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: Key

Divide each of the following numbers using long division.

1. $152 \div 7$

$7\overline{)152}$ → 21 r 5 → $\frac{152}{7} = 21 + \frac{5}{7}$

2. $3587/3$

$3\overline{)3587}$ → 1195 r 2 → $\frac{3587}{3} = 1195 + \frac{2}{3}$

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

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

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

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

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

$x+2 \overline{)x^3 - 14x^2 + 51x - 54}$ → $x^2 - 16x + 83$ r -220

$= x^2 - 16x + 83 - \frac{220}{x+2}$

8. $\frac{x^3-5x^2+3x-2}{x+1}$ $x+1 \overline{)x^3 - 5x^2 + 3x - 2}$ → $x^2 - 6x + 9$ r -11

$= x^2 - 6x + 9 - \frac{11}{x+1}$

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

$x^2 - 2x - 1 \overline{)x^4 - 12x^3 + 45x^2 - 58x + 24}$ → $x^2 - 10x + 26$

$= x^2 - 10x + 26 + \frac{-14x+5}{x^2-2x-1}$

$= x^2 - 10x + 26$ r $-14x + 50$

10. $\frac{2x^4-5x^3+7x^2-3x+1}{x-3}$ $x-3 \overline{)2x^4 - 5x^3 + 7x^2 - 3x + 1}$ → $2x^3 + x^2 + 10x + 27$ r 82

$= 2x^3 + x^2 + 10x + 27 + \frac{82}{x-3}$

11. $\frac{2x^4+5x^2-x+1}{x-1}$ $x-1 \overline{)2x^4 + 5x^3 + 5x^2 - x + 1}$ → $2x^3 + 2x^2 + 7x + 6$ r 7

$= 2x^3 + 2x^2 + 7x + 6 + \frac{7}{x-1}$

12. $\frac{5x^4-3x^3-x+4}{x-2}$ $x-2 \overline{)5x^4 - 3x^3 + 0x^2 - x + 4}$ → $5x^3 + 7x^2 + 14x + 27$ r 50

$5x^3 + 7x^2 + 14x + 27 + \frac{50}{x-2}$

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

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

$= (x-3)(x^2+7x+10)$

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

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

Yes

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

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

$3x+2 \overline{)3x^3 + 5x^2 + 8x + 7}$ → $x^2 + 3x + \frac{2}{3}$ r $\frac{5}{3}$

no it is not a factor

Use synthetic division to find the quotient.

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

$-2 \mid 1 \quad -14 \quad 51 \quad -54$

$\downarrow \quad -2 \quad 32 \quad 166$

$1 \quad -16 \quad 83 \quad 112$

$= x^2 - 16x + 83 + \frac{112}{x+2}$

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

$-2 \mid 1 \quad -4 \quad 0 \quad 9$
$\quad\quad\downarrow \quad -2 \quad 12 \quad -18$
$\quad\quad 1 \quad -6 \quad 12 \quad -9$

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

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

$-1 \mid 3 \quad 0 \quad 2 \quad 0 \quad -1$
$\quad\quad\downarrow \quad -3 \quad 3 \quad -5 \quad 5$
$\quad\quad 3 \quad -3 \quad 5 \quad -5 \quad 4$

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

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

$3 \mid 2 \quad 0 \quad -1 \quad 5$
$\quad\quad\downarrow \quad 6 \quad 18 \quad 51$
$\quad\quad 2 \quad 6 \quad 17 \quad 56$

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

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

$-1 \mid 1 \quad 5 \quad 3 \quad -2$
$\quad\quad\downarrow \quad -1 \quad -4 \quad 1$
$\quad\quad 1 \quad 4 \quad -1 \quad -1$

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

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

$10 \mid 9 \quad 7 \quad -3 \quad 0$
$\quad\quad\downarrow \quad 90 \quad 970 \quad 9670$
$\quad\quad 9 \quad 97 \quad 967 \quad 9670$

$= 9x^2 + 97x + 967 + \frac{9670}{x-10}$

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

$2 \mid 2 \quad -5 \quad 7 \quad -3 \quad 1$
$\quad\quad\downarrow \quad 4 \quad -2 \quad 10 \quad 14$
$\quad\quad 2 \quad -1 \quad 5 \quad 7 \quad 15$

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

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

$-2 \mid 4 \quad 0 \quad 3 \quad -5 \quad 2$
$\quad\quad\downarrow \quad -8 \quad 16 \quad -38 \quad 86$
$\quad\quad 4 \quad -8 \quad 19 \quad -43 \quad 88$

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

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

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

$4x^6 + x^4 - 16x^2 - 4$
$5x+3 \overline{)20x^7 + 12x^6 + 5x^5 + 3x^4 - 80x^3 - 48x^2 - 20x - 12}$
$-20x^7 + 12x^6$
$5x^5 + 3x^4$
$-5x^5 + 3x^4$
$-80x^3 - 48x^2$
$+80x^3 + 48x^2$
$-20x - 12$
$+20x + 12$

$(5x+3)(4x^6 + x^4 - 16x^2 - 4)$
$(5x+3)(x^4(4x^2+1) - 4(4x^2+1))$
$(5x+3)(x^4 - 4)(4x^2+1)$
$(5x+3)(x^2-2)(x^2+2)(4x^2+1)$

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

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

$-1 \mid 1 \quad 2 \quad -5 \quad -6$
$\quad\quad\downarrow \quad -1 \quad -1 \quad 6$
$\quad\quad 1 \quad 1 \quad -6 \quad 0$

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

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

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

$-2 \mid 3 \quad 4 \quad -19 \quad -20 \quad 20$
$\quad\quad\downarrow \quad -6 \quad 4 \quad 30 \quad -20$
$\quad\quad 3 \quad -2 \quad -15 \quad 10 \quad 0$

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

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

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

$2 \mid 5 \quad 0 \quad -46 \quad 0 \quad 80 \quad 0 \quad 96$
$\quad\quad\downarrow \quad 10 \quad 20 \quad -52 \quad -104 \quad -48 \quad -96$
$\quad\quad 5 \quad 10 \quad -26 \quad -52 \quad -24 \quad -48 \quad 0$

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

$-2 \mid 5 \quad 10 \quad -26 \quad -52 \quad -24 \quad -48$
$\quad\quad\downarrow \quad -10 \quad 0 \quad 52 \quad 0 \quad 48$
$\quad\quad 5 \quad 0 \quad -26 \quad 0 \quad -24 \quad 0$

$(x-2)(x+2)(5x^4 - 26x^2 - 24)$
$(x-2)(x+2)(5x^2 + 4)(x^2 - 6)$
$x = 2 \quad x = -2 \quad x = \pm i\sqrt{\frac{4}{5}} \quad x = \pm\sqrt{6}$