Practice: Exponents

Mr. Merrick · Math 10 · September 17, 2025

Mini Reference. For $a \neq 0$, $m, n \in \mathbb{Q}$:

$$a^m a^n = a^{m+n}, \quad \frac{a^m}{a^n} = a^{m-n}, \quad (a^m)^n = a^{mn}, \quad a^{-m} = \frac{1}{a^m}, \quad a^0 = 1, \quad a^{\frac{p}{q}} = \sqrt[q]{a^p}.$$

Combining the Exponent Laws

1. Write in a simpler form and evaluate.
   a) $\dfrac{7^5 \cdot 7}{7^3}$
   b) $\left((-2)^3\right)^2$
   c) $\left(\dfrac{3^4}{3^2}\right)^3$
   d) $\dfrac{(0.6)^7}{(0.6)^3(0.6)^2}$
   e) $-4^5 \cdot 4^{-3}$
   f) $(-6)^4 \cdot (-6)^{-2}$
   g) $-12^3 + (-12)^2$
   h) $\dfrac{-9^9}{-9^7}$
2. Write each expression in simplest form without brackets.
   a) $(-x)^{10} + (-x)^4$
   b) $(-a)^7 + (-a)^3$
   c) $-p^6 + (-p)^2$
   d) $c^4 + (-c)^6$
   e) $-r^5 + (-r)^5$
   f) $-t^4 + (-t)^3$
3. The simplified form of $\dfrac{1}{48}(3x^2)^3(-2xy^2)$ is
   A. $-\dfrac{9}{8}x^7y^2$
   B. $-\dfrac{3}{2}x^7y^2$
   C. $-\dfrac{9}{8}x^6y^2$
   D. $-\dfrac{1}{6}x^7y$
4. $\dfrac{(4x^{-3}y^5)^2}{(2xy)^4}$ equals
   A. $\dfrac{y^6}{x^{10}}$
   B. $\dfrac{4y^6}{x^{14}}$
   C. $\dfrac{1}{4}x^{-14}y^{-6}$
   D. $\dfrac{4}{x^{14}}y^6$
5. Simplify $(-2m^2n^{-3})^3(4m^{-1}n^2)^2\left(\dfrac{1}{8m^3n}\right)$ to the form $m^a n^b$. Enter $a + b$.
6. Simplify each expression.
   a) $a^{x+3}\,a^{2x-1}$
   b) $\dfrac{m^{x+7}}{m^3}$
   c) $\dfrac{p^{3m+1}}{p^{m-4}}$
   d) $\dfrac{x^{2y+5}\,x^{3y+1}}{x^{y+8}}$

Integral Exponents

1. Write the following with *positive* exponents.
   a) x^{-4}
   b) y^{-7}
   c) 5^{-1}
   d) $\dfrac{1}{a^{-3}}$
   e) $\dfrac{1}{6^{-1}}$
2. Without a calculator, show $\dfrac{4}{8^{-2}} = 256$.
3. Simplify, express with positive exponents, and evaluate.
   a) $2^5 \cdot 2^{-3}$
   b) $10^0 \cdot 10^{-2}$
   c) $\dfrac{1}{9^{-2}}$
   d) $\dfrac{7^{-3}}{7^{-1}}$
   e) $\left(3^2\right)^{-2}$
4. Express with positive exponents.
   a) $n^2 m^{-5}$
   b) $c^{-2} x^{-5}$
   c) $16h^{-1}$
   d) $\dfrac{2}{3} b^{-8}$
   e) $(y^{-4})^{-2}$
   f) $\dfrac{r^{-5}}{4}$
   g) $\dfrac{1}{4x^{-9}}$
   h) $\dfrac{4}{x^{-9}}$
   i) $\dfrac{a^2}{b^{-7}}$
   j) $\dfrac{a^{-2}}{b^7}$
5. Evaluate without a calculator.
   a) -2^{-3}
   b) $(-3)^{-2}$
   c) $-7^2 \cdot 8^{-2}$
   d) $(-5)^0$
   e) $\left[-(4.2)^0\right]^{-2}$
6. Use a calculator (exact fraction/decimal).
   a) -4^{-3}
   b) $(-7)^{-1}$
   c) $(0.5)^{-3}$
   d) $(-0.02)^{-2}$
   e) $\left(\dfrac{5}{8}\right)^{-3}$
7. True or false.
   a) $6x^{-3} = \dfrac{6}{x^3}$
   b) $5a^{-4} = \dfrac{1}{5a^4}$
   c) $\dfrac{4}{b^{-6}} = 4b^6$
   d) $\dfrac{x^{-3}}{2} = \dfrac{2}{x^3}$
   e) $\dfrac{1}{5y^{-1}} = 5y$
   f) $\dfrac{1}{4p} = \dfrac{1}{4} p^{-1}$
   g) $(3x)^5 = \dfrac{1}{(3x)^{-5}}$
   h) $\left(\dfrac{1}{7}a\right)^{-2} = 49a^2$
8. Simplify with positive exponents.
   a) $x^8 \cdot x^{-5}$
   b) $m^5 + m^8$
   c) $b^{-1} \cdot b^{-3}$
   d) $-w^0 + w^5$

9. Simplify with positive exponents.
   a) $a^8 \times a^{-10}$
   b) $10x^2 + 2x^{-1}$
   c) $\dfrac{6y^{-6}}{2y^{-4}}$
   d) $\dfrac{2a^{-5}}{4b^6}$
   e) $-7x^{-2}$
   f) $-(7x)^{-2}$
   g) $(-7x)^{-2}$
   h) $\dfrac{(-7x)^{-2}}{-7x^{-2}}$

10. Simplify, answers with positive exponents.
   a) $a^{-3}a^{-3}$
   b) $(5b^8b^{-12})(-10b^3b^{-12})$
   c) $(-7x^3x^{-5})(x^2x^{-3})$
   d) $(-2a^3)^{-3} \cdot 3a^{12}$
   e) $\dfrac{16a^6b^{-3}}{-4a^6b^3}$
   f) $(-3a^5b^{-3}c^0)^{-2}$

11. Simplify. Final answers with positive exponents.
   a) $\dfrac{32a^2b^{-4}}{4a^{-3}b^{-2}} \times \dfrac{-8a^{-2}}{-3b^{-3}}$
   b) $\dfrac{10(p^3q^2r^0)^{-3}}{(8p^{-3}q^5r^3)^{-2}}$
   c) $(-2x^5y^3z^8)^2 - (-2x^2y^{-8}z^{12})^3$
   d) $(5a^3b^2)(-2a^{-2}b)^{-3} + (-5a^8b^{-9})^{-2}$

12. Evaluate without a calculator.
   a) $\left(\dfrac{2}{3}\right)^{-3}$
   b) $\left(\dfrac{1}{5}\right)^{-2}$
   c) $\left(\dfrac{8}{5}\right)^{-1}$
   d) $\left(\dfrac{3}{2}\right)^{-4}$

13. Simplify. Final answers with positive exponents.
   a) $\left(\dfrac{c}{d}\right)^{-3}$
   b) $\left(\dfrac{x}{4}\right)^{-3}$
   c) $\left(\dfrac{p^2}{r^4}\right)^{-3}$
   d) $\left(\dfrac{a^{-2}}{b^{-5}}\right)^{-3}$
   e) $\left(\dfrac{-12x^{-3}}{6y^{-8}}\right)^{-1}$
   f) $\left(\dfrac{12x^3y^{-1}}{-8x^{-1}y^5}\right)^{-2}$

14. Simplify. Final answers with positive exponents.
   a) $\left(\dfrac{-x^3}{y}\right)^{-2} + \left(\dfrac{y^3}{x^5}\right)^2$
   b) $49\left(\dfrac{7w^3x^{-5}z^4}{w^{-3}z}\right)^{-2} \times \dfrac{14(x^4z^8)^0}{x^{-8}z}$

15. The value of $\dfrac{2^{-3}+4^0}{2^{-1}}$ is
   A. 2 **B.** $\dfrac{9}{4}$ **C.** 6 **D.** 8

16. Let $p = 5\times10^{-6}$ and $q = 4\times10^{7}$. If $r = 5\times10^{3}$ and $\dfrac{pq}{r} = c \times 10^n$, then n equals
   A. -2 **B.** -1 **C.** 1 **D.** 2

17. Which statements are true?
   i) $3a^{-3} = \dfrac{1}{3a^3}$, ii) $8x^4 \cdot 4x^7 = \dfrac{1}{2x^3}$, iii) $\dfrac{1}{2a} = 2a^{-1}$.
   A. i only **B.** ii only **C.** iii only **D.** none

Scientific Notation

1. Complete the table.

Standard Notation	Expanded Form	Scientific Notation
246 000	2.46×10^5	2.46×10^5
18.7	1.87×10^1	1.87×10^1
56 000	5.6×10^4	5.6×10^4
	9.2×10^6	9.2×10^6
	7.5×10^2	7.5×10^2
		6.8×10^3
		3.9×10^1

2. Express each number in scientific notation.
   a) 4 750
   b) 12 040 000
   c) 0.0063
   d) 98.2
   e) 0.000 000 74

3. Express the number of kilometres in scientific notation.
   a) 384 400 km
   b) 2 500 000 km

4. Express each number in standard notation.
   a) 1.2×10^{11}
   b) 6.73×10^4
   c) 9.99×10^6
   d) 4.5×10^{-2}

5. Simplify and write in scientific notation.
   a) $(3.2 \times 10^4) \times 1000$
   b) $(8.91 \times 10^7) \times 10$
   c) $\dfrac{7.2 \times 10^8}{1000}$
   d) $\dfrac{25\,000}{5 \times 10^2}$

2. Complete the table.

Standard Notation	Expanded Form	Scientific Notation
0.000 0042	$4.2 \div 10^6$	4.2×10^{-6}
0.000 1	$1 \div 10^4$	1.0×10^{-4}
	$\frac{3.5}{10^4}$	3.5×10^{-4}
	$\frac{9.9}{10}$	9.9×10^{-1}
		6.9×10^{-2}
		8.5×10^{-4}

3. For each number, indicate how many places (and in which direction) the decimal must move to make the leading number between 1 and 10.
   a) 35
   b) 480 000
   c) 0.0042
   d) 0.63
   e) 91 230 000

4. Express each number in scientific notation.
   a) 0.000 018
   b) 0.007
   c) 0.000 000 94
   d) 102 600
   e) 0.6
   f) 890 000 000
   g) 0.000 005 2
   h) 0.034
   i) 61 500 000

5. Express each number in *standard* notation.
   a) 2.7×10^{-3}
   b) 5.01×10^{-8}
   c) 1.28×10^{-4}
   d) 7.45×10^{6}
   e) 9.3×10^{1}
6. Express in scientific notation.
   a) 34.2×10^{5}
   b) 0.72×10^{3}
   c) 0.056×10^{-7}
   d) 456×10^{-9}
   e) 0.0045×10^{12}
7. Calculator—answer in scientific notation.
   a) $(3.2 \times 10^{8})(4.0 \times 10^{-5})$
   b) $(1.5 \times 10^{5}) + (2.5 \times 10^{2})$
   c) $(0.06 \times 10^{-3})(0.2 \times 10^{-8})$
   d) $(2.3 \times 10^{1}) + (0.45 \times 10^{8})$
8. Calculator—answer in *standard* notation.
   a) $(4.8 \times 10^{2})(2.4 \times 10^{-7})$
   b) $(9.1 \times 10^{2}) + (0.75 \times 10^{-2})$
   c) $(0.04 \times 10^{-3})(3.0 \times 10^{-3})$
   d) $(7.2) + (0.95 \times 10^{7})$
9. A number is 6 950 000. In $a \times 10^{n}$ the value of n is **A.** 3 **B.** 4 **C.** 6 **D.** 7
10. A film earned about 2 450 million dollars. In scientific notation this amount is **A.** 2.45×10^{10} **B.** 2.45×10^{9} **C.** 2.45×10^{6} **D.** 2.45×10^{3}
11. Speed of light $= 3 \times 10^{8}$ m/s; distance Earth–Sun $= 1.5 \times 10^{11}$ m. If time is $a \times 10^{n}$ seconds, find $a + n =$ _____.

Rational Exponents — Part One

1. Evaluate without a calculator.
   a) $27^{\frac{1}{3}}$
   b) $81^{\frac{1}{2}}$
   c) $8^{\frac{2}{3}}$
   d) $125^{\frac{1}{3}}$
   e) $36^{\frac{1}{2}}$
   f) $64^{\frac{1}{4}}$
   g) $49^{\frac{3}{2}}$
   h) $(9^2 + 16^2)^{\frac{1}{2}}$
   i) $(0.25)^{0.5}$
2. Determine the exact value without a calculator.
   a) $16^{-\frac{1}{2}}$
   b) $27^{-\frac{2}{3}}$
   c) $81^{-\frac{3}{4}}$
   d) $1000^{-\frac{1}{3}}$
   e) $64^{-\frac{5}{6}}$
3. Determine the exact value.
   a) $\left(\frac{1}{36}\right)^{\frac{1}{2}}$
   b) $\left(\frac{1}{9}\right)^{-\frac{1}{2}}$
   c) $\left(\frac{1}{8}\right)^{\frac{4}{3}}$
   d) $\left(\frac{25}{9}\right)^{-\frac{3}{2}}$
   e) $\left(\frac{49}{16}\right)^{-\frac{3}{4}}$
4. Determine the exact value.
   a) $(-64)^{\frac{1}{3}}$
   b) $(-8)^{\frac{2}{3}}$
   c) $(-125)^{-\frac{1}{3}}$
   d) $-(-27)^{\frac{2}{3}}$
   e) $(-0.01)^{\frac{1}{2}}$
5. Use a calculator to two decimals.
   a) $5^{\frac{4}{3}}$
   b) $7^{\frac{3}{4}}$
   c) $(-6)^{\frac{2}{3}}$
   d) $8^{-0.25}$
   e) $(-0.5)^{\frac{2}{3}}$
6. Write an equivalent expression using radicals.
   a) $a^{\frac{1}{4}}$
   b) $b^{\frac{1}{2}}$
   c) $c^{\frac{2}{3}}$
   d) $d^{\frac{1}{5}}$
   e) $e^{\frac{1}{10}}$
   f) $f^{\frac{3}{2}}$
   g) $g^{\frac{4}{3}}$
   h) $h^{\frac{5}{7}}$
7. A cube has volume 343 cm^3.
   a) Edge length (cm):
   b) Surface area (cm^2):
8. A cube has volume V cm^3.
   a) Edge length: $V^{\frac{1}{3}}$
   b) Face area: $V^{\frac{2}{3}}$
9. Rewrite in radical form (evaluate when possible).
   a) $5^{\frac{1}{2}}$
   b) $8^{\frac{1}{3}}$
   c) $(-3)^{\frac{1}{3}}$
   d) $\left(\frac{1}{4}\right)^{-\frac{1}{2}}$
   e) $6^{-\frac{1}{2}}$
   f) $100^{\frac{2}{3}}$
10. Order from greatest to least:
    $(-64)^{-\frac{2}{3}}$, $\left(\frac{1}{16}\right)^{\frac{1}{3}}$, $(-64)^{\frac{2}{3}}$, $\left(\frac{1}{16}\right)^{-\frac{1}{3}}$.

Rational Exponents — Part Two

1. Write each power as an entire radical.
   a) $a^{\frac{4}{3}}$
   b) $b^{\frac{3}{2}}$
   c) $c^{\frac{1}{4}}$
   d) $x^{-\frac{2}{3}}$
   e) $y^{-\frac{1}{3}}$
   f) $(2m)^{\frac{2}{3}}$
   g) $(3n)^{\frac{2}{3}}$
   h) $(-a)^{-\frac{5}{4}}$
   i) $(-b)^{\frac{5}{4}}$
   j) $(4x)^{-\frac{1}{2}}$
2. Simplify and then write an entire radical when appropriate.
   a) $2x^{\frac{3}{8}} \cdot 5x^{-\frac{3}{8}}$
   b) $y^{\frac{6}{5}} + y^{\frac{4}{5}}$
   c) $\left(a^{\frac{2}{3}}\right)^{\frac{3}{4}}$
   d) $(c^2 d)^{\frac{3}{2}}$
   e) $x^{\frac{1}{2}} \cdot x^{-1}$
   f) $y^{\frac{2}{7}} + y^{\frac{5}{7}}$
   g) $\left(\frac{x}{y^4}\right)^{\frac{1}{2}}$
   h) $\left(\frac{x^2}{y}\right)^{-\frac{3}{2}}$
3. Simplify.
   a) $64\left(a^{\frac{2}{3}}\right)^{\frac{1}{3}}$
   b) $\left((16a)^{\frac{1}{3}}\right)^{\frac{1}{2}}$
   c) $\left(81a^{\frac{1}{3}}\right)^{\frac{1}{2}}$
   d) $y^{\frac{3}{2}} \cdot y^{\frac{1}{2}}$
   e) $a^3 b^{\frac{1}{2}}$
   f) $\dfrac{10x^{-\frac{3}{5}}}{5x^{\frac{3}{5}}}$
   g) $\dfrac{(a^4)^{\frac{1}{3}} + a}{9}$
4. Write each radical as a power a^n.
   a) $\sqrt[5]{a^3}$
   b) $\sqrt[5]{a^4}$
   c) $\sqrt{a^5}$
   d) $\dfrac{1}{\sqrt[4]{a}}$
   e) $\dfrac{1}{\sqrt[4]{a^5}}$
5. Write as a power and evaluate.
   a) $\sqrt[3]{\sqrt{64}}$
   b) $\dfrac{1}{\sqrt[4]{625}}$
   c) $\sqrt{\sqrt{2401}}$
6. Put in the form ax^n, $a \in \mathbb{Z}$, $n \in \mathbb{Q}$.
   a) $\sqrt[3]{27x^7}$
   b) $\sqrt[4]{81x^3}$
   c) $\sqrt[3]{-64x}$
   d) $\sqrt[4]{x^3}\sqrt{x}$
   e) $3\sqrt[3]{x} \cdot 3\sqrt[3]{x}$
   f) $\left(\dfrac{25\sqrt[3]{x^5}}{5x^{1/3}}\right)^2$
7. Equivalent expressions using positive exponents.
   a) $\sqrt{\sqrt{x^5}}$
   b) $\sqrt[3]{\sqrt{a^8}}$
   c) $\sqrt[3]{\sqrt{729y^{12}}}$
   d) $\sqrt[3]{\sqrt{x^{2/3}}}$
   e) $(\sqrt[4]{2y-3})^{-3}$
   f) $\left(\sqrt[4]{x^4y^3}\right)^{3/2}$
   g) $-\sqrt[3]{x^2}$
   h) $\sqrt[3]{(-x)^2}$

8. **Matching.** Match the numbers to letters. Assume $p, q > 0$.

(1) $\left(\frac{p}{q}\right)^{\frac{4}{3}}$

(2) $\left(\frac{p}{q}\right)^{\frac{3}{4}}$

(3) $\left(\frac{q}{p}\right)^{-\frac{4}{3}}$

(4) $\left(\frac{p}{q}\right)^{-\frac{3}{4}}$

(5) $\left(\frac{q}{p}\right)^{\frac{3}{4}}$

(A) $\sqrt[4]{\frac{q^3}{p^3}}$ (B) $\sqrt[4]{\frac{p^3}{q^3}}$ (C) $\sqrt[3]{\frac{p^4}{q^4}}$ (D) $\sqrt[3]{\frac{q^4}{p^4}}$

9. **Multiple Choice.** Which is equivalent to $(-x^3)^{-\frac{5}{3}}$?

A. x^5 **B.** $-x^{1/3}$ **C.** $\frac{1}{x^5}$ **D.** $-\frac{1}{x^5}$

10. **Multiple Choice.** Which is *not* equivalent to the others?

A. $a^{-\frac{4}{3}}$ **B.** $(\frac{1}{a^4})^{\frac{1}{3}}$ **C.** $\frac{1}{\sqrt[3]{a^4}}$ **D.** $\frac{1}{a^{4/3}}$

Practice Test — Exponents

1. The base and exponent in $(-3)^4$ are respectively
   A. -3 and 4 **B.** 3 and 4 **C.** -3 and -4 **D.** 4 and -3
2. The coefficient in $\dfrac{-5x^4}{2}$ is **A.** -5 **B.** $-\dfrac{5}{2}$ **C.** $\dfrac{-5x}{2}$ **D.** -2
3. $-a^0$ is equivalent to **A.** 0 **B.** 1 **C.** -1 **D.** $-a$
4. Consider: I) $4p^2q = 4ppq$; II) $(xy)^3 = x^3y^3$.
   A. I only **B.** II only **C.** I and II **D.** neither
5. Which can be simplified to a^6? **A.** $a^2 \cdot a^4$ **B.** $(a^3)^2$ **C.** $\dfrac{a^8}{a^2}$ **D.** all of these
6. $7a^3 \cdot 2a^4$ simplifies to **A.** $14a^{12}$ **B.** $9a^7$ **C.** $14a^7$ **D.** a^{12}
7. $\dfrac{6a^{15}}{3a^7}$ can be written as **A.** $2a^8$ **B.** $\dfrac{1}{2}a^8$ **C.** $2a^{22}$ **D.** $\dfrac{1}{2}a^{22}$
8. $(-2p^3q)(3pq^2)(-4p^2q^3) = a\,p^x q^y$. The value of a is .
9. x^{-3} is equivalent to
   A. $\dfrac{1}{x^3}$ **B.** $\dfrac{1}{x^{-3}}$ **C.** $-3x$ **D.** $-\dfrac{1}{x^3}$
10. $\dfrac{12x^3}{2x^{-4}}$ simplifies to
    A. $6x^7$ **B.** $6x^{-7}$ **C.** $\dfrac{6}{x^7}$ **D.** $\dfrac{6}{x}$
11. $4x^{-2}$ is equivalent to
    A. $\dfrac{4}{x^2}$ **B.** $\dfrac{1}{4x^2}$ **C.** $4x^2$ **D.** $-\dfrac{4}{x^2}$
12. If $(2.5 \times 10^{-3})(4 \times 10^n) = 1.0 \times 10^2$, then $n =$
    A. 4 **B.** 5 **C.** 7 **D.** 9
13. Copier paper is 1.0×10^{-4} m thick. About how many sheets make 0.25 m?
    A. 2.5×10^3 **B.** 2.5×10^4 **C.** 2.5×10^5 **D.** 2.5×10^6
14. Express $x^{3/5}$ in radical form.
    A. $\sqrt[5]{x^3}$ **B.** $\sqrt[3]{x^5}$ **C.** $\sqrt{x^{3/5}}$ **D.** $\dfrac{1}{\sqrt[5]{x^3}}$
15. If $a > 0$, which must be negative?
    A. $a^{-\frac{4}{3}}$ **B.** $(-a)^{-\frac{4}{3}}$ **C.** $(-a)^{-\frac{5}{4}}$ **D.** $-a^{\frac{5}{4}}$
16. Use $(2^a)^4 = 2^{24}$, $(3^2)^b = 3^{10}$, $\dfrac{5^c}{5^2} = 5^4$, $7^d \cdot 7^3 = 7^{11}$.
    Find a, b, c, d.
17. Write $\dfrac{(-3p^2q)^3(2pq^2)^{-2}}{6} = p^m q^n$ and find $m + n$.

Written Response (5 marks)

Use the following information for all parts: Average height $= 1.65$ m; hairs/person $= 1.25 \times 10^5$; world population $= 6.80 \times 10^9$; Earth circumference $= 4.00 \times 10^7$ m; $m_{\text{Earth}} = 5.98 \times 10^{24}$ kg; $m_{\text{Sun}} = 1.99 \times 10^{30}$ kg; $m_{\text{Mercury}} = 3.30 \times 10^{23}$ kg; $m_e = 9.11 \times 10^{-31}$ kg.

1. To the nearest million, how many people laid head-to-toe would encircle the Earth once? (Standard form.)
2. Estimate the total number of human hairs on Earth. (Scientific notation; mantissa to the nearest hundredth.)
3. Approximately how many electrons have the same mass as Mercury? (Scientific notation; nearest hundredth.)
4. How many times heavier is the Sun than the combined mass of Earth and Mercury? (Standard decimal, nearest thousand.)