

Polynomial Division

Name:

Divide each of the following numbers using long division.

1. $152 \div 7$

2. $3587/3$

Review: Dividing by a monomial.

3. $\frac{6x^4 - 15x^2 + 3x^2}{3x^2}$

4. $\frac{21a^5b^2 - 14a^3b^2 + 63a^2b}{7ab}$

New: Dividing by a binomial.

Use factoring to simplify the top and see if any factors can simplify.

5. $\frac{w^2 - 7w + 10}{w - 5}$

6. $(4h^2 - 7h - 2) \div (h - 2)$

Long Division of Polynomials. Use long division to find the quotient.

7. $(x^3 - 14x^2 + 51x - 54) \div (x + 2)$

8. $\frac{x^3 - 5x^2 + 3x - 2}{x + 1}$

9. $\frac{x^4 - 12x^3 + 45x^2 - 58x + 24}{x^2 - 2x - 1}$

10. $\frac{2x^4 - 5x^3 + 7x^2 - 3x + 1}{x - 3}$

11. $\frac{2x^4 + 5x^2 - x + 1}{x - 1}$

12. $\frac{5x^4 - 3x^3 - x + 4}{x - 2}$

13. Determine if $x = 3$ is a root of the following polynomial. If yes, find the other roots.

$$f(x) = x^3 + 4x^2 - 11x - 30$$

14. Find the quotient using long division. Is the divisor a factor of the dividend? If so, find the other factors.

$$\frac{3x^3 + 5x^2 + 8x + 7}{3x + 2}$$

Use synthetic division to find the quotient.

15. $(x^3 - 14x^2 + 51x - 54) \div (x + 2)$

16. $(x^3 - 4x^2 + 9) \div (x + 2)$

17. $\frac{3x^4 + 2x^2 - 1}{x + 1}$

18. $\frac{2x^3 - x + 5}{x - 3}$

19. $\frac{x^3 + 5x^2 + 3x - 2}{x + 1}$

20. $\frac{9x^3 + 7x^2 - 3x}{x - 10}$

21. $\frac{2x^4 - 5x^3 + 7x^2 - 3x + 1}{x - 2}$

22. $\frac{4x^4 + 3x^2 - 5x + 2}{x + 2}$

23. Given that $5x + 3$ is a factor of the following polynomial, factor completely.

$$y = 20x^7 + 12x^6 + 5x^5 + 3x^4 - 80x^3 - 48x^2 - 20x - 12$$

24. Given that $x + 1$ is a factor of the following polynomial, factor completely.

$$y = x^3 + 2x^2 - 5x - 6$$

25. Given that -2 is a root of the following polynomial, find all other roots.

$$3x^4 + 4x^3 - 19x^2 - 20x + 20$$

26. Given that 2 is a root of the following polynomial, find all other roots.

$$5x^6 - 46x^4 + 80x^2 + 96$$

Polynomial Division

Name: Keu

Divide each of the following numbers using long division.

1. $152 \div 7$

$$7 \overline{) 152} \begin{array}{r} 21 \\ +4 \\ \hline 12 \\ \hline 0 \end{array} \quad \frac{152}{7} = 21 + \frac{5}{7}$$

2. $3587 \div 3$

$$3 \overline{) 3587} \begin{array}{r} 1195 \\ -3 \\ \hline 08 \\ -6 \\ \hline 28 \\ -27 \\ \hline 07 \\ -6 \\ \hline 017 \\ -15 \\ \hline 02 \end{array} \quad \frac{3587}{3} = 1195 + \frac{2}{3}$$

Review: Dividing by a monomial.

3. $\frac{6x^4 - 15x^2 + 3x^2}{3x^2}$

$$\frac{6x^4}{3x^2} - \frac{15x^2}{3x^2} + \frac{3x^2}{3x^2} = 2x^2 - 5 + 1$$

$2x^2 - 4$

4. $\frac{21a^5b^2 - 14a^3b^2 + 63a^2b}{7ab}$

$3a^4 - 2a^2b + 9a$

New: Dividing by a binomial.

Use factoring to simplify the top and see if any factors can simplify.

5. $\frac{w^2 - 7w + 10}{w - 5} = \frac{(w-5)(w+2)}{(w-5)} = \boxed{w+2} \quad w \neq 5$

6. $\frac{4h^2 - 7h - 2}{h - 2} \div (h - 2) = \frac{(4h+1)(h-2)}{h-2} = \boxed{4h+1} \quad h \neq 2$

Long Division of Polynomials. Use long division to find the quotient.

7. $(x^3 - 14x^2 + 51x - 54) \div (x + 2) = \boxed{x^2 - 16x + 83} r - 220$

$$\begin{array}{r} x^2 - 16x + 83 \\ \times (x + 2) \\ \hline x^3 - 14x^2 + 51x - 54 \\ -x^3 + 2x^2 \\ \hline -16x^2 + 51x - 54 \\ +16x^2 - 32x \\ \hline 83x - 54 \\ -83x + 166 \\ \hline -220 \end{array}$$

8. $(x^3 - 5x^2 + 3x - 2) \div (x + 1) = \boxed{x^2 - 6x + 9} r - 11$

$$\begin{array}{r} x^2 - 6x + 9 \\ \times (x + 1) \\ \hline x^3 - 5x^2 + 3x - 2 \\ -x^3 + x^2 \\ \hline -6x^2 + 3x - 2 \\ +6x^2 + 6x \\ \hline 9x - 2 \\ -9x + 9 \\ \hline -11 \end{array}$$

9. $(x^4 - 12x^3 + 45x^2 - 58x + 24) \div (x^2 - 2x - 1) = \boxed{x^2 - 10x + 26} r - 14x + 50$

$$\begin{array}{r} x^2 - 10x + 26 \\ \times (x^2 - 2x - 1) \\ \hline x^4 - 12x^3 + 45x^2 - 58x + 24 \\ -x^4 + 2x^3 + x^2 \\ \hline -10x^3 + 46x^2 - 58x + 24 \\ +10x^3 + 20x^2 + 10x \\ \hline -26x^2 + 68x + 24 \\ +26x^2 - 26x - 26 \\ \hline -14x + 50 \end{array}$$

10. $(2x^4 - 5x^3 + 7x^2 - 3x + 1) \div (x - 3) = \boxed{2x^3 + x^2 + 10x + 27} r 82$

$$\begin{array}{r} 2x^3 + x^2 + 10x + 27 \\ \times (x - 3) \\ \hline 2x^4 - 5x^3 + 7x^2 - 3x + 1 \\ -2x^4 + 6x^3 \\ \hline x^3 + 7x^2 - 3x + 1 \\ -x^3 + 3x^2 \\ \hline 10x^2 - 3x + 1 \\ -10x^2 + 30x \\ \hline -27x + 31 \\ +27x - 81 \\ \hline 82 \end{array}$$

11. $(2x^4 + 5x^3 - x + 1) \div (x - 1) = \boxed{2x^3 + 2x^2 + 7x + 6} r 7$

$$\begin{array}{r} 2x^3 + 2x^2 + 7x + 6 \\ \times (x - 1) \\ \hline 2x^4 + 5x^3 - x + 1 \\ -2x^4 + 2x^3 \\ \hline 7x^3 + 5x^2 - x + 1 \\ -7x^3 + 7x^2 \\ \hline 12x^2 - x + 1 \\ -12x^2 + 12x \\ \hline 11x + 1 \\ -11x + 11 \\ \hline 12 \end{array}$$

12. $(5x^4 - 3x^3 - x + 4) \div (x - 2) = \boxed{5x^3 + 7x^2 + 14x + 27} r 50$

$$\begin{array}{r} 5x^3 + 7x^2 + 14x + 27 \\ \times (x - 2) \\ \hline 5x^4 - 3x^3 - x + 4 \\ -5x^4 + 10x^3 \\ \hline 7x^3 - 8x^2 - x + 4 \\ -7x^3 + 14x^2 \\ \hline 14x^2 - x + 4 \\ -14x^2 + 28x \\ \hline 27x + 4 \\ -27x + 54 \\ \hline 50 \end{array}$$

13. Determine if $x = 3$ is a root of the following polynomial. If yes, find the other roots.

Yes $f(x) = x^3 + 4x^2 - 11x - 30$

$$\begin{array}{r} x^2 + 7x + 10 \\ \times (x - 3) \\ \hline x^3 + 4x^2 - 11x - 30 \\ -x^3 + 3x^2 \\ \hline 7x^2 - 11x - 30 \\ -7x^2 + 21x \\ \hline 16x - 30 \\ -16x + 48 \\ \hline 18 \end{array}$$

$(x-3)(x+5)(x+2)$

$x = -5 \quad x = -2$

Use synthetic division to find the quotient.

15. $(x^3 - 14x^2 + 51x - 54) \div (x + 2) = \boxed{x^2 - 16x + 83} + \frac{112}{x+2}$

$$\begin{array}{r|rrrr} -2 & 1 & -14 & 51 & -54 \\ & & -2 & 32 & 166 \\ \hline & 1 & -16 & 83 & 112 \end{array}$$

14. Find the quotient using long division. Is the divisor a factor of the dividend? If so, find the other factors.

$$\begin{array}{r} 3x^3 + 5x^2 + 8x + 7 \\ \div (3x + 2) \\ \hline x^2 + 3x + \frac{2}{3} \\ \times (3x + 2) \\ \hline 3x^3 + 5x^2 + 8x + 7 \\ -3x^3 + 2x^2 \\ \hline 3x^2 + 8x + 7 \\ -3x^2 + 6x \\ \hline 2x + 7 \\ -2x - \frac{14}{3} \\ \hline \frac{7}{3} \end{array}$$

no it is not a factor

$$16. (x^3 - 4x^2 + 9) \div (x + 2)$$

$$\begin{array}{r} -2 \mid 1 \quad -4 \quad 0 \quad 9 \\ \quad \downarrow \quad -2 \quad 12 \quad -18 \\ \hline 1 \quad -6 \quad 12 \quad -9 \end{array}$$

$$x^2 - 6x + 12 + \frac{-9}{x+2}$$

$$17. \frac{3x^4 + 2x^2 - 1}{x+1}$$

$$\begin{array}{r} -1 \mid 3 \quad 0 \quad 2 \quad 0 \quad -1 \\ \quad \downarrow \quad -3 \quad 3 \quad -5 \quad 5 \\ \hline 3 \quad -3 \quad 5 \quad -5 \quad 4 \end{array}$$

$$3x^3 - 3x^2 + 5x - 5 + \frac{4}{x+1}$$

$$18. \frac{2x^3 - x + 5}{x-3}$$

$$\begin{array}{r} 3 \mid 2 \quad 0 \quad -1 \quad 5 \\ \quad \downarrow \quad 6 \quad 18 \quad 51 \\ \hline 2 \quad 6 \quad 17 \quad 56 \end{array}$$

$$2x^2 + 6x + 17 + \frac{56}{x-3}$$

$$19. \frac{x^3 + 5x^2 + 3x - 2}{x+1}$$

$$\begin{array}{r} -1 \mid 1 \quad 5 \quad 3 \quad -2 \\ \quad \downarrow \quad -1 \quad -4 \quad 1 \\ \hline 1 \quad 4 \quad -1 \quad -1 \end{array}$$

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

$$20. \frac{9x^3 + 7x^2 - 3x}{x-10}$$

$$\begin{array}{r} 10 \mid 9 \quad 7 \quad -3 \quad 0 \\ \quad \downarrow \quad 90 \quad 970 \quad 9670 \\ \hline 9 \quad 97 \quad 967 \quad 9670 \end{array}$$

$$9x^2 + 97x + 9670$$

$$21. \frac{2x^4 - 5x^3 + 7x^2 - 3x + 1}{x-2}$$

$$\begin{array}{r} 2 \mid 2 \quad -5 \quad 7 \quad -3 \quad 1 \\ \quad \downarrow \quad 4 \quad -2 \quad 10 \quad 14 \\ \hline 2 \quad -1 \quad 5 \quad 7 \quad 15 \end{array}$$

$$2x^3 - x^2 + 5x + 7 + \frac{15}{x-2}$$

$$22. \frac{4x^4 + 3x^2 - 5x + 2}{x+2}$$

$$\begin{array}{r} -2 \mid 4 \quad 0 \quad 3 \quad -5 \quad 2 \\ \quad \downarrow \quad -8 \quad 16 \quad -38 \quad 86 \\ \hline 4 \quad -8 \quad 19 \quad -43 \quad 88 \end{array}$$

$$4x^3 - 8x^2 + 19x - 43 + \frac{88}{x+2}$$

23. Given that $5x + 3$ is a factor of the following polynomial, factor completely.

$$y = 20x^7 + 12x^6 + 5x^5 + 3x^4 - 80x^3 - 48x^2 - 20x - 12$$

$$\begin{array}{r} 5x+3 \mid 20x^7 + 12x^6 + 5x^5 + 3x^4 - 80x^3 - 48x^2 - 20x - 12 \\ \quad \underline{-20x^7 + 12x^6} \\ 4x^6 + x^4 - 16x^2 - 4 \\ \underline{-4x^6 + 3x^4} \\ -3x^4 - 80x^3 - 48x^2 - 20x - 12 \\ \underline{-3x^4 + 12x^3} \\ -11x^3 - 48x^2 - 20x - 12 \\ \underline{-11x^3 + 33x^2} \\ -15x^2 - 20x - 12 \\ \underline{-15x^2 + 45x} \\ 25x - 12 \\ \underline{-25x + 75} \\ 13 \end{array}$$

25. Given that -2 is a root of the following polynomial, find all other roots.

$$3x^4 + 4x^3 - 19x^2 - 20x + 20$$

$$\begin{array}{r} -2 \mid 3 \quad 4 \quad -19 \quad -20 \quad 20 \\ \quad \downarrow \quad -6 \quad 4 \quad 30 \quad -26 \\ \hline 3 \quad -2 \quad -15 \quad 10 \quad 0 \end{array}$$

24. Given that $x + 1$ is a factor of the following polynomial, factor completely.

$$y = x^3 + 2x^2 - 5x - 6$$

$$\begin{array}{r} -1 \mid 1 \quad 2 \quad -5 \quad -6 \\ \quad \downarrow \quad -1 \quad -1 \quad 6 \\ \hline 1 \quad 1 \quad -6 \quad 0 \end{array}$$

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

$$\begin{aligned} &(x+2)(3x^3 - 2x^2 - 15x + 10) \\ &(x+2)(x^2(3x-2) - 5(3x-2)) \\ &(x+2)(x^2-5)(3x-2) \\ &x = -2 \quad x = \pm\sqrt{5} \quad x = \frac{2}{3} \end{aligned}$$

26. Given that 2 is a root of the following polynomial, find all other roots.

$$5x^6 - 46x^4 + 80x^2 + 96$$

$$\begin{array}{r} 2 \mid 5 \quad 0 \quad -46 \quad 0 \quad 80 \quad 0 \quad 96 \\ \quad \downarrow \quad 10 \quad 20 \quad -52 \quad -104 \quad -48 \quad -96 \\ \hline 5 \quad 10 \quad -26 \quad -52 \quad -24 \quad -48 \quad 0 \end{array}$$

$$(x-2)(5x^5 + 10x^4 - 26x^3 - 52x^2 - 24x - 48)$$

$$\begin{array}{r} -2 \mid 5 \quad 10 \quad -26 \quad -52 \quad -24 \quad -48 \\ \quad \downarrow \quad -10 \quad 0 \quad 52 \quad 0 \quad 48 \\ \hline 5 \quad 0 \quad -26 \quad 0 \quad -24 \quad 0 \end{array}$$

$$\begin{aligned} &(x-2)(x+2)(5x^4 - 26x^2 - 24) \\ &(x-2)(x+2)(5x^2 + \frac{4}{5})(x^2 - 6) \end{aligned}$$

$$x = 2 \quad x = -2 \quad x = \pm i\sqrt{\frac{4}{5}} \quad x = \pm\sqrt{6}$$