

Divide using polynomial long division.

1) $(x^4 - 7x^2 + 9x - 10) \div (x - 2)$

$$\begin{array}{r} x^3 + 2x^2 - 3x + 3 \\ x-2 \overline{) x^4 + 0x^3 - 7x^2 + 9x - 10} \\ \underline{-(x^4 - 2x^3)} \\ 2x^3 - 7x^2 \\ \underline{-(2x^3 - 4x^2)} \\ -3x^2 + 9x \\ \underline{-(-3x^2 + 6x)} \\ 3x - 10 \\ \underline{-(3x - 6)} \\ -4 \end{array}$$

$x^3 + 2x^2 - 3x + 3 + \frac{-4}{x-2}$

2) $(8x^3 + 5x^2 - 12x + 10) \div (x^2 - 3)$

$$\begin{array}{r} 8x + 5 \\ x^2 - 3 \overline{) 8x^3 + 5x^2 - 12x + 10} \\ \underline{-(8x^3 - 24x)} \\ 5x^2 + 12x + 10 \\ \underline{-(5x^2 - 15)} \\ 12x + 25 \end{array}$$

$8x + 5 + \frac{12x + 25}{x^2 - 3}$

Divide using synthetic division.

3) $(x^3 - 3x^2 + 8x - 5) \div (x + 1)$

$$\begin{array}{r|rrrr} -1 & 1 & -3 & 8 & -5 \\ & & -1 & 4 & -12 \\ \hline & 1 & -4 & 12 & -17 \end{array}$$

$x^2 - 4x + 12 + \frac{-17}{x+1}$

4) $(x^4 - 6x^3 - 40x + 33) \div (x - 7)$

$$\begin{array}{r|rrrrrr} 7 & 1 & -6 & 0 & -40 & 33 \\ & & 7 & 7 & 49 & 63 \\ \hline & 1 & 1 & 7 & 9 & 96 \end{array}$$

$x^3 + x^2 + 7x + 9 + \frac{96}{x-7}$

Factor the polynomials completely.

5) $x^3 + 3x^2 - 6x - 8$

$$\begin{array}{r|rrrr} 1 & 1 & 3 & -6 & -8 \\ 1 & 1 & 4 & -2 & -10 \\ \hline 2 & 1 & 5 & 4 & 0 \\ & & x^2 + 5x + 4 & & \\ \hline & & (x+4)(x+1)(x-2) & & \end{array}$$

6) $x^3 + 7x^2 + 7x - 15$

$$\begin{array}{r|rrrr} 1 & 1 & 7 & 7 & -15 \\ 1 & 1 & 8 & 15 & 0 \\ \hline & & x^2 + 8x + 15 & & \\ \hline & & (x+5)(x+3)(x-1) & & \end{array}$$

Solve the polynomial equations.

7) $x^3 - 7x + 6 = 0$

$$\begin{array}{r|rrrr} 1 & 1 & 0 & -7 & 6 \\ 1 & 1 & 1 & -6 & 0 \\ \hline & & x^2 + x - 6 & & \\ \hline & & (x+3)(x-2) & & \end{array}$$

$x = -3, 2, 1$

8) $x^3 - 3x^2 - 16x - 12 = 0$

$$\begin{array}{r|rrrr} 1 & 1 & -3 & -16 & -12 \\ 1 & 1 & -2 & -18 & -30 \\ 2 & 1 & -1 & -18 & -48 \\ 3 & 1 & 0 & -16 & -60 \\ 4 & 1 & 1 & -12 & -60 \\ 6 & 1 & 3 & 2 & 0 \end{array}$$

$x^2 + 3x + 2 = (x+2)(x+1)$
 $x = -2, -1, 6$

Solve the following inequalities, and graph the solutions on the number line.

9) $6x^3 - 17x^2 - 5x + 6 \leq 0$

$$\begin{array}{r|rrrr} 1 & 6 & -17 & -5 & 6 \\ 2 & 6 & -11 & -16 & -10 \\ 3 & 6 & -5 & -15 & -24 \\ 6 & 6 & 1 & -2 & 0 \\ \hline & & 6x^2 + x - 2 & & \\ & & 6x^2 + 4x - 3x - 2 & & \\ & & 2x(3x+2) - 1(3x+2) & & \\ & & (2x-1)(3x+2)(x-3) & & \end{array}$$

$x \leq -\frac{2}{3}, \frac{1}{2} \leq x \leq 3$

10) $x^4 - 5x^2 + 4 \geq 0$

$$\begin{array}{r|rrrr} 1 & 1 & 0 & -5 & 0 & 4 \\ 1 & 1 & 1 & -4 & -4 & 0 \\ \hline & & x^3 + 3x + 2 & & \\ \hline & & (x+2)(x+1)(x-1)(x+2) & & \end{array}$$

$x \leq -2, -1 \leq x \leq 1, x \geq 2$

11) The height of a box is 5 inches less than twice the width of the box. The length is 3 inches more than the width. The volume of the box is 1404 in³. What are the dimensions of the box? ($V = lwh$)

$h = 2w - 5$
 $w = w$
 $l = w + 3$

$$w(w+3)(2w-5) = 1404$$

$$(w^2 + 3w)(2w - 5) = 1404$$

$$2w^3 + w^2 - 15w - 1404 = 0$$

width = 9 in, length = 12 in, height = 13 in

$$\begin{array}{r} 2 \overline{) 1404} \\ \underline{2702} \\ 3 \overline{) 351} \\ \underline{3117} \\ 3 \overline{) 39} \\ \underline{39} \\ 0 \end{array}$$

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$$\begin{array}{r} 19 \\ 171 \\ \underline{-156} \\ 156 \\ \underline{-1404} \\ 0 \end{array}$$