

$$10. \left(\frac{3}{4}\right)^8 \div \left(\frac{3}{4}\right)^5 = \left(\frac{3}{4}\right)^{8-5} \\ = \left(\frac{3}{4}\right)^3$$

$$11. b^5c^8 \div b^3c^2 = \frac{b^5c^8}{b^3c^2} \\ = \frac{b^5}{b^3} \cdot \frac{c^8}{c^2} \\ = b^{5-3}c^{8-2} \\ = b^2c^6$$

$$12. 72x^9y^7 \div 8x^3y^5 = \frac{72x^9y^7}{8x^3y^5} \\ = \frac{72}{8} \cdot \frac{x^9}{x^3} \cdot \frac{y^7}{y^5} \\ = 9x^{9-3}y^{7-5} \\ = 9x^6y^2$$

$$13. \frac{8^9 \cdot 8^2 \cdot 8^6}{8^4 \cdot 8^2 \cdot 8^3} = \frac{8^{9+2+6}}{8^{4+2+3}} \\ = \frac{8^{17}}{8^9} \\ = 8^{17-9} \\ = 8^8$$

$$14. \frac{\left(\frac{2}{3}\right)^7 \cdot \left(\frac{2}{3}\right)^3 \cdot \left(\frac{2}{3}\right)^9}{\left(\frac{2}{3}\right)^2 \cdot \left(\frac{2}{3}\right) \cdot \left(\frac{2}{3}\right)^4} = \frac{\left(\frac{2}{3}\right)^{7+3+9}}{\left(\frac{2}{3}\right)^{2+1+4}} \\ = \frac{\left(\frac{2}{3}\right)^{19}}{\left(\frac{2}{3}\right)^7} \\ = \left(\frac{2}{3}\right)^{19-7} \\ = \left(\frac{2}{3}\right)^{12}$$

$$15. \frac{y^3 \cdot y^8 \cdot y^6}{y^4 \cdot y^2 \cdot y^2} = \frac{y^{3+8+6}}{y^{4+2+2}} \\ = \frac{y^{17}}{y^8} \\ = y^{17-8} \\ = y^9$$

$$16. \frac{5a^5 \cdot 7b^4 \cdot 2b^3}{b^2 \cdot 5b^2 \cdot 2a^4} = \frac{5 \cdot 7 \cdot 2 \cdot a^5 \cdot b^4 \cdot b^3}{5 \cdot 2 \cdot b^2 \cdot b^2 \cdot a^4} \\ = \frac{70a^5b^{4+3}}{10b^{2+2}a^4} \\ = \frac{7a^5b^7}{b^4a^4} \\ = 7(a^{5-4})(b^{7-4}) \\ = 7ab^3$$

$$17. \text{ a) Volume of cube A} \\ = 100,000 \cdot 100,000 \cdot 100,000 \\ = 10^5 \cdot 10^5 \cdot 10^5 \\ = 10^{5+5+5} \\ = 10^{15} \text{ mm}^3$$

The volume of cube A is 10^{15} cubic millimeters.

$$\text{ b) } \frac{\text{Volume of cube B}}{\text{Volume of cube A}} = \frac{10^8 \cdot 10^8 \cdot 10^8}{10^{15}} \\ = \frac{10^{8+8+8}}{10^{15}} \\ = \frac{10^{24}}{10^{15}} \\ = 10^{24-15} \\ = 10^9$$

The volume of cube B is 10^9 times greater than that of cube A.

$$18. \text{ Volume of rectangular container} \\ = 15p \cdot 12p \cdot 6p \\ = 1,080p^3 \text{ m}^3$$

$$\text{Volume of each cube} = 2p \cdot 2p \cdot 2p \\ = 8p^3 \text{ m}^3$$

$$\text{Number of cubes that can be packed into} \\ \text{the container} = \frac{1,080p^3}{8p^3} \\ = 135$$

135 cubes can be packed into the rectangular container.

Lesson 1.3

$$1. (6^5)^3 = 6^{5 \cdot 3} \\ = 6^{15}$$

$$2. (9^6)^4 = 9^{6 \cdot 4} \\ = 9^{24}$$

$$3. (34^8)^2 = 34^{8 \cdot 2} \\ = 34^{16}$$

$$4. (18^6)^7 = 18^{6 \cdot 7} \\ = 18^{42}$$

$$5. (p^5)^4 = p^{5 \cdot 4} \\ = p^{20}$$

$$6. \left[\left(\frac{6}{7}\right)^{6^3}\right]^3 = \left(\frac{6}{7}\right)^{6 \cdot 3} \\ = \left(\frac{6}{7}\right)^{18}$$

$$7. [(4b)^4]^4 = (4b)^{4 \cdot 4} \\ = (4b)^{16}$$

$$8. [(28x)^7]^2 = (28x)^{7 \cdot 2} \\ = (28x)^{14}$$

$$9. [(-22)^5]^7 = (-22)^{5 \cdot 7} \\ = (-22)^{35}$$

$$10. [(-2q)^4]^2 = (-2q)^{4 \cdot 2} \\ = (-2q)^8$$

$$11. (2^5 \cdot 2^3)^2 = (2^{5+3})^2 \\ = (2^8)^2 \\ = 2^{8 \cdot 2} \\ = 2^{16}$$

$$12. (q^7 \cdot q)^4 = (q^{7+1})^4 \\ = (q^8)^4 \\ = q^{8 \cdot 4} \\ = q^{32}$$

$$13. \left[\left(\frac{5}{6} \right)^3 \cdot \left(\frac{5}{6} \right)^2 \right]^3 = \left[\left(\frac{5}{6} \right)^{3+2} \right]^3 \\ = \left[\left(\frac{5}{6} \right)^5 \right]^3 \\ = \left(\frac{5}{6} \right)^{5 \cdot 3} \\ = \left(\frac{5}{6} \right)^{15}$$

$$14. \left[\left(-\frac{9}{10} \right)^4 \cdot \left(-\frac{9}{10} \right)^8 \right]^2 = \left[\left(-\frac{9}{10} \right)^{4+8} \right]^2 \\ = \left[\left(-\frac{9}{10} \right)^{12} \right]^2 \\ = \left(-\frac{9}{10} \right)^{12 \cdot 2} \\ = \left(-\frac{9}{10} \right)^{24}$$

$$15. (2^3 \cdot 2^6)^4 \div 2^8 = (2^{3+6})^4 \div 2^8 \\ = (2^9)^4 \div 2^8 \\ = 2^{9 \cdot 4} \div 2^8 \\ = 2^{36} \div 2^8 \\ = 2^{36-8} \\ = 2^{28}$$

$$16. (11^6 \cdot 11^6)^2 \div 11^9 = (11^{6+6})^2 \div 11^9 \\ = (11^{12})^2 \div 11^9 \\ = 11^{12 \cdot 2} \div 11^9 \\ = 11^{24} \div 11^9 \\ = 11^{24-9} \\ = 11^{15}$$

$$17. (q^7 \cdot q^3)^4 \div q^5 = (q^{7+3})^4 \div q^5 \\ = (q^{10})^4 \div q^5 \\ = q^{10 \cdot 4} \div q^5 \\ = q^{40} \div q^5 \\ = q^{40-5} \\ = q^{35}$$

$$18. (y^9 \cdot y)^3 \div y^{13} = (y^{9+1})^3 \div y^{13} \\ = (y^{10})^3 \div y^{13} \\ = y^{10 \cdot 3} \div y^{13} \\ = y^{30} \div y^{13} \\ = y^{30-13} \\ = y^{17}$$

$$19. \frac{(3^3 \cdot 3^5)^4}{(3^8)^2} = \frac{(3^{3+5})^4}{3^{8 \cdot 2}} \\ = \frac{(3^8)^4}{3^{16}} \\ = \frac{3^{8 \cdot 4}}{3^{16}} \\ = \frac{3^{32}}{3^{16}} \\ = 3^{32-16} \\ = 3^{16}$$

$$20. \frac{(w^9 \cdot w^5)^4}{(w^2)^{11}} = \frac{(w^{9+5})^4}{w^{2 \cdot 11}} \\ = \frac{(w^{14})^4}{w^{22}} \\ = \frac{w^{14 \cdot 4}}{w^{22}} \\ = \frac{w^{56}}{w^{22}} \\ = w^{56-22} \\ = w^{34}$$

$$21. (u^3 \cdot u^6)^4 \div 8u^2 = (u^{3+6})^4 \div 8u^2 \\ = (u^9)^4 \div 8u^2 \\ = u^{9 \cdot 4} \div 8u^2 \\ = \frac{u^{36}}{8u^2} \\ = \frac{u^{36-2}}{8} \\ = \frac{u^{34}}{8}$$

$$22. (p^2 \cdot p^5)^9 \div 7p^3 = (p^{2+5})^9 \div 7p^3 \\ = (p^7)^9 \div 7p^3 \\ = p^{7 \cdot 9} \div 7p^3 \\ = \frac{p^{63}}{7p^3} \\ = \frac{p^{63-3}}{7} \\ = \frac{p^{60}}{7}$$

$$\begin{aligned}
23. \quad \frac{\left(\frac{3}{7}\right)^5 \cdot \left(\frac{9}{7}\right)^2}{\left(\frac{3^4}{7^3}\right)^2} &= \frac{\left(\frac{3}{7}\right)^5 \cdot \left(\frac{3^2}{7}\right)^2}{\left(\frac{3^{4 \cdot 2}}{7^{3 \cdot 2}}\right)} \\
&= \frac{\left(\frac{3}{7}\right)^5 \cdot \left(\frac{3^{2 \cdot 2}}{7^2}\right)}{\frac{3^8}{7^6}} \\
&= \frac{\left(\frac{3}{7}\right)^5 \cdot \frac{3^4}{7^2}}{\frac{3^8}{7^6}} \\
&= \frac{3^{5+4}}{7^{5+2}} \\
&= \frac{3^9}{7^7} \\
&= \frac{3^8}{7^6} \\
&= \frac{3^{9-8}}{7^{7-6}} \\
&= \frac{3}{7}
\end{aligned}$$

$$\begin{aligned}
24. \quad \frac{\left(\frac{y}{5}\right)^2 \cdot \left(\frac{y^3}{5}\right)^5}{\left(\frac{y^2}{5}\right)^6} &= \frac{\left(\frac{y}{5}\right)^2 \cdot \left(\frac{y^{3 \cdot 5}}{5^5}\right)}{\left(\frac{y^{2 \cdot 6}}{5^{1 \cdot 6}}\right)} \\
&= \frac{\left(\frac{y}{5}\right)^2 \cdot \left(\frac{y^{15}}{5^5}\right)}{\frac{y^{12}}{5^6}} \\
&= \frac{y^2 \cdot y^{15}}{5^2 \cdot 5^5} \\
&= \frac{y^{17}}{5^6} \\
&= \frac{y^{2+15}}{5^{2+5}} \\
&= \frac{y^{17}}{5^6} \\
&= \frac{y^7}{5^6} \\
&= \frac{y^{17-12}}{5^{7-6}} \\
&= \frac{y^5}{5}
\end{aligned}$$

Lesson 1.4

- $7^3 \cdot 4^3 = (7 \cdot 4)^3$
 $= 28^3$
- $8.3^5 \cdot 1.2^5 = (8.3 \cdot 1.2)^5$
 $= 9.96^5$
- $\left(\frac{3}{7}\right)^4 \cdot \left(\frac{1}{2}\right)^4 = \left(\frac{3}{7} \cdot \frac{1}{2}\right)^4$
 $= \left(\frac{3}{14}\right)^4$
- $\left(-\frac{4}{5}\right)^6 \cdot \left(-\frac{2}{3}\right)^6 = \left[\left(-\frac{4}{5}\right) \cdot \left(-\frac{2}{3}\right)\right]^6$
 $= \left(\frac{8}{15}\right)^6$
- $p^8 \cdot w^8 = (p \cdot w)^8$
 $= (pw)^8$
- $(5b)^2 \cdot (3c)^2 = (5b \cdot 3c)^2$
 $= (15bc)^2$
- $(6x)^3 \cdot (1.2y)^3 = (6x \cdot 1.2y)^3$
 $= (7.2xy)^3$
- $w^9 \div v^9 = \left(\frac{w}{v}\right)^9$
- $(5c)^5 \div (2b)^5 = \left(\frac{5c}{2b}\right)^5$
- $(8.2y)^4 \div (2x)^4 = \left(\frac{8.2y}{2x}\right)^4$
 $= \left(\frac{4.1y}{x}\right)^4$
- $21^6 \div 3^6 = \left(\frac{21}{3}\right)^6$
 $= 7^6$
- $1.8^3 \div 0.3^3 = \left(\frac{1.8}{0.3}\right)^3$
 $= 6^3$
- $9.6^5 \div 3^5 = \left(\frac{9.6}{3}\right)^5$
 $= 3.2^5$
- $12^9 \div 21^9 = \left(\frac{12}{21}\right)^9$
 $= \left(\frac{4}{7}\right)^9$
- $(-20)^2 \div (-5)^2 = \left(\frac{-20}{-5}\right)^2$
 $= 4^2$
- $(p^6q^2)^3 = p^{6 \cdot 3}q^{2 \cdot 3}$
 $= p^{18}q^6$