

Algebra 1 · Exponent Rules, Radicals and Rational Exponents · Worksheet Answer Key

Common Core N-RN.A.1, N-RN.A.2 · mathovore.fr

Every problem has a full worked solution with the final answer in bold. Compare each step with your own work, especially the order of root and power in rational exponents, and the signs in negative exponents.

Algebra 1 Common Core: N-RN.A.1 · N-RN.A.2

Problem 1: Evaluate powers

- $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$
- $(-2)^3 = (-2)(-2)(-2) = -8$
- The exponent applies only to 5, so $-5^2 = -(5 \cdot 5) = -25$.

Problem 2: Pattern of powers of 10

Divide by 10 at each step: $10^0 = 10 \div 10 = 1$, $10^{-1} = 1 \div 10 = \frac{1}{10}$, $10^{-2} = \frac{1}{100}$.

n	3	2	1	0	-1	-2
10^n	1,000	100	10	1	1/10	1/100



The completed table.

Problem 3: Product rule

- Add the exponents: $x^{6+3} = x^9$.
- $a^{1+4} = a^5$.
- $y^{2+5+1} = y^8$.

Problem 4: Quotient rule

- Subtract: $x^{12-5} = x^7$.
- $m^{7-1} = m^6$.
- $b^{6-6} = b^0 = 1$.

Problem 5: Power of a power

- a. Multiply: $y^{4 \cdot 3} = y^{12}$.
- b. n^{10} , so n^{10} .
- c. $z^{2 \cdot 6} = z^{12}$.

Problem 6: Power of a product

- a. $2^4 a^{12} = 16a^{12}$.
- b. $(-3)^3 x^6 = -27x^6$.
- c. $5^2 p^2 q^4 = 25p^2 q^4$.

Problem 7: Coefficients and variables

- a. Multiply coefficients, add exponents: $12x^7$, so $12x^7$.
- b. $(-2)(5) = -10$, $a^{3+1} = a^4$, $b^{1+4} = b^5$. Answer: $-10a^4b^5$.
- c. $(7)(-1) = -7$ and $y^{2+6} = y^8$. Answer: $-7y^8$.

Problem 8: Dividing monomials

- a. $20 \div 5 = 4$ and $m^{8-3} = m^5$: $4m^5$.
- b. $36 \div 12 = 3$, $x^{5-1} = x^4$, $y^{4-2} = y^2$: $3x^4y^2$.
- c. $-18 \div 6 = -3$ and $a^{9-9} = 1$: -3 .

Problem 9: Negative exponents

- a. Only x has the negative exponent: $\frac{4}{x^3}$.
- b. Move m^{-2} to the numerator: $5m^2$.
- c. $2^{-5} = \frac{1}{2^5} = \frac{1}{32}$.

Problem 10: Mixed exponent rules

- a. $x^{5-8} = x^{-3} = \frac{1}{x^3}$.
- b. $4x^6 \cdot x^{-4} = 4x^2$.
- c. $a^{-2-3}b^{5-2} = a^{-5}b^3 = \frac{b^3}{a^5}$.

Problem 11: Unit-fraction exponents

- a. $\sqrt{25} = 5$ because $5^2 = 25$.
- b. $\sqrt[3]{64} = 4$ because $4^3 = 64$.
- c. $\sqrt[4]{81} = 3$ because $3^4 = 81$.

Problem 12: Radicals to exponents

- a. $7^{1/2}$

b. The index 3 is the denominator, the power 5 the numerator: $x^{5/3}$.

c. $a^{3/4}$

Problem 13: Exponents to radicals

a. $\sqrt{x}$

b. $\sqrt[3]{y^2}$, which equals $(\sqrt[3]{y})^2$.

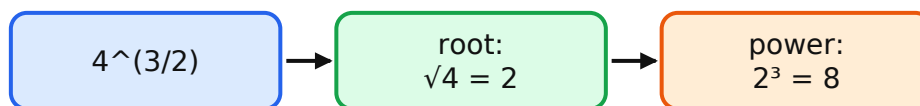
c. $\sqrt[4]{5^3}$, which equals $\sqrt[4]{125}$.

Problem 14: Rational powers

a. $8^{2/3} = (\sqrt[3]{8})^2 = 2^2 = 4$.

b. $4^{3/2} = (\sqrt{4})^3 = 2^3 = 8$.

c. $81^{3/4} = (\sqrt[4]{81})^3 = 3^3 = 27$.



Root first, then power.

Problem 15: Negative rational powers

a. $27^{2/3} = 9$, so $27^{-2/3} = \frac{1}{9}$.

b. $16^{1/2} = 4$, so $16^{-1/2} = \frac{1}{4}$.

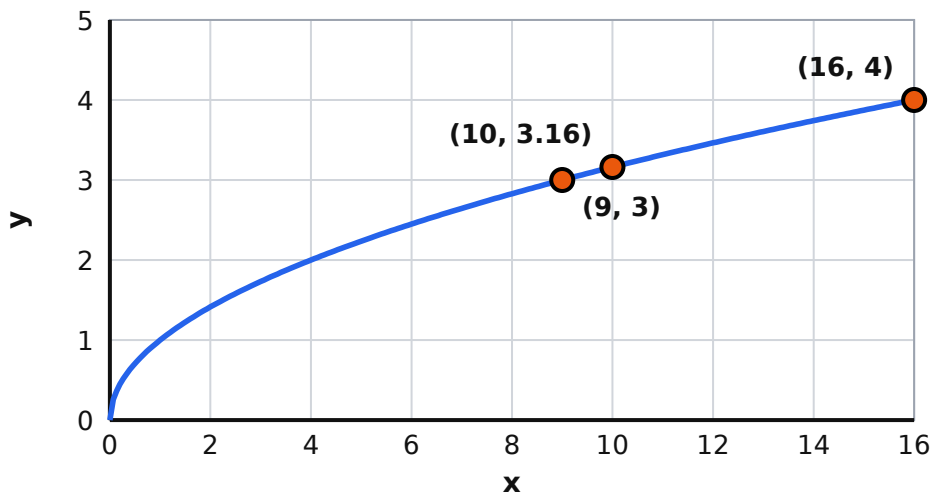
c. $32^{3/5} = 2^3 = 8$, so $32^{-3/5} = \frac{1}{8}$.

Problem 16: Reading a graph

a. The point (9, 3) is on the graph, so $9^{1/2} = 3$.

b. 10 is just past 9, so the curve is a little above 3: about **3.2** (the calculator value is 3.16).

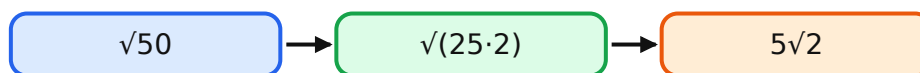
c. $x^{1/2} = 4$ means $x = 4^2 = 16$.



Reading the graph at $x = 9, 10$ and 16 .

Problem 17: Simplify numeric square roots

- a. $\sqrt{50} = \sqrt{25 \cdot 2} = 5\sqrt{2}$.
- b. The largest perfect square factor of 48 is 16: $\sqrt{16 \cdot 3} = 4\sqrt{3}$.
- c. $\sqrt{100 \cdot 2} = 10\sqrt{2}$.



Pulling the perfect square 25 out of 50.

Problem 18: Rational exponent rules

- a. Add: $x^{1/2+3/2} = x^2$, so x^2 .
- b. Subtract: $x^{5/3-2/3} = x^1$, so x .
- c. Multiply: $x^{3/4 \cdot 2} = x^{3/2}$, so $x^{3/2}$.
- d. $x^{2/3 \cdot 6} = x^4$, so x^4 .

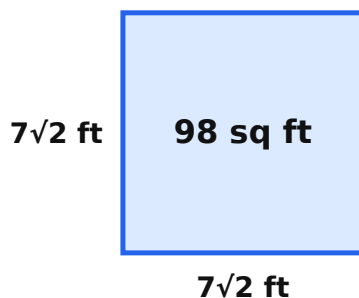
Problem 19: Square roots with variables

- a. $x^{6/2} = x^3$.
- b. $\sqrt{9 \cdot 2 \cdot x^4} = 3x^2\sqrt{2}$, so $3x^2\sqrt{2}$.
- c. $75a^5 = 25 \cdot 3 \cdot a^4 \cdot a$, so the root is $5a^2\sqrt{3a}$.

Problem 20: Square garden

$$s = \sqrt{98} = \sqrt{49 \cdot 2} = 7\sqrt{2} \text{ ft} \approx 9.9 \text{ ft}.$$

$$\text{Perimeter: } 4 \cdot 7\sqrt{2} = 28\sqrt{2} \approx 39.6 \text{ ft of fencing.}$$

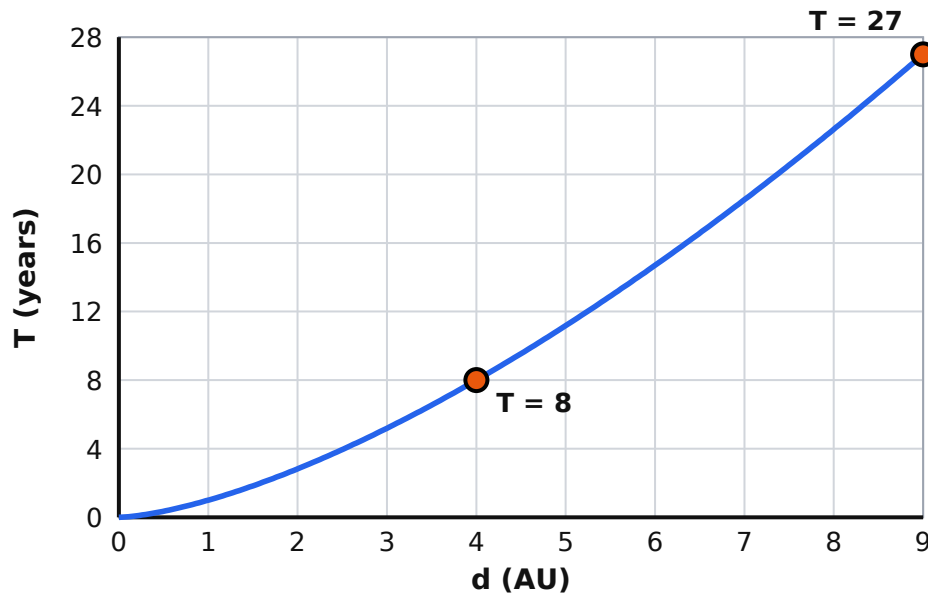


Side length $7\sqrt{2}$ ft, about 9.9 ft.

Problem 21: Orbit model

- a. $4^{3/2} = (\sqrt{4})^3 = 2^3 = 8$ years. $9^{3/2} = (\sqrt{9})^3 = 3^3 = 27$ years. Both match the graph.

b. $d^{3/2} = 64$. Raise both sides to the power $\frac{2}{3}$: $d = 64^{2/3} = (\sqrt[3]{64})^2 = 4^2 = 16$ A.U. Check:
 $16^{3/2} = 4^3 = 64$.

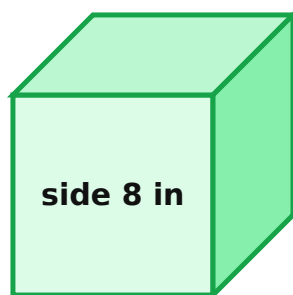


Checking the graph: $T(4) = 8$ and $T(9) = 27$.

Problem 22: Cube crate

$s^3 = 512$, so $s = 512^{1/3} = \sqrt[3]{512} = 8$ in because $8^3 = 512$.

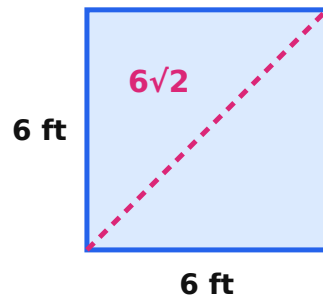
A cube has 6 square faces: $6 \cdot 8^2 = 6 \cdot 64 = 384$ square inches.



Each edge is 8 in.

Problem 23: Patio diagonal

$d^2 = 6^2 + 6^2 = 72$, so $d = \sqrt{72} = \sqrt{36 \cdot 2} = 6\sqrt{2}$ ft ≈ 8.5 ft.



Diagonal $d = 6\sqrt{2} \text{ ft} \approx 8.5 \text{ ft}$.

Problem 24: Find the errors

- Jamal did not cube the coefficient. $(2x^3)^3 = 2^3x^9 = 8x^9$.
- Aisha multiplied the base by the exponent. The denominator 2 means a square root:
 $16^{3/2} = (\sqrt{16})^3 = 4^3 = 64$.

Problem 25: Cube with a variable edge

Edge: $(27x^6)^{1/3} = 27^{1/3} \cdot x^{6/3} = 3x^2$. Check: $(3x^2)^3 = 27x^6$.

Surface area: $6 \cdot (3x^2)^2 = 6 \cdot 9x^4 = 54x^4$ square units.