -12 \\ \hline 2 & 1 & -5 & 7 & -5 & 6 & 0 \\ & & 2 & -6 & 2 & -6 \\ \hline 3 & 1 & -3 & 1 & -3 & 0 \\ & & 3 & 0 & 3 \\ \hline & 1 & 0 & 1 & 0 \end{array} \rightarrow \begin{array}{l} x^2 + 1 = 0 \\ x^2 = -1 \\ x = \pm 2, 3, \pm i \end{array}$$

② 
$$\begin{array}{r|rrrr} 3 & 2 & -11 & 12 & 9 \\ & & 6 & -15 & -9 \\ \hline & 2 & -5 & -3 & 0 \end{array}$$

→  $2x^2 - 5x - 3 = 0$   
 $(2x + 1)(x - 3) = 0$   
 $x = -\frac{1}{2}, 3, 3$

②  $x^2 - 6x + 9 = 0$   
 $(x - 3)(x - 3) = 0$   
 $x = 3, 3$

② 
$$\begin{array}{r|rrrrrrr} 1 & 1 & 0 & 1 & 2 & -12 & 8 \\ & & 1 & 1 & 2 & 4 & -8 \\ \hline 1 & 1 & 1 & 2 & 4 & -8 & 0 \\ & & 1 & 2 & 4 & 8 \\ \hline -2 & 1 & 2 & 4 & 8 & 0 \\ & & -2 & 0 & -8 \\ \hline & 1 & 0 & 4 & 0 \end{array}$$

→  $x^2 + 4 = 0$   
 $x^2 = -4$   
 $x = \pm 2i$

$x = 1, 1, -2, \pm 2i$