

Advanced Algebra

Exponent Rules and Shortcuts Practice GREEN #2 2023

Multiplying like bases

Shortcut: $b^m b^n = b^{m+n}$

Dividing like bases

Shortcut: $\frac{b^m}{b^n} = b^{m-n}$

Parenthesis Exponents

Shortcut: $(ab)^n = a^n b^n$ and $(b^m)^n = b^{mn}$

Negative Exponents

Shortcut: $b^{-m} = \frac{1}{b^m}$ and $\frac{a^{-n}}{b^{-m}} = \frac{b^m}{a^n}$

Zero Exponents

Shortcut: $b^0 = 1$

Use the shortcuts to simplify these expressions. They should be quick one-step problems:

1) $b^5 b^{10}$

$$\boxed{b^{15}}$$

2) $\frac{x^{18}}{x^8}$

$$\boxed{x^{10}}$$

3) $a^8 b^{-5}$

$$\boxed{\frac{a^8}{b^5}}$$

4) $\frac{x^6}{x^8}$

$$\boxed{\frac{1}{x^2}}$$

5) x^0

$$\boxed{1}$$

6) $(a^3 b c^5)^{10}$

$$\boxed{a^{30} b^{10} c^{50}}$$

7) $(2xy^8)^0$

$$\boxed{1}$$

8) $a^{12} a^{-7}$

$$\frac{a^{12}}{a^7} \text{ or } \boxed{a^5}$$

9) $a^{12} b^{-8} c^{-3}$

$$\boxed{\frac{a^{12}}{b^8 c^3}}$$

10) $(x^3)^{12}$

$$\boxed{x^{36}}$$

11) $(a^4)^8$

$$\boxed{a^{32}}$$

Use two of the rules together to simplify these expressions.

1) $(4x^3)^2 x^9$

$$4^2 x^6 x^9 = \boxed{16x^{15}}$$

2) $(a^5 b^2)^6 a^3 b^3$

$$a^{30} b^{12} a^3 b^3 = \boxed{a^{33} b^{15}}$$

3) $\frac{(a^3 b^5)^7}{ab^{18}}$

$$\frac{a^{21} b^{35}}{a b^{18}} = \boxed{a^{20} b^{17}}$$

4) $\frac{(5x^4)^2}{x^6}$

$$\frac{5^2 x^8}{x^6} = \boxed{25x^2}$$

5) $x^{-3} y^4 z^3 x^{-6} y^3 z^{10}$

$$x^{-9} y^7 z^{13} = \boxed{\frac{y^7 z^{13}}{x^9}}$$

6) $a^8 b^6 c^4 a^{-2} b^{-2} c^{-8}$

$$a^6 b^4 c^{-4} = \boxed{\frac{a^6 b^4}{c^4}}$$

7) $(x^4 y^7)^{-3}$

$$x^{-12} y^{-21} = \boxed{\frac{1}{x^{12} y^{21}}}$$

8) $(a^4 b^9)^{-12}$

$$a^{-48} b^{-108} = \boxed{\frac{1}{a^{48} b^{108}}}$$

9) $(\frac{a^2}{3b})^4$

$$\frac{a^8}{3^4 b^4} = \boxed{\frac{a^8}{81 b^4}}$$

Green #2

This is a great problem to check understanding of order of operations

$$10) \frac{5w^{-18}y^{-4}}{25y^8w^{-22}} = \frac{w^4}{5y^{12}}$$

$$11) (-7xy^4)(8xy^2) = -56x^2y^6$$

$$12) 8(3j^3)^4 = 8 \cdot 3^4 \cdot j^{12} = 648j^{12}$$

Remember a Root is a fraction exponent. So anything with a radical sign can be written with a rational exponent. So $\sqrt{6}$ is the same thing as $6^{\frac{1}{2}}$

Great problem for changing base !!

$$1) \sqrt[3]{81x^9y^{12}} = (81x^9y^{12})^{\frac{1}{3}} = 81^{\frac{1}{3}} x^3 y^4 = \sqrt[3]{81x^3y^4}$$

$$2) \left(\frac{b^{4x}b^{2x}}{b^4}\right)^2 = \left(\frac{b^{6x}}{b^4}\right)^2 = \frac{b^{12x}}{b^8}$$

$$3) 2^{3k+1} \cdot 8^{k-1} = 2^{3k+1} \cdot 2^{3(k-1)} = 2^{3k+1} \cdot 2^{3k-3} = 2^{6k-2}$$

$$4) (x^{\frac{1}{2}}y^{\frac{1}{5}})^{100} = x^{50}y^{20}$$

$$5) (6^5\sqrt{6^5})(\sqrt{6^3}) = 6^5 \cdot 6^{\frac{5}{2}} \cdot 6^{\frac{3}{2}} = 6^9$$

$$6) \frac{a^2b^{\frac{-1}{3}}c^{-1}}{\frac{1}{a^2}b^{\frac{4}{3}}c^2} = \frac{a^2}{a^{\frac{1}{2}}b^{\frac{4}{3}}b^{\frac{1}{3}}c^2c^1} = \frac{a^2}{a^{\frac{1}{2}}b^{\frac{5}{3}}c^3}$$

$$7) \frac{x^2y^{-3}z^{-1}}{(a^5b^5c^5)^{10}} = \frac{x^2y^{-3}z^{-1}}{a^{50}b^{50}c^{50}}$$

$$8) \frac{x^8y^{12}}{x^4y^3z^2} = \frac{x^4y^9}{z^2}$$

Re-write the following as a logarithm

9) $66^x = 281$

$$\log_{66} 281 = x$$

10) $3^x = 267$

$$\log_3 267 = x$$

11) Re-write the equation $\log_3 \frac{1}{81} = -4$ in exponent form

$$3^{-4} = \frac{1}{81}$$

12) Solve the following equation: $3^{2x-3} = 9^x$

$$2x-3 = \left(\frac{\log 9}{\log 3}\right)x \quad 2x$$