

1 Simplify each expression. Under what conditions is this expression undefined?

13. $\frac{x(x-3)(x+6)}{x^2+x-12}$

14. $\frac{y^2(y^2+3y+2)}{2y(y-4)(y+2)}$

15. $\frac{(x^2-9)(x^2-z^2)}{4(x+z)(x-3)}$

16. $\frac{(x^2-16x+64)(x+2)}{(x^2-64)(x^2-6x-16)}$

17. $\frac{x^2(x+2)(x-4)}{6x(x^2+x-20)}$

18. $\frac{3y(y-8)(y^2+2y-24)}{15y^2(y^2-12y+32)}$

2 19. **MULTIPLE CHOICE** Identify all values of x for which $\frac{(x-3)(x+6)}{(x^2-7x+12)(x^2-36)}$ is undefined.

A 3, -6

B 4, 6

C -6, 6

D -6, 3, 4, 6

3 Simplify each expression.

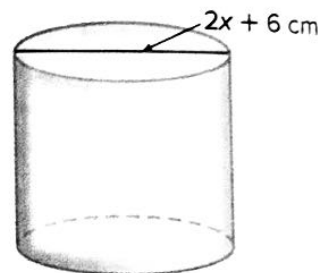
20. $\frac{x^2-5x-14}{28+3x-x^2}$

21. $\frac{x^3-9x^2}{x^2-3x-54}$

22. $\frac{(x-4)(x^2+2x-48)}{(36-x^2)(x^2+4x-32)}$

23. $\frac{16-c^2}{c^2+c-20}$

24. **GEOMETRY** The cylinder at the right has a volume of $(x+3)(x^2-3x-18)\pi$ cubic centimeters. Find the height of the cylinder.



s 4-6 Simplify each expression.

25. $\frac{3ac^3f^3}{8a^2bcf^4} \cdot \frac{12ab^2c}{18ab^3c^2f}$

26. $\frac{14xy^2z^3}{21w^4x^2yz} \cdot \frac{7wxyz}{12w^2y^3z}$

27. $\frac{64a^2b^5}{35b^2c^3f^4} \div \frac{12a^4b^3c}{70abcf^2}$

28. $\frac{9x^2yz}{5z^4} \div \frac{12x^4y^2}{50xy^4z^2}$

29. $\frac{15a^2b^2}{21ac} \cdot \frac{14a^4c^2}{6ab^3}$

30. $\frac{14c^2f^5}{9a^2} \div \frac{35cf^4}{18ab^3}$

31. $\frac{y^2+8y+15}{y-6} \cdot \frac{y^2-9y+18}{y^2-9}$

32. $\frac{c^2-6c-16}{c^2-d^2} \div \frac{c^2-8c}{c+d}$

33. $\frac{x^2+9x+20}{8x+16} \cdot \frac{4x^2+16x+16}{x^2-25}$

34. $\frac{3a^2+6a+3}{a^2-3a-10} \div \frac{12a^2-12}{a^2-4}$

35. $\frac{\frac{x^2-9}{6x-12}}{\frac{x^2+10x+21}{x^2-x-2}}$

36. $\frac{\frac{y-x}{z^3}}{\frac{x-y}{6z^2}}$

37. $\frac{\frac{a^2-b^2}{b^3}}{\frac{b^2-ab}{a^2}}$

38. $\frac{\frac{x-y}{a+b}}{\frac{x^2-y^2}{b^2-a^2}}$

Simplify each expression.

$$42. \frac{x^2 - 16}{3x^3 + 18x^2 + 24x} \cdot \frac{x^3 - 4x}{2x^2 - 7x - 4}$$

$$43. \frac{3x^2 - 17x - 6}{4x^2 - 20x - 24} \div \frac{6x^2 - 7x - 3}{2x^2 - x - 3}$$

$$44. \frac{9 - x^2}{x^2 - 4x - 21} \cdot \left(\frac{2x^2 + 7x + 3}{2x^2 - 15x + 7} \right)^{-1}$$

$$45. \left(\frac{2x^2 + 2x - 12}{x^2 + 4x - 5} \right)^{-1} \cdot \frac{2x^3 - 8x}{x^2 - 2x - 35}$$

$$46. \left(\frac{3xy^3z}{2a^2bc^2} \right)^3 \cdot \frac{16a^4b^3c^5}{15x^7yz^3}$$

$$47. \frac{20x^2y^6z^{-2}}{3a^3c^2} \cdot \left(\frac{16x^3y^3}{9acz} \right)^{-1}$$

$$48. \left(\frac{2xy^3}{3abc} \right)^{-2} \div \frac{6a^2b}{x^2y^4}$$

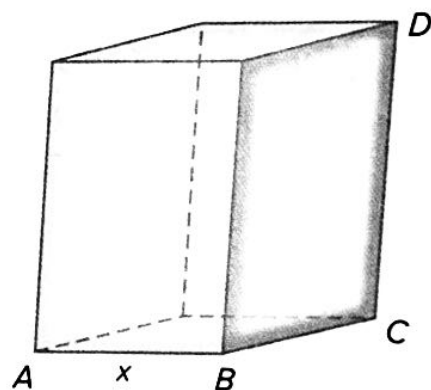
$$49. \frac{\frac{8x^2 - 10x - 3}{10x^2 + 35x - 20}}{\frac{2x^2 + x - 6}{4x^2 + 18x + 8}}$$

$$50. \frac{\frac{2x^2 + 7x - 30}{-6x^2 + 13x + 5}}{\frac{4x^2 + 12x - 72}{3x^2 - 11x - 4}}$$

$$51. \frac{\frac{4x^2 - 1}{3x^3 - 6x^2 - 24x}}{\frac{12x^2 + 12x - 9}{-2x^2 + 5x + 12}}$$

52. **GEOMETRY** The area of the base of the rectangular prism at the right is 20 square centimeters.

- Find the length of $\overline{BC}$ in terms of x .
- If $DC = 3BC$, determine the area of the shaded region in terms of x .
- Determine the volume of the prism in terms of x .



Simplify each expression.

$$53. \frac{x^2 + 4x - 32}{2x^2 + 9x - 5} \cdot \frac{3x^2 - 75}{3x^2 - 11x - 4} \div \frac{6x^2 - 18x - 60}{x^3 - 4x}$$

$$54. \frac{8x^2 + 10x - 3}{3x^2 - 12x - 36} \div \frac{2x^2 - 5x - 12}{3x^2 - 17x - 6} \cdot \frac{4x^2 + 3x - 1}{4x^2 - 40x + 24}$$

$$55. \frac{4x^2 - 9x - 9}{3x^2 + 6x - 18} \div \frac{-2x^2 + 5x + 3}{x^2 - 4x - 32} \div \frac{8x^2 + 10x + 3}{6x^2 - 6x - 12}$$

Find the LCM of each set of polynomials.

18. $24cd, 40a^2c^3d^4, 15abd^3$

20. $x^2 - 9x + 20, x^2 + x - 30$

19. $4x^2y^3, 18xy^4, 10xz^2$

21. $6x^2 + 21x - 12, 4x^2 + 22x + 24$

3 **MP PERSEVERANCE** Simplify each expression.

22. $\frac{5a}{24cf^4} + \frac{a}{36bc^4f^3}$

24. $\frac{5b}{6a} + \frac{3b}{10a^2} + \frac{2}{ab^2}$

26. $\frac{8}{3y} + \frac{2}{9} - \frac{3}{10y^2}$

28. $\frac{8}{x^2 - 6x - 16} + \frac{9}{x^2 - 3x - 40}$

30. $\frac{12}{3y^2 - 10y - 8} - \frac{3}{y^2 - 6y + 8}$

32. $\frac{2x}{4x^2 + 9x + 2} + \frac{3}{2x^2 - 8x - 24}$

23. $\frac{4b}{15x^3y^2} - \frac{3b}{35x^2y^4z}$

25. $\frac{4}{3x} + \frac{8}{x^3} + \frac{2}{5xy}$

27. $\frac{1}{16a} + \frac{5}{12b} - \frac{9}{10b^3}$

29. $\frac{6}{y^2 - 2y - 35} + \frac{4}{y^2 + 9y + 20}$

31. $\frac{6}{2x^2 + 11x - 6} - \frac{8}{x^2 + 3x - 18}$

33. $\frac{4x}{3x^2 + 3x - 18} - \frac{2x}{2x^2 + 11x + 15}$

34. ... something, the pH or acid level A of his or her mouth