

Find All Roots/Zeros **Review**

Date \_\_\_\_\_

Period \_\_\_\_\_

State the possible rational zeros for each function. Then find all zeros.

1)  $f(x) = x^3 + x^2 - 5x + 3$

$$P/Q = \pm 1, \pm 3$$

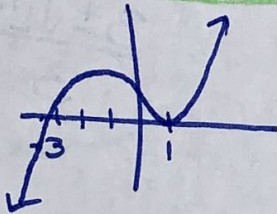
$$x = 1$$

$$\begin{array}{r|rrrr} 1 & 1 & 1 & -5 & 3 \\ & \downarrow & & & \\ & 1 & 2 & -3 & 0 \end{array}$$

$$x^2 + 2x - 3 =$$

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

$$x = -3 \quad x = 1 \text{ twice}$$



3)  $f(x) = 4x^3 + 8x^2 - 5x - 10$

$$P/Q = \pm 1, \pm 2, \pm 5, \pm 10, \pm \frac{1}{2}, \pm \frac{5}{2}, \pm \frac{1}{4}, \pm \frac{5}{4}$$

$$x = -2$$

$$\begin{array}{r|rrrr} -2 & 4 & 8 & -5 & -10 \\ & \downarrow & & & \\ & 4 & 0 & -5 & 0 \end{array}$$

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

$$\frac{4x^2}{4} = \frac{5}{4}$$

$$\sqrt{x^2} = \pm \sqrt{\frac{5}{4}} \quad \frac{\sqrt{5}}{\sqrt{4}}$$

$$x = \pm \frac{\sqrt{5}}{2}$$

2)  $f(x) = 2x^3 - x^2 - 2x + 1$

$$P/Q = \pm 1, \pm \frac{1}{2}$$

$$x = \frac{1}{2}, -1, 1$$

$$\begin{array}{r|rrrr} \frac{1}{2} & 2 & -1 & -2 & 1 \\ & \downarrow & & & \\ & 2 & 0 & -2 & 0 \end{array}$$

$$2x^2 - 2 = 0$$

$$\frac{2x^2}{2} = \frac{2}{2}$$

$$\sqrt{x^2} = \pm 1$$

$$x = \pm 1$$

4)  $f(x) = 3x^3 + x^2 - 3x - 1$

$$P/Q = \pm 1, \pm \frac{1}{3}$$

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

$$\begin{array}{r|rrrr} -\frac{1}{3} & 3 & 1 & -3 & -1 \\ & \downarrow & & & \\ & 3 & 0 & -3 & 0 \end{array}$$

$$3x^2 - 3 = 0$$

$$3(x^2 - 1) = 0$$

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

$$x = -1 \quad x = 1$$



$$5) f(x) = 2x^3 - 6x^2 - 3x + 9$$

$$P/q = \pm 1, \pm 3, \pm 9, \pm \frac{1}{2}, \pm \frac{3}{2}, \pm \frac{9}{2}$$

$$x = 3$$

$$\begin{array}{r|rrrr} 3 & 2 & -6 & -3 & 9 \\ & \downarrow & 6 & 0 & -9 \\ \hline & 2 & 0 & -3 & 0 \end{array}$$

$$2x^2 - 3 = 0$$

$$x = \frac{0 \pm \sqrt{(0)^2 - 4(2)(-3)}}{2(2)}$$

$$\pm \frac{\sqrt{24}}{4} = \pm \frac{2\sqrt{6}}{4} = \pm \frac{\sqrt{6}}{2}$$

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

$$\pm 1, \pm 2, \pm \frac{1}{3}, \pm \frac{2}{3}, \pm \frac{1}{9}, \pm \frac{2}{9}$$

$$6) f(x) = 9x^3 - 15x^2 - 12x - 2$$

$$-\frac{1}{3}$$

$$\begin{array}{r|rrrr} -\frac{1}{3} & 9 & -15 & -12 & -2 \\ & \downarrow & -3 & 6 & 2 \\ \hline & 9 & -18 & -6 & 0 \end{array}$$

$$9x^2 - 18x - 6 = 0$$

$$3(3x^2 - 6x - 2) = 0$$

$$3(3x^2 - 6x - 2) = 0$$

$$a=3 \quad b=-6 \quad c=-2$$

$$x = \frac{6 \pm \sqrt{(-6)^2 - 4(3)(-2)}}{2(3)}$$

$$\frac{6 \pm \sqrt{60}}{6} = \frac{6 \pm 2\sqrt{15}}{6}$$

$$x = \frac{3 \pm \sqrt{15}}{3}$$

$$7) f(x) = 3x^3 - 8x^2 - 36x + 5$$

$$x = 5$$

$$P/q = \pm 1, \pm 5, \pm \frac{1}{3}, \pm \frac{5}{3}$$

$$\begin{array}{r|rrrr} 5 & 3 & -8 & -36 & 5 \\ & \downarrow & 15 & 35 & -5 \\ \hline & 3 & 7 & -1 & 0 \end{array}$$

$$3x^2 + 7x - 1 = 0$$

$$x = \frac{-7 \pm \sqrt{(7)^2 - 4(3)(-1)}}{2(3)}$$

$$x = \frac{-7 \pm \sqrt{61}}{6}$$

$$8) f(x) = 5x^3 - x^2 + 25x - 5$$

$$x = \frac{1}{5}$$

$$P/q = \pm 1, \pm 5, \pm \frac{1}{5}$$

$$\begin{array}{r|rrrr} \frac{1}{5} & 5 & -1 & 25 & -5 \\ & \downarrow & 1 & 0 & 5 \\ \hline & 5 & 0 & 25 & 0 \end{array}$$

$$5x^2 + 25 = 0$$

$$5x^2 = -25$$

$$\sqrt{x^2} = \sqrt{-5}$$

$$x = \pm i\sqrt{5}$$