

Power Rules:

$$\textcircled{1} \quad \underline{3n^2} \cdot \underline{2n^3} \cdot \underline{2n^2} \quad (3 \times 2 \times 2 = \underline{12})$$

$$= \underline{12}n^{2+3+2}$$

$$= 12n^7$$

$$\textcircled{2} \quad 3p^3 \cdot p^1 \cdot 2p^3$$

$$= 6p^{3+1+3}$$

$$= 6p^7$$

$$\textcircled{3} \quad 2x^3 \cdot 2x \cdot 2x^2$$

$$= 8x^{3+1+2}$$

$$= 8x^6$$

$$\textcircled{4} \quad 3b^3 \cdot 2b^0 \cdot 2b^2$$

$$= 12b^{3+0+2}$$

$$= 12b^5$$

$$\textcircled{5} \quad x^2 y^{-5} \cdot (-y^2)^{-2}$$

$$= x^2 y^{-5} \cdot \left(\frac{1}{-y^2}\right)^2$$

$$= x^2 y^{-5} \cdot \frac{(1)^2}{(-1)^2 (y^2)^2}$$

$$= x^2 y^{-5} \cdot \frac{1}{(1)(y^4)}$$

$$= \frac{x^2 y^{-5}}{y^4}$$

$$= x^2 y^{-5-4}$$

$$= x^2 y^{-9}$$

$$= \frac{x^2}{y^9}$$

$$\textcircled{6} \quad (-xy^3)^5 \cdot x^5 y^4$$

$$= (-1)^5 \cdot x^5 \cdot (y^3)^5 \cdot x^5 y^4$$

$$= -1 x^5 y^{15} \cdot x^5 y^4$$

$$= -1 x^{10} y^{19}$$

$$\textcircled{7} x^3 y^{-5} (-x^5 y^5)^{-3}$$

$$= x^3 y^{-5} \cdot (-1)^{-3} (x^5)^{-3} (y^5)^{-3}$$

$$= x^3 y^{-5} \cdot (-1) x^{-15} y^{-15}$$

$$= -1 x^{-12} y^{-20}$$

$$= \frac{-1}{x^{12} y^{20}}$$

$$\textcircled{8} u^4 (u^{-4} v^{-5})^{-4}$$

$$= u^4 (u^{16} v^{20})$$

$$= u^{20} v^{20}$$

$$\textcircled{9} \frac{x^3 y^{-4}}{4x^3 y}$$

$$= \frac{1}{4} x^{3-3} y^{-4-1}$$

$$= \frac{1}{4} x^0 y^{-5} \quad x^0 = 1$$

$$= \frac{1}{4y^5}$$

$$\textcircled{10} \frac{3a^3 b^{-2} \cdot 3a^{-1} b^{-1}}{4ab^2}$$

$$= \frac{9a^{3+(-1)} b^{-2+(-1)}}{4ab^2}$$

$$= \frac{9a^2 b^{-3}}{4ab^2}$$

$$= \frac{9a^{2-1} b^{-3-2}}{4}$$

$$= \frac{9ab^{-5}}{4}$$

$$= \frac{9a}{4b^5}$$

$$\textcircled{11} \frac{4ab^2}{4b^3 \cdot 3a^{-4}b^4}$$

$$= \frac{4ab^2}{12a^{-4}b^{3+4}}$$

$$= \frac{4ab^2}{12a^{-4}b^7}$$

$$= \frac{1a^{1-(-4)}b^{2-7}}{3}$$

$$= \frac{1a^5b^{-5}}{3}$$

$$= \frac{1a^5}{3b^5}$$

Reduce

$$\frac{4}{12} = \frac{1}{3}$$

$$\textcircled{12} \frac{4x^{-1}y^3}{x^4y^2 \cdot x^{-2}y^3}$$

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

$$= \frac{4x^{-1}y^3}{x^2y^5}$$

$$= 4x^{-1-2}y^{3-5}$$

$$= 4x^{-3}y^{-2}$$

$$= \frac{4}{x^3y^2}$$

$$\textcircled{13} \quad \frac{2^4}{2 \cdot (2^0)^1}$$

$$= \frac{2^4}{2 \cdot 2^0}$$

$$= \frac{2^4}{2^{1+0}}$$

$$= \frac{2^4}{2^1}$$

$$= 2^{4-1}$$

$$= 2^3$$

$$= 8$$

$$\textcircled{14} \quad \frac{((-2)^{-1})^{-3}}{(-2)^4 \cdot (-2)^2}$$

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

$$= \frac{(-2)^3}{(-2)^6}$$

$$= (-2)^{3-6}$$

$$= (-2)^{-3}$$

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

$$= \frac{1^3}{(-2)^3} = \frac{1}{-8} = -\frac{1}{8}$$

$$\begin{aligned} \textcircled{15} \quad & \frac{2^0}{2 \cdot 2^{-4}} \\ &= \frac{2^0}{2^{0+(-4)}} \\ &= \frac{2^0}{2^{-4}} \\ &= 2^{0-(-4)} \\ &= 2^4 \\ &= 16 \end{aligned}$$

$$\begin{aligned} \textcircled{16} \quad & \frac{(2^4 \cdot 2^{-2})^4}{2^{-2}} \\ &= \frac{(2^{4+(-2)})^4}{2^{-2}} \\ &= \frac{(2^2)^4}{2^{-2}} \\ &= \frac{2^{2 \cdot 4}}{2^{-2}} \\ &= \frac{2^8}{2^{-2}} \\ &= 2^{8-(-2)} \\ &= 2^{10} \\ &= 1024 \end{aligned}$$

$$\begin{aligned} \textcircled{17} & \quad (x^1 x^{1/2})^2 \\ &= (x^{1+1/2})^2 \\ &= (x^{2/2+1/2})^2 \\ &= (x^{3/2})^2 \\ &= x^{\frac{3}{2} \cdot 2} \\ &= x^{\frac{6}{2}} \\ &= x^3 \end{aligned}$$

$$\begin{aligned} \textcircled{18} & \quad (v^{1/3} v^{1/2})^3 \\ &= (v^{\frac{1}{3}+\frac{1}{2}})^3 \\ &= (v^{\frac{2}{6}+\frac{3}{6}})^3 \\ &= (v^{\frac{5}{6}})^3 \\ &= v^{\frac{5}{6} \cdot 3} \\ &= v^{\frac{15}{6}} \\ &= v^{\frac{5}{2}} \quad \text{reduce} \end{aligned}$$

$$\begin{aligned} \textcircled{19} \quad & x(x^0)^{\frac{1}{3}} \\ &= x^1(x^{0 \cdot \frac{1}{3}}) \\ &= x^1 \cdot x^0 \\ &= x^{1+0} \\ &= x^1 \\ &= x \end{aligned}$$

$$\begin{aligned} \textcircled{20} \quad & a^2(a^2)^2 \\ &= a^2 \cdot a^{2 \cdot 2} \\ &= a^2 \cdot a^4 \\ &= a^{2+4} \\ &= a^6 \end{aligned}$$

$$\begin{aligned} \textcircled{a)} \quad & \underline{2}a \cdot \underline{3}a \\ 2 \times 3 = 6 & = \underline{6}a^{1+1} \\ & = 6a^2 \end{aligned}$$

$$\begin{aligned} \textcircled{b)} \quad & \underline{2}k \cdot \underline{3}k^{5/3} \\ & = \underline{6}k^{1+5/3} \\ & = 6k^{3/3+5/3} \\ & = 6k^{8/3} \\ & \text{or} \\ & = 6(\sqrt[3]{k})^8 \end{aligned}$$

Solutions to Review

$$\textcircled{1} \quad 186^{\underline{4/5}}$$

$$= \left(\sqrt[5]{186} \right)^{\underline{4}}$$

$$\textcircled{2} \quad \sqrt[8]{\left(\frac{684}{15} \right)^{\underline{11}}}$$

$$= \left(\frac{684}{15} \right)^{\underline{11/8}}$$

$$\textcircled{3} \quad 0.09^{\underline{1/2}}$$

$$= \left(\frac{9}{100} \right)^{\underline{1/2}}$$

$$\textcircled{4} \quad (-8)^{\underline{-1/3}}$$

$$= \left(-\frac{1}{8} \right)^{\underline{1/3}}$$

$$= \sqrt{9/100}$$

$$= \sqrt[3]{(-1/8)}$$

$$= \frac{\sqrt{9}}{\sqrt{100}}$$

$$= \frac{\sqrt[3]{-1}}{\sqrt[3]{8}}$$

$$= \frac{3}{10}$$

$$= -\frac{1}{2}$$

Solutions to Review

$$\textcircled{5} \quad \left(\frac{16}{625}\right)^{\frac{1}{4}}$$

$$= \frac{\sqrt[4]{16}}{\sqrt[4]{625}}$$

$$= \frac{\sqrt[4]{16}}{\sqrt[4]{625}}$$

$$= \frac{2}{5}$$

$$\textcircled{6} \quad \left(\frac{125}{8}\right)^{\frac{4}{3}}$$

$$= \left(\frac{\sqrt[3]{125}}{\sqrt[3]{8}}\right)^4$$

$$= \frac{(\sqrt[3]{125})^4}{(\sqrt[3]{8})^4}$$

$$= \frac{(5)^4}{(2)^4}$$

$$= \frac{625}{16}$$

$$\textcircled{7} \quad 2^{-3}$$

$$= \left(\frac{1}{2}\right)^3$$

$$= \frac{1^3}{2^3}$$

$$= \frac{1}{8}$$

$$\textcircled{8} \quad \left(\frac{2}{3}\right)^{-3}$$

$$= \left(\frac{3}{2}\right)^3$$

$$= \frac{3^3}{2^3}$$

$$= \frac{27}{8}$$

Solutions to Review

$$\textcircled{9} \quad x^{-2} y^6 \cdot x^3 y^{-8}$$

$$= x^{-2+3} y^{6+(-8)}$$

$$= x^1 y^{-2}$$

$$= \frac{x}{y^2}$$

$$\textcircled{10} \quad \frac{12 p^3 q^{-7}}{15 p q^6}$$

$$= \frac{4 p^{3-1} q^{-7-6}}{5}$$

$$= \frac{4 p^2 q^{-13}}{5}$$

$$= \frac{4 p^2}{5 q^{13}}$$

$$\textcircled{11} \quad \left(\frac{-8}{5}\right)^{\frac{7}{4}} \cdot \left(\frac{-8}{5}\right)^{\frac{1}{4}}$$

$$= \left(\frac{-8}{5}\right)^{\frac{7}{4} + \frac{1}{4}}$$

$$= \left(\frac{-8}{5}\right)^{\frac{8}{4}}$$

$$= \left(\frac{-8}{5}\right)^2$$

$$= \frac{(-8)^2}{(5)^2}$$

$$= \frac{64}{25}$$

$$\textcircled{12} \quad \frac{(5b^7)^3}{(2a^3)^4}$$

$$= \frac{5^{1 \cdot 3} b^{7 \cdot 3}}{2^{1 \cdot 4} a^{3 \cdot 4}}$$

$$= \frac{5^3 b^{21}}{2^4 a^{12}}$$

$$= \frac{125 b^{21}}{16 a^{12}}$$

Solutions to Review

$$\textcircled{13} \frac{(m^3 n^{-3})^{-1}}{(m^{-2} n)^4}$$

$$= \frac{m^{3 \cdot (-1)} n^{-3 \cdot (-1)}}{m^{-2 \cdot 4} n^{1 \cdot 4}}$$

$$= \frac{m^{-3} n^3}{m^{-8} n^4}$$

$$= m^{-3 - (-8)} n^{3 - 4}$$

$$= m^5 n^{-1}$$

$$= \frac{m^5}{n}$$

Solutions to Review

Evaluate

$$a) (2401)^{\frac{3}{4}}$$

$$= (\sqrt[4]{2401})^3$$

$$= (7)^3$$

$$= 343$$

$$b) 32^{-0.4}$$

$$= (32)^{-\frac{4}{10}} \leftarrow \text{write as a fraction}$$

$$= (32)^{-\frac{2}{5}} \leftarrow \text{reduce}$$

$$= \left(\frac{1}{32}\right)^{\frac{2}{5}} \leftarrow \text{make exponent positive by flipping base!}$$

$$= \left(\sqrt[5]{\frac{1}{32}}\right)^2$$

$$= \frac{(\sqrt[5]{1})^2}{(\sqrt[5]{32})^2}$$

$$= \frac{(1)^2}{(2)^2}$$

$$= \frac{1}{4}$$

Solutions to Review

Simplify

$$a) \left(\frac{6x^8 y^{-3} \cdot x^{11} y^3}{2xy} \right)^{-2}$$

$$= \left(\frac{6x^{8+11} y^{-3+3}}{2xy} \right)^{-2}$$

$$= \left(\frac{6x^{19} y^0}{2xy} \right)^{-2}$$

$$= \left(\frac{3x^{19-1} y^{0-1}}{y} \right)^{-2}$$

$$= \left(3x^{18} y^{-1} \right)^{-2}$$

$$= 3^{1 \cdot (-2)} x^{18 \cdot (-2)} y^{(-1) \cdot (-2)}$$

$$= 3^{-2} x^{-36} y^{14}$$

$$= \frac{y^{14}}{3^2 x^{36}}$$

$$= \frac{y^{14}}{9x^{36}}$$

$$b) \left(\frac{5^6 x^3 y^5}{5x^2 y^3} \right)^3$$

$$= \left(5^{6-1} x^{3-2} y^{5-3} \right)^3$$

$$= \left(5^5 x^1 y^2 \right)^3$$

$$= 5^{5 \cdot 3} x^{1 \cdot 3} y^{2 \cdot 3}$$

$$= 5^{15} x^3 y^6$$

