

pg. 371 # 3-33 x3 pg. 376 # 4-44 x4 & 52

$$\begin{aligned} 3. \quad & \sqrt[3]{9} \cdot \sqrt[3]{-81} \\ & = \sqrt[3]{-729} \\ & = -9 \end{aligned}$$

$$\begin{aligned} 9. \quad & \sqrt{20x^3} \\ & \sqrt{4} = 2 \quad \begin{array}{l} 2^1 \cdot 10 \\ 2^1 \cdot 5 \end{array} \quad \begin{array}{l} \text{XX} \\ X \end{array} \quad \sqrt{x^2} = x \end{aligned}$$

$$2x\sqrt{5x}$$

$$\begin{aligned} 10. \quad & \sqrt{8y^5} \cdot \sqrt{40y^2} \\ & = \sqrt{320y^7} \\ & \sqrt{16} = 4 \quad \begin{array}{l} 16^1 \cdot 20 \\ \sqrt{4} = 2 \quad 4^1 \cdot 5 \end{array} \quad \begin{array}{l} yy \\ yy \\ yy \\ y \end{array} \quad \sqrt{y^2} = y \end{aligned}$$

$$= 4 \cdot 2 \cdot y^3 \sqrt{5y}$$

$$= 8y^3 \sqrt{5y}$$

$$24. \quad \frac{\sqrt{48x^3}}{\sqrt{3xy^2}} = \sqrt{\frac{48x^3}{3xy^2}} = \sqrt{\frac{16x^2}{y^2}} = \frac{4x}{y}$$

$$27. \quad \frac{\sqrt{x}}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2x}}{\sqrt{4}} = \frac{\sqrt{2x}}{2}$$

$$4. \quad 3\sqrt{x} - 5\sqrt{x} = -2\sqrt{x}$$

like radicals.

subtract "coefficients"

$$8. \frac{14\sqrt{20}}{\sqrt{4}\sqrt{5}} - \frac{3\sqrt{125}}{\sqrt{25}\sqrt{5}}$$

$$= 14 \cdot 2 \cdot \sqrt{5} - 3 \cdot 5 \cdot \sqrt{5}$$

$$= 28\sqrt{5} - 15\sqrt{5}$$

$$= 13\sqrt{5}$$

$$16. (\sqrt{3} + \sqrt{5})^2 \quad \text{P}\square\text{T} \quad a^2 + 2ab + b^2$$

$$= (\sqrt{3})^2 + 2(\sqrt{3} \cdot \sqrt{5}) + (\sqrt{5})^2$$

$$= 3 + 2\sqrt{15} + 5$$

$$= 8 + 2\sqrt{15}$$

$$20. (4 - 2\sqrt{3})(4 + 2\sqrt{3}) \quad \text{D}\square\text{ } a^2 - b^2$$

$$= 4^2 - (2\sqrt{3})^2$$

$$= 4^2 - 2^2(\sqrt{3})^2$$

$$= 16 - 4 \cdot 3$$

$$= 16 - 12$$

$$= 4$$

$$24. \frac{4}{(-2 + 3\sqrt{3})} \cdot \frac{(-2 - 3\sqrt{3})}{(-2 - 3\sqrt{3})} = \frac{-8 - 12\sqrt{3}}{4 - 9 \cdot 3} = \frac{-8 - 12\sqrt{3}}{4 - 27}$$

$$= \frac{-8 - 12\sqrt{3}}{-23}$$

$$\text{or} = \frac{8 + 12\sqrt{3}}{23}$$

$$28. \frac{\sqrt{75}}{\sqrt{25}\sqrt{3}} + \frac{2\sqrt{48}}{\sqrt{16}\sqrt{3}} - 5\sqrt{3}$$

$$5\sqrt{3} + 2 \cdot 4\sqrt{3} - 5\sqrt{3}$$

$$5\sqrt{3} + 8\sqrt{3} - 5\sqrt{3}$$

$$= 8\sqrt{3}$$

$$52. \frac{4}{\sqrt{5}-\sqrt{3}} - \frac{4}{\sqrt{5}+\sqrt{3}}$$

get common denominator

$$\frac{4}{\sqrt{5}-\sqrt{3}} \cdot \frac{(\sqrt{5}+\sqrt{3})}{(\sqrt{5}+\sqrt{3})} - \frac{4}{\sqrt{5}+\sqrt{3}} \cdot \frac{(\sqrt{5}-\sqrt{3})}{(\sqrt{5}-\sqrt{3})} \quad \text{woohoo! conjugates!}$$

$$\frac{\cancel{4}\sqrt{5} + 4\sqrt{3} - \cancel{4}\sqrt{5} + 4\sqrt{3}}{5-3} = \frac{8\sqrt{3}}{2} = 4\sqrt{3}$$

- | | | |
|---|-------------------------------------|----------------------------------|
| 1. 16 | 2. 4 | 3. -9 |
| 4. 4 | 5. not possible | 6. not possible 5 |
| 7. -6 | 8. 6 | 9. $2x/\sqrt{5x}$ |
| 10. $3\sqrt[3]{3x^2}$ | 11. $5x^2\sqrt{2x}$ | 12. $2a\sqrt[3]{4a^2}$ |
| 13. $3y^3\sqrt[3]{2y}$ | 14. $10a^3b^3\sqrt{2b}$ | 15. $-5x^2y\sqrt[3]{2y^2}$ |
| 16. $2y\sqrt[4]{4x^3y^2}$ | 17. $2\sqrt[3]{12}$ | 18. $8y^3\sqrt{5y}$ |
| 19. $7x^3y^4\sqrt{6y}$ | 20. $40xy\sqrt{3}$ | 21. $30y^2\sqrt[3]{2y}$ |
| 22. $-2x^2y\sqrt[3]{30x}$ | 23. 10 | 24. $\frac{4x}{y}$ |
| 25. $2x^2y^2\sqrt{2}$ | 26. $5x\sqrt[3]{x^2y^2}$ | 27. $\frac{\sqrt{2x}}{2}$ |
| 28. $\frac{\sqrt{10x}}{4x}$ | 29. $\frac{\sqrt[3]{4x}}{2}$ | 30. $\frac{\sqrt[3]{45x^2}}{3x}$ |
| 31. $\frac{\sqrt[4]{250}}{5}$ | 32. $5x^2\sqrt{5}$ | 33. $\frac{\sqrt{15y}}{5y}$ |
| 34. $\frac{x\sqrt{10}}{2y}$ | 35. $r = \frac{\sqrt{Gm_1m_2F}}{F}$ | |
| 36. a. $\frac{\sqrt{6} + 3}{15}$ | | |
| b. $\frac{\sqrt{6} + 3}{15}$ | | |
| c. Answers may vary. Sample: First simplify the denominator. Since $\sqrt{98} = \sqrt{2 \cdot 49} = 7\sqrt{2}$, to rationalize the denominator, multiply the fraction by $\frac{\sqrt{2}}{\sqrt{2}}$. This yields $\frac{\sqrt{2} \cdot 2 + \sqrt{3} \cdot 2}{7\sqrt{2} \cdot 2} = \frac{2 + \sqrt{6}}{14}$. | | |
| 37. $10\sqrt{2}$ | 38. $4\sqrt[3]{5}$ | 39. $3x^6y^5\sqrt{2y}$ |
| 40. $20x^2y^3\sqrt{y}$ | 41. $10 + 7\sqrt{2}$ | 42. $15 + 3\sqrt{21}$ |
| 43. $5 + 5\sqrt{3}$ | 44. $2x\sqrt[3]{2}$ | 45. $3x^2\sqrt[3]{x}$ |

Exercises pp. 376-378

- $5\sqrt{6} + \sqrt{6} = (5+1)\sqrt{6} = 6\sqrt{6}$
- $6\sqrt[3]{3} - 2\sqrt[3]{3} = (6-2)\sqrt[3]{3} = 4\sqrt[3]{3}$
- $4\sqrt{3} + 4\sqrt[3]{3}$; cannot combine
- $3\sqrt{x} - 5\sqrt{x} = (-2)\sqrt{x}$
- $14\sqrt{x} + 3\sqrt{y}$; cannot combine
- $7\sqrt[3]{x^2} - 2\sqrt[3]{x^2} = (7-2)\sqrt[3]{x^2} = 5\sqrt[3]{x^2}$
- $6\sqrt{18} + 3\sqrt{50} = 6\sqrt{3^2 \cdot 2} + 3\sqrt{5^2 \cdot 2} = 18\sqrt{2} + 15\sqrt{2} = (18+15)\sqrt{2} = 33\sqrt{2}$
- $14\sqrt{20} - 3\sqrt{125} = 14\sqrt{2^2 \cdot 5} - 3\sqrt{5^2 \cdot 5} = 28\sqrt{5} - 15\sqrt{5} = (28-15)\sqrt{5} = 13\sqrt{5}$
- $\sqrt{18} + \sqrt{32} = \sqrt{3^2 \cdot 2} + \sqrt{4^2 \cdot 2} = 3\sqrt{2} + 4\sqrt{2} = (3+4)\sqrt{2} = 7\sqrt{2}$
- $\sqrt[3]{54} + \sqrt[3]{16} = \sqrt[3]{3^3 \cdot 2} + \sqrt[3]{2^3 \cdot 2} = 3\sqrt[3]{2} + 2\sqrt[3]{2} = (3+2)\sqrt[3]{2} = 5\sqrt[3]{2}$
- $3\sqrt[3]{81} - 2\sqrt[3]{54} = 3\sqrt[3]{3^3 \cdot 3} - 2\sqrt[3]{3^3 \cdot 2} = 9\sqrt[3]{3} - 6\sqrt[3]{2}$
- $\sqrt[4]{32} + \sqrt[4]{48} = \sqrt[4]{2^4 \cdot 2} + \sqrt[4]{2^4 \cdot 3} = 2\sqrt[4]{2} + 2\sqrt[4]{3}$
- $(3 + \sqrt{5})(1 + \sqrt{5}) = 3 + 3\sqrt{5} + 1\sqrt{5} + 5 = 8 + 4\sqrt{5}$
- $(2 + \sqrt{7})(1 + 3\sqrt{7}) = 2 + 6\sqrt{7} + 1\sqrt{7} + 21 = 23 + 7\sqrt{7}$
- $(3 - 4\sqrt{2})(5 - 6\sqrt{2}) = 15 - 18\sqrt{2} - 20\sqrt{2} + 48 = 63 - 38\sqrt{2}$
- $(\sqrt{3} + \sqrt{5})^2 = (\sqrt{3} + \sqrt{5})(\sqrt{3} + \sqrt{5}) = 3 + 2\sqrt{15} + 5 = 8 + 2\sqrt{15}$
- $(\sqrt{13} + 6)^2 = (\sqrt{13} + 6)(\sqrt{13} + 6) = 13 + 12\sqrt{13} + 36 = 49 + 12\sqrt{13}$
- $(2\sqrt{5} + 3\sqrt{2})^2 = (2\sqrt{5} + 3\sqrt{2})(2\sqrt{5} + 3\sqrt{2}) = 20 + 12\sqrt{10} + 18 = 38 + 12\sqrt{10}$
- $(5 - \sqrt{11})(5 + \sqrt{11}) = 25 - 11 = 14$
- $(4 - 2\sqrt{3})(4 + 2\sqrt{3}) = 16 - 12 = 4$
- $(2\sqrt{6} + 8)(2\sqrt{6} - 8) = 24 - 64 = -40$
- $(\sqrt{3} + \sqrt{5})(\sqrt{3} - \sqrt{5}) = 3 - 5 = -2$

Chapter 7, page 195

7.3

4. $-2\sqrt{x}$
 8. $13\sqrt{5}$
 12. $2\sqrt[4]{2} + 2\sqrt[4]{3}$
 16. $8 + 2\sqrt{15}$
 20. 4
 24. $\frac{12\sqrt{3} + 8}{23}$
 28. $8\sqrt{3}$
 32. $-2\sqrt[3]{2}$
 36. $-36 - 15\sqrt{2}$
 40. $2\sqrt{3} - \sqrt{2}$
 44. $2\sqrt[3]{2} - \sqrt[3]{12}$
 52. $4\sqrt{3}$

23. $\frac{4}{1+\sqrt{3}} \cdot \frac{1-\sqrt{3}}{1-\sqrt{3}} = \frac{4-4\sqrt{3}}{1-3} = \frac{4-4\sqrt{3}}{-2} = -2 + 2\sqrt{3}$

24. $\frac{4}{3\sqrt{3}-2} \cdot \frac{3\sqrt{3}+2}{3\sqrt{3}+2} = \frac{12\sqrt{3}+8}{27-4} = \frac{12\sqrt{3}+8}{23}$

25. $\frac{5+\sqrt{3}}{2-\sqrt{3}} \cdot \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{10+7\sqrt{3}+3}{4-3} = 13+7\sqrt{3}$

26. $\frac{3+\sqrt{8}}{2-2\sqrt{8}} \cdot \frac{2+2\sqrt{8}}{2+2\sqrt{8}} = \frac{6+8\sqrt{8}+16}{4-32} = \frac{22+8\sqrt{8}}{-28} = \frac{22+16\sqrt{2}}{-28} = \frac{11+8\sqrt{2}}{-14}$

27. $\sqrt{72} + \sqrt{32} + \sqrt{18} = 6\sqrt{2} + 4\sqrt{2} + 3\sqrt{2} = (6+4+3)\sqrt{2} = 13\sqrt{2}$

28. $\sqrt{75} + 2\sqrt{48} - 5\sqrt{3} = 5\sqrt{3} + 8\sqrt{3} - 5\sqrt{3} = 8\sqrt{3}$

29. $5\sqrt{32x} + 4\sqrt{98x} = 20\sqrt{2x} + 28\sqrt{2x} = (20+28)\sqrt{2x} = 48\sqrt{2x}$

30. $\sqrt{75} - 4\sqrt{18} + 2\sqrt{32} = 5\sqrt{3} - 12\sqrt{2} + 8\sqrt{2} = 5\sqrt{3} + (-12+8)\sqrt{2} = 5\sqrt{3} - 4\sqrt{2}$

31. $4\sqrt{216y^2} + 3\sqrt{54y^2} = 4(6y)\sqrt{6} + 3(3y)\sqrt{6} = 24y\sqrt{6} + 9y\sqrt{6} = (24y+9y)\sqrt{6} = 33y\sqrt{6}$

32. $3\sqrt[3]{16} - 4\sqrt[3]{54} + \sqrt[3]{128} = 3(2)\sqrt[3]{2} - 4(3)\sqrt[3]{2} + 8\sqrt[3]{2} = (6-12+8)\sqrt[3]{2} = 2\sqrt[3]{2}$

33. $(\sqrt{3} - \sqrt{7})(\sqrt{3} + 2\sqrt{7}) = 3 + 2\sqrt{21} - \sqrt{21} - 14 = -11 + \sqrt{21}$

34. $(2\sqrt{5} + 3\sqrt{2})(5\sqrt{5} - 7\sqrt{2}) = 50 - 14\sqrt{10} + 15\sqrt{10} - 42 = 8 + \sqrt{10}$

35. $(1 + \sqrt{72})(5 + \sqrt{2}) = 5 + \sqrt{2} + 5\sqrt{72} + \sqrt{144} = 5 + \sqrt{2} + 30\sqrt{2} + 12 = 17 + 31\sqrt{2}$

36. $(2 - \sqrt{98})(3 + \sqrt{18}) = 6 + 2\sqrt{18} - 3\sqrt{98} - \sqrt{1764} = 6 + 6\sqrt{2} - 21\sqrt{2} - 42 = -36 - 15\sqrt{2}$

37. $(\sqrt{x} + \sqrt{3})(\sqrt{x} + 2\sqrt{3}) = x + 2\sqrt{3x} + \sqrt{3x} + 6 = x + 3\sqrt{3x} + 6$

38. $(2\sqrt{y} - 3\sqrt{2})(4\sqrt{y} - 5\sqrt{2}) = 8y - 10\sqrt{2y} - 12\sqrt{2y} + 30 = 8y - 22\sqrt{2y} + 30$

39. $\frac{4 + \sqrt{27}}{2 - 3\sqrt{27}} = \frac{4 + 3\sqrt{3}}{2 - 9\sqrt{3}} \cdot \frac{2 + 9\sqrt{3}}{2 + 9\sqrt{3}} = \frac{8 + 36\sqrt{3} + 6\sqrt{3} + 81}{4 - 243} = \frac{89 + 42\sqrt{3}}{-239}$

40. $\frac{4 + \sqrt{6}}{\sqrt{2} + \sqrt{3}} \cdot \frac{\sqrt{2} - \sqrt{3}}{\sqrt{2} - \sqrt{3}} = \frac{4\sqrt{2} - 4\sqrt{3} + \sqrt{12} - \sqrt{18}}{2 - 3} = \frac{4\sqrt{2} - 4\sqrt{3} + 2\sqrt{3} - 3\sqrt{2}}{-1} = \frac{-2\sqrt{3} + \sqrt{2}}{-1} = 2\sqrt{3} - \sqrt{2}$

41. $\frac{5 - \sqrt{21}}{\sqrt{3} - \sqrt{7}} \cdot \frac{\sqrt{3} + \sqrt{7}}{\sqrt{3} + \sqrt{7}} = \frac{5\sqrt{3} + 5\sqrt{7} - \sqrt{63} - \sqrt{147}}{3 - 7} = \frac{5\sqrt{3} + 5\sqrt{7} - 3\sqrt{7} - 7\sqrt{3}}{-4} = \frac{-2\sqrt{3} + 4\sqrt{7}}{-4} = \frac{\sqrt{3} - \sqrt{7}}{2}$

42. $\frac{3 + \sqrt[3]{2}}{\sqrt[3]{2}} \cdot \frac{\sqrt[3]{2}}{\sqrt[3]{2}} = \frac{3\sqrt[3]{4} + 2}{2} = \frac{2 + 3\sqrt[3]{4}}{2}$

43. $\frac{5 + \sqrt[4]{x}}{\sqrt[4]{x}} \cdot \frac{\sqrt[4]{x^3}}{\sqrt[4]{x^3}} = \frac{5\sqrt[4]{x^3} + x}{x} = \frac{x + 5\sqrt[4]{x^3}}{x}$

44. $\frac{4 - 2\sqrt[3]{6}}{\sqrt[3]{4}} \cdot \frac{\sqrt[3]{4^2}}{\sqrt[3]{4^2}} = \frac{4\sqrt[3]{16} - 2\sqrt[3]{96}}{4} = \frac{8\sqrt[3]{2} - 4\sqrt[3]{12}}{4} = 2\sqrt[3]{2} - \sqrt[3]{12}$