ZERO AND NEGATIVE EXPONENTS

A nonzero number to the zero power is 1.

$$a^0 = 1$$

Examples: Evaluate.

1. $5^0 = 1$ 2. $(-3)^0 = 1$ 3. $(\frac{1}{9})^0 = 1$

-3^0

-1

Zero raised to the zero power is undefined.

NEGATIVE EXPONENTS

$$a^{-n} = \frac{1}{a^n} \quad \text{or} \quad a^n = \frac{1}{a^{-n}}$$

Examples: Evaluate.

4. $\dfrac{2^{-2}}{1}$

$\dfrac{1}{2^2}$

$\boxed{\dfrac{1}{4}}$

5. $\dfrac{1}{(-3)^{-4}}$

$(-3)^4$

$\boxed{81}$

6. $\left(\frac{1}{4}\right)^{-3}$ ← turns to pos. (Flip fraction)

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

$(4)^3$

$\boxed{64}$

Examples: Evaluate.

7. $6^{-4} \cdot 6^4$

6^{-4+4}

6^0

$\boxed{1}$

8. $(2^{-3})^{-2}$

2^6

$\boxed{64}$

9. $(-3 \cdot 2)^{-2}$

$(-3)^{-2} \quad (2)^{-2}$

$\frac{1}{(-3)^2} \cdot \frac{1}{(2)^2}$

$\frac{1}{9} \cdot \frac{1}{4} = \boxed{\frac{1}{36}}$

10. $(3^{-2})^{-2}$

3^4

$\boxed{81}$

11. $(2 \cdot 5)^{-2}$

10^{-2}

$\frac{1}{10^2} = \boxed{\frac{1}{100}}$

12. $4^2 \cdot 4^{-3}$

4^{2+-3}

$4^{-1} = \frac{1}{4^1} = \boxed{\frac{1}{4}}$

Examples: Rewrite using positive exponents.

13. $2x^{-2}y^{3}$

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

14. $\frac{5c^{-4}}{d^{-5}}$

$\frac{5d^5}{c^4}$

15. $(5a)^{-3}$

$\frac{1}{(5a)^3}$

$\frac{1}{5^3a^3}$

$\frac{1}{125a^3}$

16. $\frac{4k^{-3}}{m^8p^{-2}}$

$\frac{4p^2}{k^3m^8}$

Examples: Rewrite using positive exponents.

17. $(3x^{-2}y^2)^3$

$\left(\frac{3y^2}{x^2}\right)^3$

$\frac{3^3(y^2)^3}{(x^2)^3} = \frac{27y^6}{x^6}$

18. $\frac{4x^{-2}y^4}{8xy^6}$

$\frac{1}{2}x^{-2-1}y^{4-6}$

$\frac{1}{2}\frac{x^{-3}y^{-2}}{1} = \frac{1}{2x^3y^2}$

19. $\left(\frac{2g^{-1}h^{-3}}{3g^{-3}h^4}\right)^2$

$\left(\frac{2g^{-1+3}h^{-3-4}}{3}\right)^2$

$\left(\frac{2g^2h^{-7}}{3}\right)^2 = \left(\frac{2g^2}{3h^7}\right)^2$

$\frac{2^2(g^2)^2}{3^2(h^7)^2} = \frac{4g^4}{9h^{14}}$

20. $\left(\frac{-5j^{-6}k^8}{4j^{-2}k^4}\right)^3$

$\left(\frac{-5j^{-6+2}k^{8-4}}{4}\right)^3$

$\left(\frac{-5j^{-4}k^4}{4}\right)^3$

$\left(\frac{-5k^4}{4j^4}\right)^3$

$\frac{(-5)^3(k^4)^3}{4^3(j^4)^3} = \frac{-125k^{12}}{64j^{12}}$