Grade 9

Number Sense and Numeration: Exponents

Play the **Exponents less than and Greater than** Game
http://www.softschools.com/math/games/exponents_practice.jsp.
You may also go to www.wiredmath.ca for the link.

Recall some of the rules of exponents:

1. $x^0 = 1, \quad x \neq 0$
2. $x^1 = x$
3. $x^m \times x^n = x^{m+n}$
4. $x^m \div x^n = x^{m-n}, \quad x \neq 0$
5. $(x^m)^n = x^{m \times n}$
6. $(xy)^m = x^m y^m$
7. $\left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}, \quad y \neq 0$
8. $x^{-m} = \frac{1}{x^m}, \quad x \neq 0$

1. Evaluate each power.

a. 4^3 b. $\left(\frac{3}{5}\right)^4$ c. -7^6 d. $(-4)^5$

2. Write the following in exponential form.

a. $11 \times 11 \times 11 \times 11 \times 11$ b. $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$

c. $\frac{1}{2 \times 2 \times 2}$ d. $\frac{1}{7 \times 7 \times 7 \times 7 \times 7}$

e. $3 \times y \times y \times y$ f. $2n \times 2n \times 2n \times 2n \times 2n$

g. $\frac{5}{r \times r \times r \times r}$ h. $\frac{d \times d \times d \times 6 \times 6 \times 6 \times 6}{7 \times 7 \times m \times m \times n}$

i. $(-5) \times (-5y) \times (-5y)$ j. $2lk \times 2lk \times 3lk \times 3l \times 3k \times 3k$

3. Write each as a repeated multiplication.

a. 9^5 b. $5s^4$ c. $(4a)^2$ d. -12^4 e. $\left(\frac{2}{n}\right)^6$

f. $7 \times \left(-\frac{1}{2}\right)^3$ g. $-\left(\frac{2}{3}\right)^4$ h. $7^3 y^2$ i. $-53x^4$ j. $\left(\frac{116}{m^3}\right)^2$

4. Simplify. Leave your answer in exponential form.

a. $7^3 \times 7^2$ b. 5×5^6 c. $z^4 \times z^8$ d. $12^4 \div 12^3$ e. $2^4 \div 2^4$

f. $p^{12} \div p^8$ g. $(3^2)^4$ h. $(2^4)^4$ i. $(s^3)^2$ j. $m^{11} \div m^5 \times m^4$

5. Write each expression as a simple positive power.

a. $\frac{9^6 \times 9}{9^4}$ b. $\frac{4^3}{4^4 \times 4^4}$ c. $\frac{(-5)^5 \times (-5)^3}{(-5)^3}$ d. $\frac{(-6)^8}{(-6)^5 \times (-6)^5}$

6. Determine the value of x.

a. $4^2 \times 4^x = 4^6$ b. $5^x \times 5^3 = 5^9$ c. $t^3 \times t^x = t^4$ d. $8^7 \div 8^x = 8^5$ e. $7^x \div 7^9 = 7$

f. $m^6 \div m^x = m^2$ g. $(4^2)^x = 4^8$ h. $(14^x)^6 = 14^{36}$ i. $(b^x)^3 = b^3$ j. $2^{2x} \times 2^3 = 2$

7. Evaluate all of the powers of -3 up to $(-3)^{10}$, beginning with $(-3)^1$.

a. i. When will $(-3)^n$ be negative? ii. Why do you think this is so?

b. i. When will $(-3)^n$ be positive? ii. Why do you think this is so?

8. Simplify. Leave your answer in exponential form.

a. $4^3 \times 5^3$ b. $10^8 \times 3^8$ c. $7^x \times 8^x$

d. $5^2 \times 5^2 \times 5^2 + 5^6$ e. $8^4 \times 3^4 \times 2^4$ f. $9^t \times 2^t \times b^t$

9. Simplify. Leave your answer in exponential form.

a. $\dfrac{4^3}{2^3}$ b. $\dfrac{6^7}{9^7}$ c. $\dfrac{10^v}{4^v}$ d. $\dfrac{10^9}{\left(\frac{1}{2}\right)^9}$ e. $\dfrac{6^2}{\left(\frac{5^2}{10^2}\right)}$

f. $\dfrac{2^4}{\left(\frac{2^2}{4^2}\right)^2}$ g. $\dfrac{5^a}{\left(\frac{25^a}{125^a}\right)}$ h. $\dfrac{3^5 \times 12^2}{21^7}$ i. $\dfrac{4a^2 \times 2a^3}{16}$ j. $\dfrac{7^7 \times 49^2}{\left(\frac{21}{3}\right)^4}$

10. a. On a quiz, Fauna wrote the following: $4^4 \times 4^2 = 16^6$.

i. What mistake did Fauna make? ii. What does $4^4 \times 4^2$ equal?

b. On the same quiz, Mark calculated $15^3 \div 5^2 = 3^1$.

i. What mistakes did Mark make? ii. Calculate $15^3 \div 5^2$.

11. Lani's giant rectangular backyard is 9^5 m long and 9^3 m wide. What is the area of the backyard? Express your answer in exponential form.

12. Keiko's gigantic cube-shaped bedroom is 7^5 mm long. What is the volume of her bedroom? Express your answer in exponential form.

CHALLENGE YOURSELF!

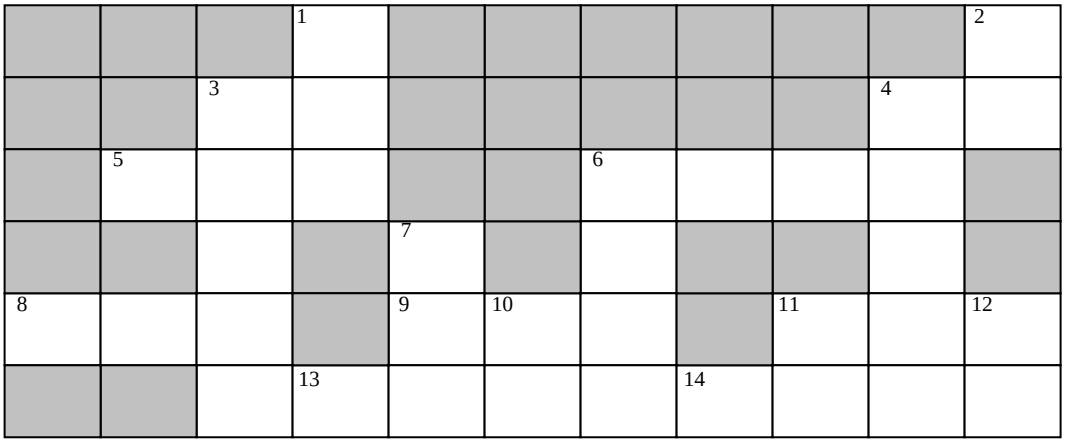
13. Simplify the following expressions:

a. $\dfrac{4a^x \times 2a^6}{16}$ b. $12^{\frac{1}{2}} \times 15^{\frac{1}{3}} \times 12^{\frac{5}{4}} \times 15^{\frac{2}{9}}$ c. $2^{15} \times 4^7 \times 8^{-22}$

d. $\dfrac{9^{\frac{3}{4}} \times 9^{\frac{5}{6}}}{9^{\frac{2}{3}} \times 9^{\frac{4}{5}}}$ e. $\dfrac{xy^{-\frac{7}{5}} \times y^{-34}x^{\frac{1}{9}}}{\left(-y^{-18}\right)^2\left(x^{-\frac{7}{6}}y^{\frac{14}{5}}\right)^{-3}x^{\frac{11}{18}}}$ f. $\dfrac{7^4 \times 7^{-9} + 7^{-5}}{7^{-12}}$

EXTENSION

14. In the cross word below, solve for the value of α.
(where there is an exponential solution, such as 2^5, solve for the actual value).



Across

2. $5^9 \div 5^{10} \times \alpha = 1$

3. $\dfrac{2^3}{(6^5)^6} \times \dfrac{9^2}{6^{37}} = \dfrac{3}{6^\alpha}$

4. $5d + 17c + 8d + \alpha c = 13(d + c)$

5. $2^{3.5} \times 2^\alpha \times 4^{3.6} = 2048$

6. $\dfrac{0.1(10^2 \times 10^3)^2 (0.1^2)^3 (10^4)^3}{10^{-3}(10^3)^7 (0.1^4 \times 0.1^3)10} = \alpha$

8. $(-b^{-3})^5 = -b^\alpha$

9. $130\left(\dfrac{7}{2}\right)^2 - 62\left(\dfrac{7}{2}\right)^2 = \alpha$

11. $\dfrac{(o^2 m^{12} \times m^{15})^9 (m^8 \times m^3 n^4)^2}{(m^2 n o^0)^3} = m^\alpha n^y o^z$

Down

1. $(5 + 2)^3 = \alpha$

2. $\dfrac{-12c(6c^3)(-3c^2)^3}{(2 \times 3c^5)^2} = \alpha$

3. $\dfrac{(-5pe^3)^2 (pe)^{-1}}{(2e)^2 pe^2} = \alpha$

4. $\dfrac{-3t^5}{24t^2} = \alpha^3$

6. $\alpha^3 = 3581577n^3$

7. $3p \times (951p - 183p) = \alpha^2$

10. $\dfrac{(5u^5c^8)}{-uc^{6-o}}(-4u^2c^\alpha) = 20u^6c^{2+4o}$

11. $\dfrac{4^3 \times 2^{2n}}{2^\alpha \div 8^3} = \dfrac{16^4}{2}$

12. $\dfrac{-11u^5s^7}{-729s(us^3)^3} = \dfrac{11u^2}{\alpha^3}$

13. $\dfrac{8x^{25}y^{14}z^4(3xyz)^2}{6^2x^4z^6(x^{10}y^8)^2 2x^2} = \alpha$

14. $\dfrac{89(89^{\alpha+2}k)^3 \times 89^e l^{59d}}{l^{4d+1}(89^{15e+3}k)^2} = \dfrac{89^{15e} kl^{67d} \times 89^{2e+1}}{l^{12d+1} \times 89^{43e}}$

Did You Know?
There are more than 2^{72} possible grids of classic Sudoku.