

# Exponents Lesson 2

October 22, 2018 6:45 PM

Done your journal? Start on "Warm-Up"

Math 10

## Unit 2: Exponents

Lesson 2: pages 10-12

**Warm-Up:**

1.  $5^{-2} = \frac{1}{5^2} = \frac{1}{25}$

2.  $8^{-1} = \frac{1}{8^1} = \frac{1}{8}$

3.  $3^{-3} = \frac{1}{3^3} = \frac{1}{27}$

4.  $(-2)^4 = (-2) \cdot (-2) \cdot (-2) \cdot (-2) = 16$

5.  $\left(\frac{3}{10}\right)^{-2} = \frac{3^{-2}}{10^{-2}} = \frac{10^2}{3^2} = \frac{100}{9}$

6.  $a^{\frac{8}{3}} \times a^{\frac{1}{3}} = a^{\frac{8}{3} + \frac{1}{3}} = a^{\frac{9}{3}} = a^3$

7.  $a^{-8} \div a^1 = a^{-8-1} = a^{-9} = \frac{1}{a^9}$

8.  $\frac{100x^9}{50x^8} = \frac{100 \div 50}{x^9 \div x^8} = \frac{2}{x^{9-8}} = \frac{2}{x^1} = \frac{2}{x}$

9.  $a^9 \div a^{12} = a^{9-12} = a^{-3} = \frac{1}{a^3}$

10.  $\frac{6x^4}{6x^5} = \frac{6 \div 6}{x^4 \div x^5} = \frac{1}{x^{4-5}} = \frac{1}{x^{-1}} = \frac{1}{\frac{1}{x}} = \frac{1}{1 \cdot \frac{1}{x}} = \frac{1}{\frac{1}{x}} = \frac{1 \cdot x}{1} = x$

11.  $\left(\frac{2}{5}\right)^{-3} = \frac{2^{-3}}{5^{-3}} = \frac{1}{2^3} \cdot \frac{5^3}{1} = \frac{125}{8}$

12.  $6m^{12} \div 12m^{12} = \frac{6 \div 12}{m^{12} \div m^{12}} = \frac{1}{2} \cdot \frac{m^{12-12}}{1} = \frac{1}{2} \cdot \frac{m^0}{1} = \frac{1}{2} \cdot 1 = \frac{1}{2}$

13.  $30m^8 \div (-10m) = \frac{30 \div (-10)}{m^8 \div m^1} = \frac{-3}{m^{8-1}} = \frac{-3}{m^7} = -3m^{-7}$

14.  $\frac{3m^4}{4m^2} = \frac{3m^4}{4m^2}$

you can take the reciprocal (flip) of select terms.

exponents are (+), then it is simplified.

**Exponent Laws:**

From Math 9, you should have learned how to simplify the following monomial expressions using the following exponent laws:

**Note: DO NOT use exponent laws when bases aren't equal**

eg.  $x^2 \div y^3 \neq xy^{2-3}$

$3^3 \cdot 3^5 = 3^{3+5}$  ✓  
 $3^3 \cdot 2^5 \neq 6^{3+5}$  X

bases NOT equal → cannot apply laws.

Exponent Laws	Examples (simplify & evaluate where possible)
<b>Power of a Power</b> $(a^m)^n = a^{m \cdot n}$	a) $(0.25^{-3})^{-5} = 0.25^{-3 \cdot -5} = 0.25^{15}$ b) $(8^{-2})^4 = 8^{2 \cdot 4} = 8^8 = 16777216$ c) $(m^5)^3 = m^{5 \cdot 3} = m^{15}$ d) $(2m^{10})^3 = 2^3 \cdot m^{10 \cdot 3} = 8 \cdot m^{30} = 8m^{30}$
<b>Power of a Product</b> $(ab)^n = a^n \cdot b^n$	a) $(-6my^3)^2 = (-6)^2 \cdot (m^1)^2 \cdot (y^3)^2 = 36m^2y^6$ b) $(x^4y^{-2})^5 = (x^4)^5 \cdot (y^{-2})^5 = x^{20} \cdot y^{-10} = \frac{x^{20}}{y^{10}}$ c) $(8x^{-4})^2 = (8)^2 \cdot (x^{-4})^2 = 64 \cdot x^{-8} = \frac{64}{x^8}$ d) $(3m^{-2}y^3)^{-3} = (3)^{-3} \cdot (m^{-2})^{-3} \cdot (y^3)^{-3} = \frac{1}{27} \cdot m^6 \cdot y^{-9} = \frac{m^6}{27y^9}$ e) $(3t^0)^4 = 3^4 \cdot (t^0)^4 = 81 \cdot t^{0 \cdot 4} = 81 \cdot t^0 = 81 \cdot 1 = 81$

NOTE:  $a^m \cdot a^n \neq (a^m)^n$  NOT the same

\* exponent applies to all terms in brackets.

↑↑ bases... coefficients, variables, 2^+....

$(-6my^3)^2 = -216m^2y^6$

$(x^4y^{-2})^5 = \frac{x^{20}}{y^{10}}$  ← exp.

$(3m^{-2}y^3)^{-3} = \frac{m^6}{27y^9}$

(More Complicated) Examples ☹️: Evaluate or simplify the following expressions.

1.  $\left(\frac{2x^4y^{-9}}{3x^{-2}y}\right)^{-2} = \left(\frac{3x^2y}{2x^4y^{-9}}\right)^2$   
 ① Flip (reciprocate) to make exponent ⊕  
 ② Simplify inside brackets:  $\left(\frac{3x^2y}{2x^4y^{-9}}\right) = \frac{3y \cdot y^9}{2x^4 \cdot x^2} = \frac{3y^{10}}{2x^6}$  ADD your exponent  
 ③ Expand + Simplify:  $\left(\frac{3y^{10}}{2x^6}\right)^2 = \frac{9y^{20}}{4x^{12}}$  simplified as a power, all exp. must be ⊕

2.  $(-10xy^4)^2 \cdot (5x^2y^3)^{-2}$   
 $[-10 \cdot x^1 \cdot y^4]^2 \cdot [5 \cdot x^2 \cdot y^3]^{-2}$  ① expand expan.  
 $[100 \cdot x^2 \cdot y^8] \cdot [5^{-2} \cdot x^{-4} \cdot y^{-6}]$  ② Apply rules.  
 $5^2 \cdot x^4 \cdot y^6$  Flip (all exp are ⊖)

$= \frac{100x^2y^8}{25x^4y^6} = 4x^{-2}y^2$  Flip.  
 $\frac{4y^2}{x^2}$  ✓ simplified all ⊕ exponents.  
 $100 \div 25 = 4$   
 $x^2 \div x^4 = x^{2-4} = x^{-2}$   
 $y^8 \div y^6 = y^{8-6} = y^2$   
 FMPC 10  
 Updated June 2018  
 HW p 10-12

**Challenge #6**

51. Evaluate.

$(5^2)^3$

$5^{2 \cdot 3} = 5^6 = 15625$

Explain your steps.

apply "power of a power"  
 $(a^m)^n = a^{m \cdot n}$

15625

**Challenge #7**

52. Simplify.

$(m^3)^2$

Explain your steps.

Challenge #8

53. Simplify.  
 $(2m^4)^3$

Explain your steps.

Simplify the following.

<p>54. <math>(m^3)^2</math></p> $= m^3 \times m^3$ $= m^6$ <p style="text-align: center;">⋮</p> $= m^{3 \times 2}$ $= m^6$	<p>55. <math>(t^4)^0</math></p>	<p>56. <math>(x^2y^3)^{-3}</math></p>
<p>57. <math>(2m^4)^3</math></p> $2m^4 \times 2m^4 \times 2m^4$ $= 2 \times 2 \times 2 \times m^4 \times m^4 \times m^4$ $= 8m^{12}$ <p>OR</p> $= 2^3 m^{4 \times 3}$ $= 8m^{12}$	<p>58. <math>(2c^4d^3)^{-3}</math></p>	<p>59. <math>(-3x^{-2}y^3)^{-4}</math></p>
<p>60. <math>(3x^{-2}y^{-3})^{-3}</math></p>	<p>61. <math>(-2xy^3)(-3x^2y^3)^2</math></p>	<p>62. <math>(2a^2)^3(4a^3b)^2</math></p>

<p><b>Power of a Power:</b> Multiply the exponents.</p> <p>Eg. <math>(5^2)^3 = (5 \times 5)^3</math>  <math>= (5 \times 5)(5 \times 5)(5 \times 5)</math>  <math>= 5 \times 5 \times 5 \times 5 \times 5 \times 5</math>  <math>= 5^6</math></p> <p>THE RULE:  <math>(a^m)^n = a^{m \times n}</math></p> <p>If you have a power of a power ... multiply exponents.</p> <p>Eg. <math>(x^2)^5 = x^{2 \times 5} = x^{10}</math></p>	<p><b>Power of a Product:</b> Apply the exponent to all factors.</p> <p>Eg. <math>(5 \times 2)^3</math>  <math>= (5 \times 2) \times (5 \times 2) \times (5 \times 2)</math>  <math>= 5 \times 5 \times 5 \times 2 \times 2 \times 2</math>  <math>= 5^3 \times 2^3</math></p> <p>THE RULE:  <math>(ab)^m = a^m b^m</math></p> <p>If you have a power of a product ... apply the exponent to EVERY factor in the product.</p> <p>Eg. <math>(a^2b^3)^{-3} = a^{2 \times -3} b^{3 \times -3} = a^{-6} b^{-9}</math></p>
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**Challenge #9**

63. Evaluate.

$$\left(\frac{2}{5}\right)^3$$

Explain your steps.

$$\frac{8}{125}$$

**Challenge #10**

64. Evaluate.

$$\left(\frac{2}{5}\right)^{-3}$$

Explain your steps.

$$\frac{125}{8}$$

**Challenge #11**

65. Simplify.

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

Explain your steps.

**Challenge #12**

66. Simplify.

$$\left(\frac{6x^5y^3}{8y^4}\right)^{-2}$$

Explain your steps.