

section 5.2

5.2 LL

$$82-a) x^4 \cdot x^2 = x^{(4+2)} = \underline{x^6}$$

$$82-b) 8^{9x} \cdot 8^3 = \underline{8^{(9x+3)}}$$

$$82-c) 3z^{25} \cdot 5z^8 = 15z^{(25+8)} = \underline{15z^{33}}$$

$$82-d) y \cdot y^3 \cdot y^5 = y^{(1+3+5)} = \underline{y^9}$$

$$84-a) q^{27} \cdot q^{15} = q^{(27+15)} = \underline{q^{42}}$$

$$84-b) 5^x \cdot 5^{4x} = 5^{(x+4x)} = \underline{5^{5x}}$$

$$84-c) 9m^{41} \cdot 7m^{53} = 63m^{(41+53)} = \underline{63m^{94}}$$

$$84-d) c^5 \cdot c^{11} \cdot c^2 = c^{(5+11+2)} = \underline{c^{18}}$$

$$86) n^y \cdot n^2 = \underline{n^{(y+2)}}$$

$$88) x^p \cdot x^q = \underline{x^{(p+q)}}$$

$$90-a) \frac{y^{20}}{y^{10}} = y^{(20-10)} = \underline{y^{10}}$$

$$92-a) \frac{u^{24}}{u^3} = u^{(24-3)} = \underline{u^{19}}$$

$$90-b) \frac{7^{16}}{7^2} = 7^{(16-2)} = \underline{7^{14}}$$

$$92-b) \frac{9^{15}}{9^5} = 9^{(15-5)} = \underline{9^{10}}$$

$$90-c) \frac{t^{10}}{t^{40}} = t^{(10-40)} = t^{-30} = \frac{1}{\underline{t^{30}}}$$

$$92-c) \frac{x}{x^7} = x^{(1-7)} = x^{-6} = \frac{1}{\underline{x^6}}$$

$$90-d) \frac{8^3}{8^5} = 8^{(3-5)} = 8^{-2} = \frac{1}{8^2} = \frac{1}{\underline{64}}$$

$$92-d) \frac{10}{10^3} = 10^{(1-3)} = 10^{-2} = \frac{1}{10^2} = \frac{1}{\underline{100}}$$

$$94-a) 13^0 = \underline{1}$$

$$94-b) k^0 = \underline{1}$$

$$96-a) -15^0 = \underline{-1}$$

$$96-b) = -(15^0) = -(1) = \underline{-1}$$

$$98-a) b^{-4} = \frac{1}{\underline{\underline{b^4}}}$$

$$98-b) 10^{-2} = \frac{1}{10^2} = \frac{1}{\underline{\underline{100}}}$$

$$98-c) \frac{1}{b^{-3}} = \underline{\underline{b^3}}$$

$$98-d) \frac{1}{5^{-2}} = 5^2 = \underline{\underline{25}}$$

$$100-a) a^{-8} = \frac{1}{\underline{\underline{a^8}}}$$

$$100-b) 10^{-2} = \frac{1}{10^2} = \frac{1}{\underline{\underline{100}}}$$

$$100-c) \frac{1}{t^{-9}} = \underline{\underline{t^9}}$$

$$100-d) \frac{1}{10^{-4}} = 10^4 = \underline{\underline{10000}}$$

$$102-a) \left(\frac{3}{10}\right)^{-2} = \left(\frac{10}{3}\right)^2 = \left(\frac{10}{3}\right)\left(\frac{10}{3}\right) = \frac{100}{9}$$

$$102-b) \left(\frac{-2}{8}\right)^{-3} = \left(\frac{-8}{2}\right)^3 = \left(\frac{-8}{2}\right)\left(\frac{-8}{2}\right)\left(\frac{-8}{2}\right) = \frac{-8^3}{8}$$

$$104-a) \left(\frac{7}{2}\right)^{-3} = \left(\frac{2}{7}\right)^3 = \left(\frac{2}{7}\right)\left(\frac{2}{7}\right)\left(\frac{2}{7}\right) = \frac{8}{343}$$

$$104-b) \left(\frac{-3}{x}\right)^{-3} = \left(\frac{-x}{3}\right)^3 = \left(\frac{x}{3}\right)\left(\frac{x}{3}\right)\left(\frac{x}{3}\right) = \frac{x^3}{27}$$

$$106-a) -5^{-3} = \frac{-1}{5^3} = \frac{-1}{\underline{\underline{125}}}$$

$$106-b) \left(\frac{-1}{5}\right)^{-3} = \left(\frac{-5}{1}\right)^3 = (-5)(-5)(-5) = \underline{\underline{-125}}$$

$$106-c) -\left(\frac{1}{5}\right)^{-3} = -(5)^3 = -(5)(5)(5) = \underline{\underline{-125}}$$

$$106-d) (-5)^{-3} = \frac{1}{(-5)^3} = \frac{1}{(-5)(-5)(-5)} \\ = \frac{1}{-125} = \underline{\underline{\frac{-1}{125}}}$$

$$108-a) 3 \cdot 4^{-2} = 3 \left( \frac{1}{4^2} \right) = 3 \left( \frac{1}{16} \right) = \underline{\underline{\frac{3}{16}}}$$

$$108-b) (3 \cdot 4)^{-2} = \frac{1}{(3 \cdot 4)^2} = \frac{1}{(12)^2} = \underline{\underline{\frac{1}{144}}}$$

$$110-a) \Delta^3 \cdot \Delta^{-7} = \Delta^3 \left( \frac{1}{\Delta^7} \right) = \frac{\Delta^3}{\Delta^7} = \frac{\Delta^3}{(\Delta^3)(\Delta^4)} = \underline{\underline{\frac{1}{\Delta^4}}}$$

$$110-b) (m^3 n^{-2})(m^{-5} n^{-1}) = \left( \frac{m^3}{n^2} \right) \left( \frac{1}{m^5 n^1} \right) = \frac{m^3}{m^5 n^3} = \frac{m^3}{m^3(m^2 n^3)} = \underline{\underline{\frac{1}{m^2 n^3}}}$$

$$110-c) (-2j^{-5} k^8)(7j^2 k^{-3}) = \left( \frac{-2k^8}{j^5} \right) \left( \frac{7j^2}{k^3} \right) = \frac{-14j^2 k^8}{j^5 k^3} = \underline{\underline{\frac{-14k^5}{j^3}}}$$

$$112-a) y^5 \cdot y^{-5} = (y^5) \left( \frac{1}{y^5} \right) = \frac{y^5}{y^5} = \underline{\underline{1}}$$

$$112-b) (p q^{-4})(p^{-6} q^{-3}) = \left( \frac{p}{q^4} \right) \left( \frac{1}{p^6 q^3} \right) = \frac{p}{p^6 q^7} = \underline{\underline{\frac{1}{p^5 q^7}}}$$

$$112-c) (-5 m^4 n^6)(8 m^{-5} n^{-3}) = (-5 m^4 n^6) \left( \frac{8}{m^5 n^3} \right) = \frac{-40 m^4 n^6}{m^5 n^3} = \underline{\underline{\frac{-40 n^3}{m}}}$$

$$114) x^4 \cdot x^{-2} \cdot x^{-3} = x^{(4+(-2)+(-3))} = x^{(-1)} = \underline{\underline{\frac{1}{x}}}$$

$$116-a) (b^2)^7 = (b^2)(b^2)(b^2)(b^2)(b^2)(b^2)(b^2) = b^{(2)(7)} = \underline{\underline{b^{14}}}$$

$$116-b) (3^8)^2 = (3^8)(3^8) = 3^{(8)(2)} = \underline{\underline{3^{16}}}$$

$$116-c) (k^2)^{-5} = \frac{1}{(k^2)^5} = \frac{1}{k^{(2)(5)}} = \underline{\underline{\frac{1}{k^{10}}}}$$

$$118-a) (x^2)^y = x^{(2)(y)} = \underline{x^{2y}}$$

$$118-b) (7^a)^b = 7^{(a)(b)} = \underline{7^{ab}}$$

$$118-c) (a^9)^{-10} = \frac{1}{(a^9)^{10}} = \frac{1}{a^{(9)(10)}} \\ = \underline{\underline{\frac{1}{a^{90}}}}$$

$$120-a) (-4ab)^2 = (-4ab)(-4ab) = \underline{16a^2b^2}$$

$$120-b) (5x)^0 = \underline{1}$$

$$120-c) (4y^3)^{-3} = \frac{1}{(4y^3)^3} = \frac{1}{(4y^3)(4y^3)(4y^3)} = \underline{\underline{\frac{1}{64y^9}}}$$

$$120-d) (-7y^{-3})^2 = \left(\frac{-7}{y^3}\right)^2 = \left(\frac{-7}{y^3}\right)\left(\frac{-7}{y^3}\right) = \underline{\underline{\frac{49}{y^6}}}$$

$$122-a) (-3xyz)^4 = (-3xyz)(-3xyz)(-3xyz)(-3xyz) = \underline{\underline{81x^4y^4z^4}}$$

$$122-b) (-7mn)^0 = \underline{1}$$

$$122-c) (-3x^3)^{-2} = \frac{1}{(-3x^3)^2} = \frac{1}{(-3x^3)(-3x^3)} = \underline{\underline{\frac{1}{9x^6}}}$$

$$122-d) (2y^{-5})^2 = \left(\frac{2}{y^5}\right)^2 = \left(\frac{2}{y^5}\right)\left(\frac{2}{y^5}\right) = \underline{\underline{\frac{4}{y^{10}}}}$$

$$124-a) \left(\frac{x}{3}\right)^4 = \left(\frac{x}{3}\right)\left(\frac{x}{3}\right)\left(\frac{x}{3}\right)\left(\frac{x}{3}\right) = \underline{\underline{\frac{x^4}{81}}}$$

$$124-b) \left(\frac{a}{b}\right)^5 = \left(\frac{b}{a}\right)^5 = \left(\frac{b}{a}\right)\left(\frac{b}{a}\right)\left(\frac{b}{a}\right)\left(\frac{b}{a}\right)\left(\frac{b}{a}\right) = \underline{\underline{\frac{b^5}{a^5}}}$$

$$124-c) \left(\frac{2x^2y^3}{z^2}\right)^2 = \left(\frac{2x^2y^3}{z^2}\right)\left(\frac{2x^2y^3}{z^2}\right) = \underline{\underline{\frac{4x^4y^6}{z^4}}}$$

$$124-d) \left(\frac{x^3y}{z^4}\right)^2 = \left(\frac{x^3y}{z^4}\right)\left(\frac{x^3y}{z^4}\right) = \underline{\underline{\frac{x^6y^2}{z^8}}}$$

$$126-a) \left(\frac{x}{2y}\right)^3 = \left(\frac{x}{2y}\right)\left(\frac{x}{2y}\right)\left(\frac{x}{2y}\right) = \frac{x^3}{8y^3}$$

$$126-b) \left(\frac{10}{3q}\right)^4 = \left(\frac{3q}{10}\right)^4 = \left(\frac{3q}{10}\right)\left(\frac{3q}{10}\right)\left(\frac{3q}{10}\right)\left(\frac{3q}{10}\right) = \frac{81q^4}{10000}$$

$$126-c) \left(\frac{2x^3y^4}{3z^2}\right)^5 = \left(\frac{2x^3y^4}{3z^2}\right)\left(\frac{2x^3y^4}{3z^2}\right)\left(\frac{2x^3y^4}{3z^2}\right)\left(\frac{2x^3y^4}{3z^2}\right)\left(\frac{2x^3y^4}{3z^2}\right) = \frac{32x^{15}y^{20}}{243z^{10}}$$

$$126-d) \left(\frac{5a^3b^{-1}}{2c^4}\right)^{-3} = \left(\frac{5a^3}{2b^{-1}c^4}\right)^{-3} = \left(\frac{2b^{-1}c^4}{5a^3}\right)^3 = \left(\frac{2bc^4}{5a^3}\right)\left(\frac{2bc^4}{5a^3}\right)\left(\frac{2bc^4}{5a^3}\right) = \frac{8b^3c^{12}}{125a^9}$$

$$128-a) (10k^4)^3 (5k^6)^2 = (10k^4)(10k^4)(10k^4)(5k^6)(5k^6) = \underline{25000k^{24}}$$

$$128-b) \frac{(q^3)^6 (q^{-2})^3}{(q^4)^8} = \frac{(q^{18})(q^{-6})}{(q^{32})} = \frac{(q^{18})}{(q^{32})(q^6)} = \frac{q^{18}}{q^{38}} = \frac{1}{q^{20}}$$

$$130-a) (3pq^4)^2 (6p^6q)^2 = (3pq^4)(3pq^4)(6p^6q)(6p^6q) = \underline{324p^{14}q^{10}}$$

$$130-b) \frac{(-2k^{-3})^2 (6k^2)^4}{(9k^4)^2} = \frac{(-2)^2 (k^{-3})^2 (6)^4 (k^2)^4}{(9)^2 (k^4)^2} = \frac{(-2)(-2) \overset{2}{\cancel{6}} \overset{2}{\cancel{6}} \overset{2}{\cancel{6}} \overset{2}{\cancel{6}} (k^2)^4}{\overset{3}{\cancel{9}} \overset{3}{\cancel{9}} (k^4)^2 (k^3)^2} = \frac{64k^8}{(k^8)(k^6)} = \underline{\underline{\frac{64}{k^6}}}$$

$$132-a) 6r^{-1} = \frac{6}{\underline{\underline{r}}}$$

$$132-b) (6r)^{-1} = \frac{1}{\underline{\underline{6r}}}$$

$$132-c) (-6r)^{-1} = \frac{1}{(-6r)} = \frac{-1}{\underline{\underline{6r}}}$$

$$134-a) (2q)^{-4} = \frac{1}{(2q)^4} = \frac{1}{\underline{\underline{2^4}}}$$

$$134-b) 2q^{-4} = \frac{2}{\underline{\underline{q^4}}}$$

$$134-c) = -2q^{-4} = \frac{-2}{\underline{\underline{q^4}}}$$

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$$136) (y^4)^3 \cdot (y^5)^2 = (y^{12})(y^{10}) = \underline{\underline{y^{22}}}$$

$$138) (b^7)^5 \cdot (b^2)^6 = (b^{35})(b^{12}) = \underline{\underline{b^{47}}}$$

$$140) (3y^2)^4 = (3y^2)(3y^2)(3y^2)(3y^2) = (3)^4 (y^2)^4 = \underline{\underline{81y^8}}$$

$$142) (2mn^4)^5 = (2)^5 (m)^5 (n^4)^5 = \underline{\underline{32m^5n^{20}}}$$

$$144) (-10u^2v^4)^3 = (-10)^3 (u^2)^3 (v^4)^3 = \underline{\underline{-1000u^6v^{12}}}$$

$$146) \left(\frac{7}{9}pq^4\right)^2 = \left(\frac{7}{9}\right)^2 (p)^2 (q^4)^2 = \underline{\underline{\frac{49}{81}p^2q^8}}$$

$$148) (5r^2)^3 (3r)^2 = (5)^3 (r^2)^3 (3)^2 (r)^2 = \underline{\underline{1125r^8}}$$

$$150) (4x^3)^3 (2x^5)^4 = (4)^3 (x^3)^3 (2)^4 (x^5)^4 = \underline{\underline{1024x^{29}}}$$

$$152) \left(\frac{1}{3} m^3 n^2\right)^4 (9 m^8 n^3)^2 = \left(\frac{1}{3}\right)^4 (m^3)^4 (n^2)^4 (9)^2 (m^8)^2 (n^3)^2 \quad 5.2 \quad \boxed{7}$$

$$= \frac{\overbrace{(\cancel{9})^4}^{3 \cdot 3 \cdot 3 \cdot 3}}{\underbrace{(\cancel{3})^4}_{1 \cdot 1 \cdot 1 \cdot 1}} (m^{12}) (n^8) (m^{16}) (n^6) = \underline{\underline{m^{28} n^{14}}}$$


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$$154) (2 p q^4)^3 (5 p^6 q)^2 = (2)^3 (p)^3 (q^4)^3 (5)^2 (p^6)^2 (q)^2$$

$$= \underline{\underline{200 p^{15} q^{14}}}$$


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$$156-a) \left(\frac{1}{2} y^2\right)^3 \left(\frac{2}{3} y\right)^2 = \left(\frac{1}{2} y^2\right) \left(\frac{1}{2} y^2\right) \left(\frac{1}{2} y^2\right) \left(\frac{2}{3} y\right) \left(\frac{2}{3} y\right)$$

$$= \frac{\overbrace{(\cancel{2})^3}^{1 \cdot 1 \cdot 1}}{\underbrace{(\cancel{2})^2 (\cancel{2}) (2) (3) (3)}_{1 \cdot 1}} y^8 = \underline{\underline{\frac{y^8}{18}}}$$


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$$156-b) \left(\frac{1}{2} j^2\right)^5 \left(\frac{2}{5} j^3\right)^2 = \left(\frac{1}{2} j^2\right) \left(\frac{1}{2} j^2\right) \left(\frac{1}{2} j^2\right) \left(\frac{1}{2} j^2\right) \left(\frac{1}{2} j^2\right) \left(\frac{2}{5} j^3\right) \left(\frac{2}{5} j^3\right)$$

$$= \frac{\overbrace{(\cancel{2})^5}^{1 \cdot 1 \cdot 1 \cdot 1 \cdot 1}}{\underbrace{(\cancel{2})^4 (\cancel{2}) (2) (2) (\cancel{2}) (5) (5)}_{1 \cdot 1}} j^{16} = \underline{\underline{\frac{j^{16}}{200}}}$$


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$$158) \left(\frac{k^{-2} k^8}{k^5}\right)^2 = \left(\frac{k^8}{(k^5)(k^2)}\right)^2 = \left(\frac{k^8}{k^7}\right)^2 = \left(\frac{k^1}{1}\right)^2 = (k)^2 = \underline{\underline{k^2}}$$


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$$160) \frac{(-10 n^{-2})^3 (4 n^5)^2}{(2 n^8)^2} = \frac{(-10)^3 (n^{-2})^3 (4)^2 (n^5)^2}{(2)^2 (n^8)^2}$$

$$= \frac{\overbrace{(-10)(-10)(-10)}^{2 \cdot 2} \overbrace{(4)(4)}^{2 \cdot 2} (n^{-6})(n^5)}{(2)(2) (n^{16})} = \frac{-4000 (n^5)}{(n^{16})(n^6)} = \frac{-4000 (n^5)}{(n^{17})(n^5)} = \underline{\underline{\frac{-4000}{n^{17}}}}$$

$$162-a) \underline{57000} = \underline{5.7 \times 10^4}$$

$$162-b) \underline{0.026} = \underline{2.6 \times 10^{-2}}$$

$$164-a) \underline{8750000} = \underline{8.75 \times 10^6}$$

$$164-b) \underline{0.00000087} = \underline{8.7 \times 10^{-6}}$$

$$166-a) 5.2 \times 10^2 = \underline{520}$$

$$166-b) 2.5 \times 10^{-2} = \underline{0.025}$$

$$168-a) 7.5 \times 10^6 = \underline{7500000}$$

$$168-b) -4.13 \times 10^{-5} = \underline{-0.0000413}$$

$$170-a) (3 \times 10^{-5})(3 \times 10^9) = (3)(3) \times 10^{(-5+9)} = \underline{9 \times 10^4} = \underline{90000}$$

$$170-b) \frac{7 \times 10^{-3}}{1 \times 10^{-7}} = \left(\frac{7}{1}\right) \times 10^{(-3-(-7))} = 7 \times 10^4 = \underline{70000}$$

$$172-a) (7.1 \times 10^{-2})(2.4 \times 10^{-4}) = (7.1)(2.4) \times 10^{(-2)+(-4)}$$

$$= 17.04 \times 10^{-6} = 1.704 \times 10^{-5}$$

$$= \underline{0.00001704}$$

$$172-b) \frac{6 \times 10^4}{3 \times 10^{-2}} = \left(\frac{6}{3}\right) \times 10^{(4-(-2))} = 2 \times 10^6$$

$$= \underline{2000000}$$