

Solutions

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1. Write in radical form. Then evaluate without using a calculator.

a) $49^{\frac{1}{2}}$

$$= \sqrt{49}$$

$$= 7$$

c) $(-125)^{\frac{1}{3}}$

$$= \sqrt[3]{-125}$$

$$= -5$$

e) $81^{\frac{1}{4}}$

$$= \sqrt[4]{81}$$

$$= 3$$

b) $100^{\frac{1}{2}}$

$$= \sqrt{100}$$

$$= 10$$

d) $16^{0.25}$

$$= 16^{\frac{1}{4}}$$

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

$$= 2$$

f) $-(144)^{0.5}$

$$= -(144)^{\frac{1}{2}}$$

$$= -\sqrt{144}$$

$$= -12$$

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2. Write in exponent form, then evaluate. Express answers in rational form.

$$\begin{aligned} \text{a) } \sqrt[9]{512} &= 512^{1/9} \\ &= 2 \end{aligned}$$

$$\begin{aligned} \text{c) } \sqrt[3]{27^2} &= 27^{2/3} \\ &= 9 \end{aligned}$$

$$\begin{aligned} \text{e) } \sqrt[5]{\frac{-32}{243}} &= \left(\frac{-32}{243}\right)^{1/5} \\ &= \frac{-2}{3} \end{aligned}$$

$$\begin{aligned} \text{b) } \sqrt[3]{-27} &= (-27)^{1/3} \\ &= -3 \end{aligned}$$

$$\begin{aligned} \text{d) } (\sqrt[3]{-216})^5 &= (-216)^{5/3} \\ &= -7776 \end{aligned}$$

$$\begin{aligned} \text{f) } \sqrt[4]{\left(\frac{16}{81}\right)^{-1}} &= \sqrt[4]{\frac{81}{16}} \\ &= \left(\frac{81}{16}\right)^{1/4} \\ &= \frac{3}{2} \end{aligned}$$

$$\left[\begin{array}{l} -216^{1/3} = -6 \\ -6^5 = -7776 \end{array} \right]$$

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3. Write as a single power.

$$\begin{aligned} \text{a) } 8^{\frac{2}{3}}(8^{\frac{1}{3}}) &= 8^{2/3+1/3} \\ &= 8^1 \end{aligned}$$

$$\begin{aligned} \text{b) } 8^{\frac{2}{3}} \div 8^{\frac{1}{3}} &= 8^{2/3-1/3} \\ &= 8^{1/3} \end{aligned}$$

$$\begin{aligned} \text{c) } (-11)^2(-11)^{\frac{3}{4}} &= (-11)^{2+3/4} \\ &= (-11)^{8/4+3/4} \\ &= (-11)^{11/4} \end{aligned}$$

$$\begin{aligned} \text{d) } (7^{\frac{5}{6}})^{\frac{6}{5}} &= 7^{5/6-6/5} \\ &= 7^{25/30-36/30} \\ &= 7^{-11/30} \\ \text{e) } \frac{9^{\frac{-1}{5}}}{9^{\frac{2}{5}}} &= 9^{-1/5-2/5} \\ &= 9^{-3/5-10/5} \\ &= 9^{-13/5} \end{aligned}$$

$$\begin{aligned} \text{f) } 10^{-\frac{4}{5}}(10^{\frac{1}{5}}) \div 10^{\frac{2}{3}} &= 10^{-4/5+1/5-2/3} \\ &= 10^{-12/15+1/5-10/15} \\ &= 10^{-21/15} \\ &= 10^{-7/5} \end{aligned}$$

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5. Evaluate.

a) $49^{\frac{1}{2}} + 16^{\frac{1}{2}}$	c) $16^{\frac{3}{4}} + 16^{\frac{3}{4}} - 81^{-\frac{1}{4}}$	e) $16^{\frac{3}{2}} + 16^{-0.5} + 8 - 27^{\frac{2}{3}}$
$= 7 + 4$	$= 2^3 + 2^3 - \left(\frac{1}{81}\right)^{\frac{1}{4}}$	$= 4^3 + \left(\frac{1}{16}\right)^{\frac{1}{2}} + 8 - 3^2$
$= 11$	$= 8 + 8 - \left(\frac{1}{3}\right)$	$= 64 + \frac{1}{4} + 8 - 9$
	$= 16 - \frac{1}{3}$	$= 63\frac{1}{4}$
	$= 15\frac{2}{3}$	$= \frac{253}{4}$
	$= \frac{47}{3}$	

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6. Write as a single power, then evaluate. Express answers in rational form.

a) $4^{\frac{1}{5}}(4^{0.3})$	c) $\frac{64^{\frac{4}{3}}}{64}$	e) $\frac{(16^{-2.5})^{-0.2}}{16^{\frac{3}{4}}}$
$= 4^{\frac{1}{5} + 0.3}$	$= 64^{4/3 - 1}$	$= 16^{-2.5(-0.2) - 3/4}$
$= 4^{1/2}$	$= 64^{1/3}$	$= 16^{0.5 - 0.75}$
$= 2$	$= 4$	$= 16^{-0.25}$
		$= \left(\frac{1}{16}\right)^{1/4}$
		$= \frac{1}{2}$

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6. Write as a single power, then evaluate. Express answers in rational form.

b) $100^{0.2}(100^{\frac{-7}{10}})$	d) $\frac{27^{-1}}{27^{\frac{-2}{3}}}$	f) $\frac{(8^{-2})(8^{2.5})}{(8^6)^{-0.25}}$
$= 100^{0.2+(-0.7)}$	$= 27^{-1-(-\frac{2}{3})}$	$= \frac{8^{-2+2.5}}{8^{6(-0.25)}}$
$= 100^{-0.5}$	$= 27^{-1+\frac{2}{3}}$	$= \frac{8^{0.5}}{8^{-1.5}}$
$= \left(\frac{1}{100}\right)^{\frac{1}{2}}$	$= 27^{-\frac{1}{3}}$	$= 8^{0.5-(-1.5)}$
$= \frac{1}{10}$	$= \left(\frac{1}{27}\right)^{\frac{1}{3}}$	$= 8^2$
	$= \frac{1}{3}$	$= 64$

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7. Predict the order of these six expressions in terms of value from lowest to highest. Check your answers with your calculator. Express answers to three decimal places.

a) $\sqrt[4]{623}$	c) $\sqrt[6]{10.24}$	e) $17.5^{\frac{5}{8}}$
$= 4.996$	$= 1.262$	$= 5.983$
4 TH	6 TH (low)	3 RD
b) $125^{\frac{2}{5}}$	d) $80.9^{\frac{1}{4}}$	f) $21.4^{\frac{3}{2}}$
$= 6.899$	$= 2.999$	$= 98.997$
2 ND	5 TH	1 ST (high)

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4. Simplify. Express answers with positive exponents.

$$\begin{aligned} \text{a) } (pq^2)^{-1}(p^3q^3) &= p^{-1}q^{-2}p^3q^3 \\ &= p^2q \\ \text{c) } \frac{(ab)^{-2}}{b^5} &= a^{-2}b^{-2}b^{-5} \\ &= a^{-2}b^{-7} \\ &= \frac{1}{a^2b^7} \\ \text{e) } \frac{(w^2x)^2}{(x^{-1})^2w^3} &= \frac{w^4x^2}{x^{-2}w^3} \\ &= w^4x^2x^2w^{-3} \\ &= wx^4 \end{aligned}$$

$$\begin{aligned} \text{b) } \left(\frac{x^3}{y}\right)^{-2} &= \frac{x^{-6}}{y^{-2}} \\ &= \frac{y^2}{x^6} \\ \text{d) } \frac{m^2n^2}{(m^3n^{-2})^2} &= \frac{m^2n^2}{m^6n^{-4}} \\ &= m^2n^2m^{-6}n^4 \\ &= m^{-4}n^6 \\ &= \frac{n^6}{m^4} \\ \text{f) } \left(\frac{(ab)^{-1}}{a^2b^{-3}}\right)^{-2} &= \frac{a^2b^2}{a^{-4}b^6} \\ &= a^2b^2a^4b^{-6} \\ &= a^6b^{-4} \\ &= \frac{a^6}{b^4} \end{aligned}$$

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5. Simplify. Express answers with positive exponents.

$$\begin{aligned} \text{a) } (3xy^4)^2(2x^2y)^3 &= (3^2x^2y^8)(2^3x^6y^3) \\ &= (9x^2y^8)(8x^6y^3) \\ &= 72x^8y^{11} \\ \text{c) } \frac{(10x)^{-1}y^3}{15x^3y^{-3}} &= \frac{\frac{1}{10}x^{-1}y^3}{15x^3y^{-3}} \\ &= \left(\frac{1}{10}x^{-1}y^3\right)\left(\frac{1}{15}x^{-3}y^3\right) \\ &= \frac{1}{150}x^{-4}y^6 \\ &= \frac{y^6}{150x^4} \\ \text{e) } \frac{p^{-5}(r^3)^2}{(p^2r)^2(p^{-1})^2} &= \frac{p^{-5}r^6}{p^4r^2p^{-2}} \\ &= p^{-5}r^6p^{-4}r^{-2}p^2 \\ &= p^{-7}r^4 \\ &= \frac{r^4}{p^7} \end{aligned}$$

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5. Simplify. Express answers with positive exponents.

$$\begin{array}{l}
 \text{b) } \frac{(2a^3)^2}{4ab^2} \\
 = \frac{2^2 a^{3 \times 2}}{4ab^2} \\
 = \frac{4a^6}{4ab^2} \\
 = \frac{a^5}{b^2}
 \end{array}
 \quad
 \begin{array}{l}
 \text{d) } \frac{(3m^4n^2)^2}{12m^{-2}n^6} \\
 = \frac{3^2 m^{4 \times 2} n^{2 \times 2}}{12m^{-2}n^6} \\
 = \frac{9m^8n^4}{12m^{-2}n^6} \\
 = \frac{3m^{10}}{4n^2}
 \end{array}
 \quad
 \begin{array}{l}
 \text{f) } \left(\frac{(x^3y)^{-1}(x^4y^3)}{(x^2y^{-3})^{-2}} \right)^{-1} \\
 = \frac{(x^2y^{-3})^{-2}}{(x^3y)^{-1}(x^4y^3)} \\
 = \frac{x^{2 \times -2} y^{-3 \times -2}}{x^{3 \times -1} y^{-1} x^4 y^3} \\
 = \frac{x^{-4} y^6}{x^{-3} y^{-1} x^4 y^3} \\
 = \frac{x^{-4} y^6}{x y^2} \\
 = x^{-5} y^4 = \frac{y^4}{x^5}
 \end{array}$$

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6. Simplify. Express answers with positive exponents.

$$\begin{array}{l}
 \text{a) } (x^4)^{\frac{1}{2}} (x^6)^{-\frac{1}{3}} \\
 = x^{4 \times \frac{1}{2}} x^{6 \times -\frac{1}{3}} \\
 = x^2 x^{-2} \\
 = x^0 \\
 = 1
 \end{array}
 \quad
 \begin{array}{l}
 \text{c) } \frac{\sqrt{25m^{-12}}}{\sqrt{36m^{10}}} \\
 = \frac{5m^{-12 \times \frac{1}{2}}}{6m^{10 \times \frac{1}{2}}} \\
 = \frac{5m^{-6}}{6m^5} \\
 = \frac{5}{6} m^{-11} \\
 = \frac{5}{6m^{11}}
 \end{array}
 \quad
 \begin{array}{l}
 \text{e) } \left(\frac{(32x^5)^{-2}}{(x^{-1})^{10}} \right)^{0.2} \\
 = \frac{(32x^5)^{-2 \times 0.2}}{(x^{-1})^{10 \times 0.2}} \\
 = \frac{(32x^5)^{-0.4}}{(x^{-1})^2} \\
 = \frac{32^{-0.4} x^{5(-0.4)}}{x^{-1(2)}} \\
 = \frac{\left(\frac{1}{32}\right)^{0.4} x^{-2}}{x^{-2}} \\
 = \left(\frac{1}{32}\right)^{2/5} \\
 = \left(\sqrt[5]{\frac{1}{32}}\right)^2 = \left(\frac{1}{2}\right)^2 = \frac{1}{4}
 \end{array}$$

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6. Simplify. Express answers with positive exponents.

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$$b) \frac{9(c^8)^{0.5}}{(16c^{12})^{0.25}}$$

$$= \frac{9c^{8(0.5)}}{16^{0.25} c^{12(0.25)}}$$

$$= \frac{9c^4}{2c^3}$$

$$= \frac{9c}{2}$$

$$d) \sqrt[3]{\frac{(10x^3)^2}{(10x^6)^{-1}}}$$

$$= \sqrt[3]{\frac{10^2 x^6}{\frac{1}{10} x^{-6}}}$$

$$= \sqrt[3]{\frac{100x^6}{0.1x^{-6}}}$$

$$= \sqrt[3]{1000x^{12}}$$

$$= 1000^{\frac{1}{3}} x^{12(\frac{1}{3})}$$

$$= 10x^4$$

$$f) \frac{\sqrt[10]{1024x^{20}}}{\sqrt[9]{512x^{27}}}$$

$$= \frac{1024^{\frac{1}{10}} x^{20(\frac{1}{10})}}{512^{\frac{1}{9}} x^{27(\frac{1}{9})}}$$

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

$$= \frac{1}{x}$$

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