b. $\sqrt[3]{-40x^4y^{13}} = \sqrt[3]{-8x^3y^{12}} \cdot \sqrt[3]{5xy} = -2xy^4\sqrt[3]{5xy}$

8 is a perfect cube and the exponents on the variables are separated so that one exponent on each variable is divisible by 3.

c. $\sqrt[3]{250a^8b^{11}} = \sqrt[3]{125a^6b^9} \cdot \sqrt[3]{2a^2b^2} = 5a^2b^3\sqrt[3]{2a^2b^2}$

125 is a perfect cube and the exponents on the variables are separated so that one exponent on each variable is divisible by 3.

Now work margin exercise 4.

Margin Exercise Answers

1. a. $7\sqrt{2}$ **b.** $3\sqrt{5}$ **c.** $\frac{2\sqrt{3}}{5}$ **2. a.** $6z$ **b.** $5b\sqrt{3}$ **c.** $3cd\sqrt{5}$ **3. a.** $4x^4$ **b.** $10xy\sqrt{xy}$ **c.** $2x^4y^6\sqrt{3}$ **d.** $\frac{5z^9}{y^4}$ **4. a.** $2z\sqrt[3]{6}$ **b.** $-3a^2b^4\sqrt[3]{3a^2}$ **c.** $7x^2y^3\sqrt[3]{2y^2}$

13.2 Exercises

Concept Check

Fill-in-the-Blank. Complete each sentence using information found in this section.

1. A cube root is considered in simplest form when the radicand has no perfect cube as a/an _____.
2. When simplifying with cube roots, look for variables with exponents that are multiples of ___.
3. To find the square root of an expression with even exponents, divide the exponents by ___.
4. A square root is in simplest form when the radicand has no _____ _____ as a factor.
5. If a and b are positive real numbers, then $\sqrt{ab} =$ ____.
6. If a and b are positive real numbers, then $\sqrt{\frac{a}{b}} =$ ____.

True/False. Determine whether each statement is true or false. If a statement is false, explain how it can be changed so the statement will be true. (**Note:** There may be more than one acceptable change.)

7. Any variable term with an exponent of 5 has a perfect cube factor within that variable term.
8. The simplest form of a radical expression can be found by using prime factorization.
9. If x is a real number, then $\sqrt{x^2} = x$.
10. The term $7b\sqrt[3]{6c^2}$ is in simplified form.

Practice

Simplify each of the following radical expressions. Assume that all variables represent positive real numbers.

1. $\sqrt{12}$
2. $-\sqrt{45}$
3. $\sqrt{288}$
4. $-\sqrt{63}$
5. $-\sqrt{72}$
6. $\sqrt{98}$
7. $-\sqrt{56}$
8. $\sqrt{162}$
9. $-\sqrt{125}$
10. $-\sqrt{121}$
11. $\sqrt{\frac{1}{4}}$
12. $\sqrt{\frac{32}{49}}$
13. $-\sqrt{\frac{11}{64}}$
14. $-\sqrt{\frac{125}{100}}$
15. $\sqrt{\frac{28}{25}}$
16. $\sqrt{\frac{147}{100}}$
17. $\sqrt{36x^2}$
18. $\sqrt{49y^2}$
19. $\sqrt{8x^3}$
20. $\sqrt{18a^5}$
21. $\sqrt{24x^{11}y^2}$
22. $\sqrt{20x^{15}y^3}$
23. $\sqrt{125x^3y^6}$
24. $\sqrt{8x^5y^4}$
25. $-\sqrt{18x^2y^2}$
26. $-\sqrt{32x^4y^8}$
27. $\sqrt{12ab^2c^3}$
28. $\sqrt{45a^2b^3c^4}$
29. $\sqrt{75x^4y^6z^8}$
30. $\sqrt{200x^2y^2z^2}$
31. $\sqrt{\frac{5x^4}{9}}$
32. $-\sqrt{\frac{7y^6}{16x^4}}$
33. $\sqrt{\frac{32a^5}{81b^{16}}}$
34. $\sqrt{\frac{75x^8}{121y^{12}}}$
35. $\sqrt{\frac{200x^8}{289}}$
36. $\sqrt{\frac{32x^{15}y^{10}}{169}}$
37. $\sqrt[3]{216}$
38. $\sqrt[3]{1}$
39. $\sqrt[3]{56}$
40. $\sqrt[3]{72}$
41. $\sqrt[3]{-1}$
42. $\sqrt[3]{-125}$
43. $\sqrt[3]{-128}$
44. $\sqrt[3]{-250}$
45. $\sqrt[3]{125x^4}$
46. $\sqrt[3]{64a^{12}}$
47. $\sqrt[3]{-8x^8}$
48. $\sqrt[3]{-512a^5}$
49. $\sqrt[3]{72a^6b^4}$
50. $\sqrt[3]{108ab^9}$
51. $\sqrt[3]{216x^6y^5}$
52. $\sqrt[3]{64x^9y^2}$
53. $\sqrt[3]{24x^5y^7z^9}$
54. $\sqrt[3]{250x^6y^9z^{15}}$
55. $\frac{\sqrt[3]{81}}{6}$
56. $\frac{\sqrt[3]{192}}{10}$
57. $\sqrt[3]{\frac{375}{8}}$
58. $\sqrt[3]{\frac{-48}{125}}$
59. $\sqrt[3]{\frac{125y^{12}}{27x^6}}$
60. $\sqrt[3]{\frac{x^6z^3}{64y^9}}$

Applications

Use the following two formulas associated with electricity to answer Exercises 61–64.

$I = \sqrt{\frac{P}{R}}$

$E = \sqrt{PR}$

P = power (in watts)
I = current (in amperes)
E = voltage (in volts)
R = resistance (in ohms, Ω)

61. What is the current in amperes of a light bulb that produces 150 watts of power and has a 25 Ω resistance?

62. If a light bulb has a resistance of 30 Ω and produces 90 watts of power, what is its current in amperes?

63. How many volts of electricity would Meghan need to produce 48 Ω of resistance from a 300 watt lamp?

64. A 5000 Ω resistor is rated at 2.5 watts. What is the maximum voltage of electricity that should be connected across it?

65. A nut company is determining how to package their new type of party mix. The marketing department is experimenting with different-sized cans for the party mix packaging. The designers use the equation $r = \sqrt{\frac{V}{h\pi}}$ to determine the radius of the can for a certain height h and volume V. The company decides they want the can to have a volume of 1200π cm^3. Keep your answers in simplified radical form.

a. Find the radius of the can if the height is 12 cm.

b. Find the radius of the can if the height is 10 cm.

c. Find the radius of the can if the height is 8 cm.

Writing & Thinking

66. Under what conditions is the expression $\sqrt{a}$ not a real number?

67. Explain why the expression $\sqrt[3]{y}$ is a real number regardless of whether $y > 0$, $y < 0$, or $y = 0$.