Exponents and Powers

This belongs to:_____

LESSON #	DATE	QUESTIONS FROM NOTES	Questions that I find difficult
1.		Pg.	
2.		Pg.	
3.		Pg.	
4.		Pg.	
5.		Pg.	
6.		Pg.	
7.		Pg.	
8.		Pg.	
9.		REVIEW	
10.		**TEST**	

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Your teacher has important instructions for you to write down below.

Exponents and Powers

IRP	#	Daily Topic	Key Ideas
A1 demonstrate an understanding of powers with integral bases (excluding base 0) and whole number exponents by • representing repeated multiplication using powers • using patterns to show that a power with an exponent of zero is equal to one • solving problems involving powers [C, CN, PS, R, V] A2 demonstrate an understanding of operations on powers with integral bases (excluding base 0) and whole number exponents [C, CN, PS, R, T]	1.	Introduction to Exponents (pg. 4-8) • Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2 • Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged (e.g., 10^3 and 3^{10}) • Express a given power as a repeated multiplication • Express a given repeated multiplication as a power • Explain the role of parentheses in powers by evaluating a given set of powers (e.g., $(-2)^4$, (-2^4) and -2^4) • Evaluate powers with integral bases (excluding base 0) and whole number exponents	• Does $2^3 = 3^2$? Explain your reasoning with a picture. • Use repeated multiplication to explain the difference between 2^5 and 5^2? • Express 5^4 as a repeated multiplication. • Express (-3)(-3)(-3)(-3) as power. • Which of the following are equal: -3^2, (-3^2), $-(3)^2$, $(-3)^2$ Explain your reasoning.
	2.	Order of operations and Calculator skills(pg. 9-13) • Determine the sum of two given powers (e.g., $5^2 + 5^3$) and record the process • Determine the difference of two given powers (e.g., $4^3 - 4^2$) and record the process • Identify the error(s) in a given simplification of an expression involving power.	• Evaluate $5^2+3^3=$ and record the process. • Evaluate $-3^2-2^3=$ and record the process. • Spot the error. $(5-3 \times 2)^2=$ $=(2 \times 2)^2$ $=(4)^2=16$
	3.	Extra time for first two sections.	
	4.	Exponent laws (pg. 14-17) • Evaluate a given expression by applying the exponent laws	Evaluate. • $-19^{20} \div (-19)^{18}$, • $\frac{2^5 \times 2}{2^2} \times \frac{2^2 \times 2^4}{2^5} =$
	5.	Exponent laws (Pg. 17-20) • Identify and correct an error in a given incorrect solution of a linear equation • Identify the error(s) in a given simplification of an expression involving powers. • Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$)	Determine a pattern to explain the value of 2^0.
	6.	Exponent laws (Pg. 21-26) • Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents:	Evaluate. $\frac{2^2 \times 2^8 \left(2^5\right)^2}{2^3 \left(2^2\right)^6} =$ Use an example to clearly explain each exponent law.
	7.	Extra time for last three sections.	
	8.	Chapter Review and Practice Test • Help students develop sound study habits. • Many students will graduate high school saying they do not know how to study for math tests.	
	9.	Go over Practice Test	
	10.	Unit Evaluation	

Exponent Laws and Key Terms

	Definition	Example
Base	The number that is multiplied by itself in a power.	5^7→ the 5 is the base.
Coefficient	A number in front of a variable.	$2b^3+5$ →The 2 is the coefficient.
Cube number	A number that is a product of three identical numbers.	1,8,27,64,…
Evaluate	Determine the answer.	Evaluate 2+3→5
Exponent	A raised number that tells you how many times to multiply the base by itself.	$2b^3+5$ →The 3 is the exponent.
Exponential form	A faster way of writing a repeated multiplication.	5x5x5x5x5x5→5^6
Power	An expression made up of a base and an exponent.	5^7
Power of a product	A product raised to an exponent.	$(2x3)^7$
Power of a quotient	A quotient raised to an exponent.	$\left(\frac{5}{7}\right)^4$
Power of power	A power raised to an exponent.	$(2^3)^5$
Repeated multiplication	Writing in exponential form to show its meaning.	5^6→5x5x5x5x5x5
Solve	A direction to determine the value of a variable.	The solution to $x+8=18$ is x=10.
Square number	A number that is a product of two identical numbers.	1,4,9,16,25…
Variable	A letter that is used to represent a number.	$2b^3+5$ →The b is the variable.

Exponent Laws

Exponent Law	$m^x \times m^y = m^{x+y}$	$m^x \div m^y = m^{x-y}, x>y$	$\left(m^x\right)^y = m^{xy}$
Example	$5^2x5^3=5^{2+3}=5^5$	$5^4\div5^3=\frac{5^4}{5^3}=5^{4-3}=5^1$	$(5^2)^3=5^{2x3}=5^6$
Explanation	$5^2x5^3=$ $=(5x5)x(5x5x5)$ $=5x5x5x5x5$ $=5^5$	$\frac{5^4}{5^3}=$ $=\frac{5\times5\times5\times5}{5\times5\times5}$ $=\frac{\cancel{5\times5\times5}\times5}{\cancel{5\times5\times5}}=5^1$	$(5^2)^3=$ $=(5^2)(5^2)(5^2)$ $=(5x5)(5x5)(5x5)$ $=5x5x5x5x5x5$ $=5^6$

Exponent Law	$(mn)^x = m^x n^x$	$\left(\frac{m}{n}\right)^x = \frac{m^x}{n^x}, n\neq0$	$m^0=1$ & m≠0
Example	$(2x5)^3=2^3x5^3$	$\left(\frac{5}{2}\right)^3=\frac{5^3}{2^3}, 2\neq0$	$2^0=1$
Explanation	$(2x5)^3=$ $=(2x5)(2x5)(2x5)$ $=2x5x2x5x2x5$ $=2x2x2x5x5x5$ $=2^3x5^3$	$=\left(\frac{5}{2}\right)^3=$ $=\left(\frac{5}{2}\right)\left(\frac{5}{2}\right)\left(\frac{5}{2}\right)$ $=\frac{5^3}{2^3}$	$2^0=$ $2^0=2^{3-3}=\frac{2^3}{2^3}=\frac{\cancel{2\times2\times2}}{\cancel{2\times2\times2}}=1$

The Power of Exponents

Challenge #1:

1. Your eccentric Aunt Weltheezan is extremely rich and quirky. She is modifying her will and gives you two options:

- Option #1: \$100 000 cash on your 16th birthday
- Option #2: 1 cent on your 16th birthday, 2cents on your 17th birthday, 4cents on your 18th birthday… continuing this pattern for a total of 30 birthdays.

In true quirky fashion, she insists that you make your decision immediately and without a calculator.

Please fill out the agreement.

The Weltheezan Agreement.

On _____/month_____/day _____/year, I _____, choose option #_____. I realize that once I fill this form out it cannot be changed. Since I believe option #2 to be worth \$_____, I am choosing option #_____because:

_____

_____

Signature_____, Witness_____ Date_____

As soon as you signed the papers, she hands you a calculator and says you will only receive the money if you can explain why you made a wise decision. Defend your decision.

Challenge #2:

2. A credit card company charges its clients 18% interest on all unpaid debts. At this rate, an un paid bill will double every 4 years. Hiden has a small outstanding balance of \$100. He thought the credit card company might forget his bill if he never pays it. After 40 years of ignoring his bill, the credit card company shoed up at his home and asked him to pay his bill. How much do you think his bill will be?

A. How many doublings have occurred in 40 years?	B. How large is his bill?	C. Determine a value for n in $b=\$100x2^n$.
D. In an effort to be able to communicate with people all over the world about money, mathematicians have agreed to use the same names for parts of the equation $b=\$100x2^n$. 100 is called the principal, _____is the power, _____is the base_____ is the exponent.		

Exponents Introduction

a^x	a is the base, x is the exponent and a^x is the power.
5^2	Is read 5 to the exponent 2 and equals 5×5 as a repeated multiplication and evaluates to 25.
2^5	Is read 2 to the exponent 5 and equals $2 \times 2 \times 2 \times 2 \times 2$ as a repeated multiplication and evaluates to 32.

Writing numbers in expanded form and exponential form.

3. Express 5^4 as a repeated multiplication.	4. Express AAA as power.	5. Express 7^2 as a repeated multiplication.
6. Express (-3)(-3)(-3)(-3) as power.	7. Express 8^5 as a repeated multiplication.	8. Express nnnnnnn as power.
9. Express $(-2)^4$ as a repeated multiplication.	10. Express mmmmm as power.	11. Express A^3B^2 as a repeated multiplication.
12. Express mGmGmmG as power.	13. Express A^0B^3 as a repeated multiplication.	14. Express AABBAABAB as power.

15. Which form would you rather use, exponential form or repeated multiplication? Why?

Challenge #3:

16. Which of the following are equal:

A. -3^2

B. (-3^2)

C. $-(3)^2$

D. $(-3)^2$

Explain your reasoning.

17. Does $2^3=3^2$? Explain how you know.

Common Errors

Does $-3^2 = +9$?	Does $2^3=3^2$?
NO! • -3^2 means $-(3^2)$ which means $-(3x3)=-9$ Don't confuse it with: • $(-3)^2$ means $(-3)(-3) = +9$	No! • 2^3 means $2x2x2=8$ • 3^2 means $3x3=9$

Which of the following when evaluated will be positive?

18.	A. 2^1	B. 2^2	C. 2^3	D. 2^4	E. 2^5	F. 2^6
19.	A. -2^1	B. -2^2	C. -2^3	D. -2^4	E. -2^5	F. -2^6
20.	A. $(-2)^1$	B. $(-2)^2$	C. $(-2)^3$	D. $(-2)^4$	E. $(-2)^5$	F. $(-2)^6$

Evaluate the following in your head without using a calculator.

21. $(-1)^2=$	22. $(-1)^3=$	23. $(-1)^4=$	24. $(-1)^5=$	25. $(-1)^{30}=$
26. $(-1)^{72}=$	27. $-1^{33}=$	28. $-1^{30}=$	29. $-1^{35}=$	30. $(-1)^{301}=$
31. $(-1)^{72}(-1)^3=$	32. $(-1)^{33}(-1)^3=$	33. $-1^{30}(-1)^3=$	34. $-1^{35}(-1)^3=$	35. $(-1)^{301}(-1)^4=$

Evaluate the following powers.

36. Spot the error. $2^3=$ **2x3=6**	37. Evaluate. $5^4=$	38. Evaluate. $3^3=$	39. Evaluate. $-3^2=$
40. Evaluate. $(-3)^2=$	41. Evaluate. $(-2)^3=$	42. Evaluate. $-2^2=$	43. Evaluate. $(-2)^4=$
44. Evaluate. $-1^{21}=$	45. Spot the error. $-(3)^2=$ **=6**	46. Evaluate. $-(-2)^3=$	47. Evaluate. $(-1)^{30}=$

48. Use repeated multiplication to explain the difference between 2^5 and 5^2?

Order the numbers from smallest to biggest.

49.
A. 5^2
B. 2^5
C. -2^3
D. -3^2

_____<_____<_____<_____

50.
A. -10^2
B. $(-10)^3$
C. $(-10)^1$
D. $(-10)^2$

_____<_____<_____<_____

51.
A. $(-10)^2$
B. $(-1)^4$
C. $-(-10)^2$
D. $-(-10)^3$

_____<_____<_____<_____

Is each statement true? Explain your reasoning.

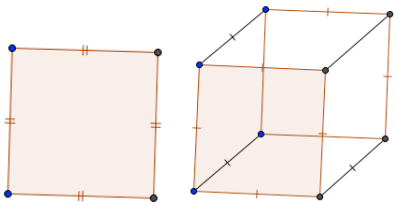
52. Is $-2^4 = \left(-2\right)^4$?

53. Is $-2^4 = -\left(4\right)^2$

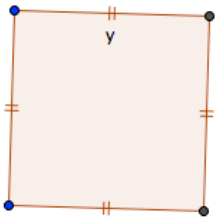
54. Is $-3^3 = \left(-3\right)^3$

Area and surface area

55. Does $2^3 = 3^2$? Use the drawings below to support your explanation.

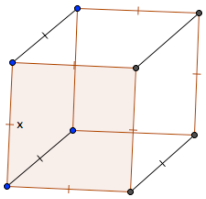


56. A square has a side length of y cm, write the area as a power.



57. If y= 5cm, determine the area of the square.

58. If a cube has an edge length of x cm, write the surface area as a product and a power.



59. If x=10cm determine the surface area of the cube.

Predict whether each power will be positive or negative.

60. -41^6

61. $-(-93)^8$

62. $\left(-2^4\right)^3$

63. $-(25.2)^6$

Determine the solution.

64. The population of certain forms of bacteria double every day. If the population began with 1 million, how large would the population be after 7 days? Write your answer first as a power and then evaluate it.

65. Rory is 16 and just invested $1000 in a mutual fund that should grow in value by 8% per year. At this rate his money will double every 9 years. How much will his initial investment be worth when he retires at age 61? Write your answer first as a power and then evaluate it.

66. The Richter scale represents a 10-fold increase in intensity for every 1 unit of magnitude on the Richter scale. That means that a Richter scale rating of 2 is ten times more intense than a Richter scale rating of 1. How much greater is a Richter scale rating of 8 compared to a Richter scale rating of 4? Write your answer first as a power and then evaluate it.

Evaluate: These are higher thinking questions.

67. $(-1)^{\text{An even \#}}=$

68. $(-1)^{\text{An odd \#}}=$

69. $-1^{\text{An even \#}}=$

70. $-1^{\text{An odd \#}}=$

71. If n is an integer evaluate: $(-1)^{2n+2}=$

72. If n is an integer evaluate: $(-1)^{2n-5}=$

73. If n is an integer evaluate: $(-1)^{2n+4}=$

74. If n is an integer evaluate: $(-1)^{2n+1}=$

Challenge #4:

75. Evaluate $(-3)^2-2^3=$ Explain the process.

76. Evaluate. $2(3-2^3)^3\div5^2$ Explain the process

Order of Operations and Exponents

What does BEDMAS stand for?

77. B	78. E	79. D*	80. M*	81. A**	82. S**
83. *What order do you do D & M?			84. **What order do you do A & S?		

Evaluate each of the following and record the process.(Show your work)

85. $(-3)^2-2^3=$ Possible solution strategy: $=(-3)^2-2^3 \rightarrow (-3)(-3)-2x2x2$ $=9-8$ $=1$	86. $5^2+3^3=$	87. $(-3)^2+(-2)^3=$	88. $(-3)^2-(-2)^3=$
89. $-(-3)^2-2^3=$	90. $-3^2-2^3=$	91. $-3^2-(2)^3=$	92. $3^2-2^3=$
93. $(5-3 \times 2)^3=$	94. $(5+1 \times 2)^2=$	95. $(3-2 \times 2)^2=$	Spot the error. 96. $(5-3 \times 2)^2=$ $=(2 \times 2)^2$ $=(4)^2$ $=16$
97. $2(3-2^3)^3 \div 5^2$ Possible solution strategy: $=2(3-2^3)^3 \div 5^2$ $=2(3-8)^3 \div 25$ $=2(-5)^3 \div 25$ $=2(-125) \div 25$ $=-250 \div 25$ $=-10$	98. $(5^2-7 \times 3)^2=$	99. $(18-5 \times 2^2)^2=$	100. $(40-2^3 \times 5)^2=$

Insert brackets to make each statement true.

101. $6+3^2 \div 3=27$	102. $9-5-2^3 \times 3+2^2=200$	103. $30-3+2^2 \times 10^2=500$

Which of the following are true. Explain how you know.

104. True or False?

$2^3 + 2^2 = 2^3 \times 2^2$

105. True or False?

$10 \times \left(2 \times 2 \times 2\right) \times \left(2 \times 2\right) = 2^2 \times 5 \times 2^4$

106. Which of the following do the brackets not make a difference to:

A. $\left(-3^2 x2\right) + 4$

B. $-3^2 x\left(2 + 4\right)$

C. $\left(-3^2\right) x2 + 4$

D. $-\left(3^2 x2\right) + 4$

107. Which operation must be completed first?

$3 - 5\left(4\right)^3 + 7$

108. Which operation must be completed first?

$3 + 5\left[10 \times \left(4 - 7\right)\right]^3 \div 2$

109. Which of the following do the brackets make no difference:

A. $10\left(-5\right)^2 x10$

B. $10 - \left(5^2 x10\right)$

C. $\left(10 - 5^2\right) x10$

D. $\left(10 - 5\right)^2 x10$

Determine the missing value.

110. Solve for x.

$2^3 + 3^x = 17$

111. Solve for x.

$\left(5^2 - 7 \times 3\right)^x = 16$

112. Solve for x.

$3^2 \times 10^x = 9000$

113. Solve for x.

$\left[2^x - \left(33\right)\right]^x = -1$

Challenge #5: Use your calculator to evaluate each problem.

114. $\sqrt{1024}$

115. 5^4

116. $\left(-4\right)^4$ & -4^4

Calculator Skills

There are many different calculators.
Write down the buttons you need to press on your calculator to get the answer.

	Option #1	Option #2	What buttons do you press?
117. $\sqrt{1024} = 32$	Press 1024 → $\sqrt{}$ →=	Press $\sqrt{}$ →1024→=	
118. $5^4 = 625$	Press 5→ x^y →4→=	Press 5→ ^ →4→=	
119. $\left(-4\right)^4 = 256$	Press (→ -4 →) → x^y → 4=		
120. $-4^4 = -256$	You may need to type it into your calculator as $-(4^4)$. Remember each calculator is different.		

*Sometimes you need to press 2nd or INV or Shift

Evaluate the following using your calculator:

121. $\sqrt{4096} =$	122. $-4^2 =$	123. $5^1 =$	124. $(-1)^{50} =$
125. $\sqrt{256} =$	126. $3^5 =$	127. $\sqrt[3]{64} =$	128. $-2^5 =$
129. $-4^3 =$	130. $-2^2 + 2 =$	131. $(-7)^3 =$	132. $\sqrt{900} =$

Evaluate the following using your calculator:

133. -5^2	134. $\left(-5\right)^2$	135. $-1^{200} - 3^2$	136. $-\left(-3\right)^2 \div 3 \times 2^3$
137. $2 - \left(3 - 2 \times 5\right)^2$	138. $5\left(2 - 7\right) - \left(10 - 2 \times 3\right)^3$	139. $2 - \left(3 - 2 \times 5\right)^5 \div \left(5 + 2\right)^3$	140. $\dfrac{10 - 3^2 \times 4}{-2^4 - 10}$

Challenge #6:

141. How would you write 4096 as a power of 2? Another way of saying this is, 2 to what exponent equals 4096.

Write down the steps to solve the challenge to the left.

142. Write 4096 as a power of 2.

Solution #1	Solution #2	Solution #3→Math 12
• Divide by 2 and keep track. • 4096→2048→1024→512→256→128→64→32→16→8→4→2 • Count the how many numbers there are • There are 12→2^{12}=4096	• Smart Guessing • Try 2^{10}=1024→too small • Try 2^{15}=32768→too big • Try 2^{13}=8192→closer… • Try 2^{12}=4096→Done	• Use LOGS • 2^N=4096→$\text{Log}_2 4096=N$ • $\log_2 4096 = \frac{\log 4096}{\log 2} = 12$

Which way works best for you?

Write the following as a power of 2.

143. 64=	144. 8=	145. 256=	146. 32=

Solve for x.

147. $81=3^x$	148. $27=3^x$	149. $9=3^x$	150. $19683=3^x$
151. $100=10^x$	152. $100000=10^x$	153. $10=10^x$	154. $1=10^x$

Using exponents and order of operations to solve problems.

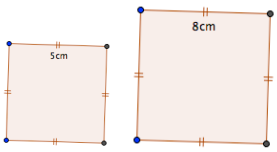
155. Balkee invested $2000 in a mutual fund that returned 8% interest each year. The following formula can be used to determine the answer. $A=\$2000(1.08)^{23}$. How large will the investment be in 23 years?

156. A colony of bees increases 2 fold every week. How large will the colony grow to after 20 weeks if it began with 2 bees. The following formula can be used to determine the answer. $A=2(2)^{20}$.

157. A very nosey student asked Mr. Spray how much he charges his tenants each month for rent. Mr. Spray gladly answered, "I charge them 0.15×10^4 dollars each month." How much does he charge his tenants each month and how weird is he?

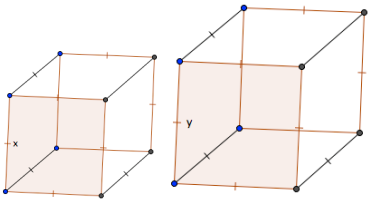
Write an expression to represent the difference between the areas of the two shapes.

158. Express the difference in area between the two squares as a difference of two powers.



159. Calculate the difference in area between the two squares.

160. Create an expression to represent the difference in surface area between the two cubes.



161. Calculate the difference if x=3cm and y=5cm.

Insert brackets to make each statement true.

162. $5+2^2-40^2=81$

163. $5+2^3\times 5-30^2=105$

164. $405-5-2\times 10^2=0$

Using exponents and order of operations to solve problems.

165. The surface area of a sphere can be found using the formula $A=4\pi r^2$. If the radius of the sphere we live on is 6378 km. Determine the surface area of our planet. (Use π=3.14)

166. Let's revisit Aunt Weltheezan's proposition of a gift of 1 cent on your 16th birthday, 2cents on your 17th birthday and so on for a total of 30 birthdays. The formula, $sum=\frac{0.01\left(2^{30}-1\right)}{2-1}$ will calculate the sum of the first 30 gifts. Determine the sum.

167. Review Aunt Weltheezan's proposition at the start of this section. Many people will choose the $100 000 cash now. They say they will invest it now and make more money. Use the following formula to determine the value of the $100 000 invested for 30 years growing at 8%. $\$=100000\left(1.08\right)^{30}$

168. The population of rabbits living near the university has doubled ever year since the first two rabbits escaped from the biology lab. If the current population of rabbits is 32,768, how many years ago did the first two rabbits escape?

Exponent Laws: Multiplication and Division

Challenge #7: Determine the answer by any method and explain your solution.

169. $2^3 \times 2^4 = 2^x$

Explain your solution:

170. $\frac{2^5}{2^3} = 2^x$

Explain your solution:

Challenge #8: Can you think of another way of explaining each solution.

171. Justin's explanation on how to solve $2^9 x 2^7 = 2^n$.

$2^9 x 2^7$
$(2^9)x(2^7)$
I wrote each power in expanded form.
(2x2x2x2x2x2x2x2x2)x(2x2x2x2x2x2x2)
I removed the brackets since there is only multiplication.
2x2x2x2x2x2x2x2x2x2x2x2x2x2x2x2
I counted the 16 twos being multiplied together.
Therefore n=16 and $2^9 x 2^7 = 2^{16}$.

Is there another way? Explain.

172. Justin's explanation on how to solve $\frac{2^{12}}{2^4} = 2^n$.

I wrote each power in expanded form.

$$\frac{2^{12}}{2^4} = \frac{2x2x2x2x2x2x2x2x2x2x2x2}{2x2x2x2}$$

I reduced the fraction.

$$= \frac{2x2x2x2x2x2x2x2x\cancel{2x}\cancel{2x}\cancel{2x}\cancel{2}}{\cancel{2x}\cancel{2x}\cancel{2x}\cancel{2}}$$

I counted 8 twos that are still being multiplied together.

Therefore n=8 and $\frac{2^{12}}{2^4} = 2^8$

Is there another way? Explain.

Write your answer in simplified exponential form.

173. $(mmm)(mmmm) =$

174. $(mm)(mmmmmm) =$

175. $(mm)(mmmm) =$

176. $(mmm)(mmmmmm) =$

177. $\left(m^3\right)\left(m^4\right) =$

178. $\left(m^2\right)\left(m^6\right) =$

179. $\left(m^2\right)\left(m^4\right) =$

180. $\left(m^3\right)\left(m^6\right) =$

181. When powers are multiplied together what happens to the exponents?

Exponent Laws: Multiplication and Division

Multiplication Rule	Division Rule
182. $m^a \times m^b = m$_____	184. $\frac{m^a}{m^b} = m$_____
183. When powers with the same bases are multiplied together their exponents are _____ together.	185. When powers with the same base are divided their exponents are _____.

Simplify:

186. $\frac{mmm}{mmm} =$	187. $\frac{mmmmm}{mmm} =$	188. $\frac{mmmmm}{mm} =$	189. $\frac{mm}{mm} =$
190. $\frac{m^3}{m^3} =$	191. $\frac{m^5}{m^3} =$	192. $\frac{m^5}{m^2} =$	193. $\frac{m^2}{m^2} =$
194. $m^3 \div m^3 =$	195. $m^5 \div m^3 =$	196. $m^5 \div m^2 =$	197. $m^2 \div m^2 =$

198. When powers are divided what happens to the exponents?

Write each as a single power.

199. $\frac{m^{30}}{m^3} =$	200. $\frac{m^{12}}{m^5} =$	201. $\frac{m^{20}}{m^9} =$	202. Spot the error. $\frac{m^{14}}{m^7} = \mathbf{m2}$
203. $7^5 \times 7^6 =$	204. $(-11)^6 \times (-11)^{50} =$	205. $m^4 \times m^{60} =$	206. $9^{12} \times (-9^6) =$
207. $-m^2 \times m =$	208. $m^9 \times m =$	209. $(-11) \times (-11)^9 =$	210. $8 \times 8^9 \times 8^0 =$
211. Spot the error. $(-4)^{120} \div (-4)^{20} =$ $=(-4)^6$	212. $(-11)^{25} \div (-11)^3 =$	213. Spot the error. $-8^{400} \div 8^{300} =$ $=8^{100}$	214. Evaluate. $10^{30} \div 10^{30} =$

Write each as a single power.

215. $m^5 \times m^6 \times m^2 \times m^3 =$	216. $10^5 \times 10^{60} \times 10^2 \times 10^3 =$	217. $m^0 \times m^6 \times m \times m^3 =$	218. Spot the error. $m^5 \times m^6 \times m \times m^3 =$ $= m^{5+6+0+3}$ $= m^{14}$
219. $m^{12} \div m =$	220. $5^{12} \div 5^2 =$	221. Evaluate. $-19^{20} \div (-19)^{18} =$	222. Evaluate. $41^4 \div 41^3 =$

Write as a product or a quotient.

223. Write 7^{10+6} as a product of two powers.	224. Write $(-6)^{17-15}$ as a division of two powers.	225. Write $-m^{7+5}$ as a product of two powers.	226. Write -11^{70-50} as a division of two powers.

Explain.

227. Does $(-2)^2(-2)^3 = -2^5$? Explain.	228. Does $(-1)^5(-1)^3 = -1^8$? Explain.	229. Does $2^3 + 2^2 = 2^5$? Explain.

True or false

230. True or False?

A. $2 \times 5^3 \times 5^2 = 10^5$ B. $2^2 \times 5^2 = 10^2$ C. $m^{200} + m^{400} = m^{600}$ D. $5^2 \times 5^5 = 5^7$

231. True or False?

A. $5^3 + 5^4 = 5^7$ B. $2^2 + 5^2 = 7^2$ C. $m^5 \times m^4 = 2m^9$ D. $2^3 \times 5^2 = 10^5$

Simplify and write your answer as a single power.

232. $\frac{8^5 \times 8^3}{8^4} =$

233. $\frac{9^{50} \times 9^3}{9^{40}} =$

234. $\frac{(-7)^2(-7)^7}{(-7)^5} =$

235. $\frac{(-5)^4(-5)^6}{(-5)^8} =$

236. Evaluate.

$\frac{2^5 \times 2}{2^2} \times \frac{2^2 \times 2^4}{2^5} =$

237. Evaluate.

$\frac{9^7 \times 9^2}{9^4 \times 9^3} \times \frac{9 \times 9^2}{9^3} =$

238. $\frac{M^5M^4}{M^6} \times \frac{M^2M^7}{1} =$

Spot the error.

239. $m^5m^6 \times \frac{m^2m^3}{m^8} =$

$m^{11} \times \frac{m^5}{m^8} = \frac{m^{16}}{m^8}$

$\frac{m^{16}}{m^8} = m^2$

Challenge #9:

240. Simplify $(2m^5)(5m^6)=$

Explain your solution.

241. Simplify $\frac{6m^6}{2m^2} =$

Explain your solution.

Simplify each product or quotient as a single power.

242. $(2m^5)(5m^6)=$

Possible solution strategy:

- **Multiply Coefficients**
- **Multiply Powers (Add exp)**
- **$(2m^5)(5m^6)=$**
- **$=2x5xm^5m^6$**

$=10m^{11}$

243. $(3m^5)(4m^6)=$

244. $(-3m^2)(-m^2)=$

245. $(5m^5)(4m^6)=$

246. $-3m^4(5m^6)=$

247. $-3m^2(-10m^{60})=$

248. $2m^{50}(-4m^6)=$

249. $\frac{6m^6}{2m^2} =$

Possible solution strategy:

$\frac{\cancel{6}^{3}m^6}{\cancel{2}m^2} = \frac{3m^6}{m^2} = 3m^4$

250. $\frac{40m^{40}}{20m^{20}} =$

251. $\frac{-10M^{10}}{-5M^5} =$

252. $\frac{20M^{20}}{5M^5} =$

253. $\frac{9m}{6} =$

254. $\frac{16m^{16}}{2m^2} =$

255. $\frac{18m^{18}}{12m^{12}} =$

Simplify.

256. $(2m^2)(3m^3)(-m^6)(2m)=$	257. $(-2m^3)(-3m)(-m^5)(2m)=$	258. $(-5m^{20})(-2m^3)(-m^5)(2m)=$
259. $m^5m^3\div m^3=$ **Possible solution strategy:** $\mathbf{m^5m^3\div m^3}$ $\mathbf{=m^{5+3-3}=m^5}$	260. $m^5\div m^3\ m^2=$	261. $m^5\div mm^4=$
262. $m^7m^2\div m^4=$	263. $m^3\div m^0\ m=$	264. Spot the error: $m^0\div mm^4=$ $\mathbf{=m^0\div m^5=}$ $\mathbf{=m^{-5}}$

Challenge #10: Write each product or quotient as a single power.

265. Simplify $2^x2^{2x}=$	Explain your solution	266. Simplify $2^{2x+1}\div 2^{x+1}=$	Explain your solution

Write as a single power.

267. $2^x2^{2x}=$ **Possible solution strategy:** $\mathbf{2^X2^{2X}=2^{X+2X}=}$ $\mathbf{=2^{X+2X}}$ $\mathbf{=2^{3X}}$	268. $2^{4x}2^{5x}=$	269. $2^x2^y=$	270. $2^x2^{y-x}=$
271. $2^{x+1}2^{2x}=$	272. $2^{4x+1}2^{5x-1}=$	273. $2^{x+2y}2^{y+3x}=$	274. $2^{3x+4y}2^{5x+2y}=$

Simplify where possible.

275. $m^2 + m^3 \times m^5$	276. $m^2 \times m^3 \times m^5$	277. $m^2 + m^2 + m^2$	278. $m^{20} \times m^{10} - m^5$	279. $m^{20} \times m^{10} \div m^5$

Write an equivalent expression without a fraction.

280. $\frac{mmmmnnn}{mmmnn} =$

281. $\frac{mnnnmm}{nmmmn} =$

282. $\frac{mmmmnnn}{nmm} =$

283. $\frac{mmn}{m} =$

284. $\frac{m^3n^3}{m^3n^2} =$

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

286. $\frac{m^5n^{30}}{m^4n^8} =$

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

288. $\frac{20m^5m^3}{5m} \times \frac{2m^2}{4m^3} =$

289. $\frac{-4m^7m^2}{10m^3} \times \frac{-5m}{m^3} =$

290. $\frac{-6m^5}{m} \times \frac{2m^2m^3}{-4} =$

291. $\frac{m^5n^3}{m^4} \times \frac{m^2n^4}{nm^3} =$

Write as a single power.

292. $3^{2x+1} \div 3^{x+1} =$

Possible solution strategy:

$3^{2x+1} \div 3^{x+1} = 3^{2x+1-(x+1)}$

$= 3^{2x+1-x-1}$

$= 3^{x}$

293. $3^{3x-4} \div 3^{x+1} =$

294. $3^{3x+1} \div 3^{x-4} =$

295. $3^{4x-1} \div 3^{x-1} =$

296. $3^{3x+4} \div 3^{-x+1} =$

297. $3^{2x+5} \div 3^{2x-2} =$

298. $3^{0} \div 3^{4x-2} =$

Challenge #11:

299. What do you think $\left(2^{100}\right)^3$ would be as a single power?

Explain your solution:

300. Explain why $\left(2^5\right)^2 = 2^7$ is not true.

Explain your solution:

Challenge #12:

301. Does $2^0 = 7^0$?	302. Solve for x and evaluate: $\frac{2^3}{2^3} = 2^x =$ _____ $5^2 \div 5^2 = 5^x =$ _____	303. Determine a pattern to explain the value of 2^0. $2^4 =$ $2^3 =$ $2^2 =$ $2^1 =$ $2^0 =$

Write your answer in simplified exponential form.

304. $(mmmmm)(mmmmm) =$	305. (2x2x2)(2x2x2)(2x2x2)	306. (7x7)(7x7)(7x7)(7x7)
307. $\left(m^5\right)^2 =$	308. $\left(2^3\right)^3 =$	309. $\left(7^2\right)^4 =$

310. When a power is raised to an exponent what happens to the exponents?

Exponent Laws: Power raised to an exponent and the zero exponent.

Power Raised to an Exponent	Zero Rule
311. $\left(m^a\right)^b = m$_____	313. $m^0 =$ _____
312. When a power is raised to an exponent, the exponents are _____ together.	314. Any number raised to the exponent zero is equal to _____ .

Write as a single power.

315. $\left(N^2\right)^3 =$	316. $\left(N^3\right)^2 =$	317. $\left(N^5\right)^3 =$	318. $\left(N^7\right)^2 =$
319. $\left(N^6\right)^3 =$	320. $\left(N^2\right)^4 =$	321. $\left(N^8\right)^2 =$	322. $\left(N^7\right)^0 =$
323. $9^5 \times 9^{20} =$	324. $(9^5)^{20} =$	325. $9^5 \times 9^4 =$	326. $(9^5)^4 =$

Challenge #13: Write as a single power.

327. Simplify. $7^5 \times 7^{20}(7^5)^4 =$

Explain your solution.

328. Simplify. $(7^5)^{x+1} =$

Explain your solution.

Simplify and leave your answer as a single power.

329. $7^5 \times 7^{20}(7^5)^4 =$

Possible solution strategy:

$=7^5 7^{20}(7^5)^4$

$=7^5 7^{20} 7^{20}$

$=7^{45}$

330. $7^5 \times 7^2(7^{50})^4 =$

331. $7^7 \times 7^{22}(7^3)^5 =$

332. $7^{52} \times 7^2(7^3)^2 =$

333. $(7^5)^4 \times 7^{20}(7^5)^4 =$

334. Evaluate.

$$\frac{2^2 \times 2^8 \left(2^5\right)^2}{2^3 \left(2^2\right)^6} =$$

335. Evaluate.

$$\frac{3^2 \left(3^8\right)^2 \left(3^5\right)^2}{3^{25}} =$$

336. Spot the error.

$$\frac{4m^5 m^3 \left(m^3\right)^2}{6m^3 \left(m^2\right)^2} =$$

$$= \frac{4m^5 m^3 m^5}{6m^3 m^4}$$

$$= \frac{4m^{13}}{6m^7} = \frac{2m^6}{3}$$

Write each as a single power.

337. $(11^5)^{x+1} =$

Possible solution strategy:

- $=(11^5)^{x+1}$
- $=11^{5(x+1)}$

$=11^{5x+5}$

338. $(11^2)^{x+2} =$

339. $(11^6)^{x+3} =$

340. $(11^2)^{x+4} =$

341. $(11^2)^{3x+1} =$

342. $(11^2)^{2x-4} =$

343. $(11^4)^{x-2} =$

344. Spot the error.

$(11^2)^{3x-5} =$

11^{6x-5}

Evaluate.

345. $(-15)^0=$	346. $-A^0=$	347. $5^0+8^0-135^0=$	348. $(m^2n)^0=$
349. $(25m^2n-8)^0=$	350. $-(25m^2n-8)^0=$	351. $2(m^2n)^0=$	352. $-4(m^2n)^0=$

Challenge #14:

353. $\left(2\times 3\right)^2 = 2^x \times 3^y$ Explain your solution:

354. $\left(\frac{2}{3}\right)^2 = \frac{2^x}{3^y}$ Explain your solution:

Exponent Laws: Products and Quotients

Product Rule	Quotient Rule
355. $\left(m\times n\right)^a = m^{\_\_}n^{\_\_}$	357. $\left(\frac{m}{n}\right)^a = \frac{m^{\_\_}}{n^{\_\_}}$
356. When a product is raised to an exponent each number in the brackets is raised to the same_____.	358. When a quotient is raised to an exponent each number in the brackets is raised to the same _____.

Write each product as product of two powers.

359. $\left(5\times 2\right)\left(5\times 2\right)\left(5\times 2\right)$	360. $\left(mn\right)\left(mn\right)\left(mn\right)\left(mn\right)\left(mn\right)$	361. $\left(m^2n\right)\left(m^2n\right)\left(m^2n\right)\left(m^2n\right)\left(m^2n\right)$
362. $\left(5\times 2\right)^3$	363. $\left(mn\right)^5$	364. $\left(m^2n\right)^5$

365. When a product is raised to an exponent what happens to each number in the brackets?

Write each quotient as a quotient of two powers.

366. $\frac{2\times2\times2\times2\times2}{3\times3\times3\times3\times3}$	367. $\frac{mmm}{nnn}$	368. $\frac{2m\times2m\times2m\times2m}{5n\times5n\times5n\times5n}$
369. $\left(\frac{2}{3}\right)^5$	370. $\left(\frac{m}{n}\right)^3$	371. $\left(\frac{2m}{n}\right)^4$

372. When a quotient is raised to an exponent what happens to each number in the brackets?

Explain.

373. When you multiply powers, what do you do with the exponents?	374. When you divide powers, what do you do with the exponents?	375. When you raise a power to a power, what do you do with the exponents?	376. Any term to the power zero is equal to=

377. Explain why $\left(2^3\right)^2 \neq 2^5$

Write without brackets.

378. $(mn)^2$=	379. $(mn)^3$=	380. $(5n)^2$=	381. $(2n)^3$=
382. $(mn)^5$=	383. $(mn)^7$=	384. $(-2n)^2$=	385. $(-2n)^3$=

Simplify and evaluate where possible.

386. $\left(\frac{2}{3}\right)^3$ =	387. $\left(\frac{1}{2}\right)^5$ =	388. $\left(\frac{7}{2}\right)^2$ =	389. $\left(\frac{-1}{2}\right)^4$ =
390. $\left(\frac{2m}{n}\right)^3$ =	391. $\left(\frac{2m}{5n}\right)^2$ =	392. $\left(\frac{m}{5}\right)^2$ =	393. $\left(\frac{-1}{m}\right)^5$ =

Write without brackets.

394. $(m^2n)^3=$	395. $(m^2n^3)^3=$	396. $(-2m^2n^3)^3=$	397. $(-m^5n^2)^4=$
398. $\left(\frac{2m^3}{5n^2}\right)^2=$ Solution: $\left(\frac{2m^3}{5n^2}\right)\left(\frac{2m^3}{5n^2}\right)=\frac{4m^6}{25n^4}$	399. $\left(\frac{-2m^3}{3n^5}\right)^3=$	400. $\left(\frac{-m^3}{n^3}\right)^5=$	401. $-\left(\frac{-m^3}{n^5}\right)^{30}=$

Write without brackets.

402. $(m^2n)^3(m^5n)^4=$	403. $(m^2n^3)^3(m^4n^2)^2=$	404. $(-2m^2n^3)^3(m^2n^3)^3=$	405. $(-m^5n^2)^4(-m^5n^2)^3=$
406. $\frac{\left(m^5n^3\right)^4}{\left(m^3n^4\right)^2}=$	407. Evaluate. $\frac{\left(2\times5^5\times3^3\right)^4}{16\left(5^6\times3^4\right)^3}=$	408. $\frac{\left(m^5n^3\right)^4\left(m^2n^3\right)^3}{\left(m^3n^4\right)^2}=$	409. $\frac{\left(M^4N^2\right)^4\left(M^2N\right)^3}{\left(MN^4\right)^2}=$
410. $\left(\frac{2n^3}{m}\right)^2\times\left(\frac{5m^4}{n}\right)^2=$	411. $\left(\frac{-n^4}{m}\right)^3\times\left(\frac{-2m^4}{-n}\right)^2=$	412. Evaluate. $\left(\frac{-2^2}{2\times5^2}\right)^3\times\left(\frac{2\times5^4}{-2}\right)^2=$	413. Spot the error. $\left(\frac{-m^2}{2n}\right)^3\times\left(\frac{4n^4}{-3m}\right)^2=$ $=\frac{-m^6}{2n}\cdot\frac{16n^8}{-9m^2}$ $=\frac{16n^8m^6}{18m^2n}$ $=\frac{8m^4n^7}{9}$

Use an example to clearly explain each exponent law.

	414. $m^x \times m^y = m^{x+y}$	415. $m^x \div m^y = m^{x-y}$	416. $\left(m^x\right)^y = m^{xy}$
Example and proof			
Explain using words the meaning of each exponent law.			
	417. $\left(mn\right)^x = m^x n^x$	418. $\left(\frac{m}{n}\right)^x = \frac{m^x}{n^x}, n \neq 0$	419. $m^0 = 1$
Example and proof			
Explain using words the meaning of each exponent law.			

Which of the following are possible? Explain or provide an example

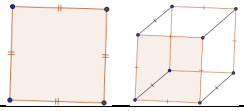
420. Could a power with base four be equal to a power with base eight?

421. Could a power with base five be equal to a power with base ten?

422. Explain why $\left(m^3\right)^2 \neq m^5$

Review Check List

Definitions:		Pg #	Face it ☺☹*
Go to page 3 and write down any definitions that you are unsure of.	Define each word and be able to show your understanding with examples.	3	

Learning Target	Example	Pg #	Face it ☺☹
Demonstrate the differences between the exponent and the base by building models of a given power, such as 2^3 and 3^2	Does $2^3 = 3^2$? Use the drawings below to support your explanation. 	7,	
Explain, using repeated multiplication, the difference between two given powers in which the exponent and base are interchanged (e.g., 10^3 and 3^{10})	Use repeated multiplication to explain the difference between 2^5 and 5^2?	7	
Express a given power as a repeated multiplication	Express 5^4 as a repeated multiplication.	5	
Express a given repeated multiplication as a power	Express (-3)(-3)(-3)(-3) as power.	5	
Explain the role of parentheses in powers by evaluating a given set of powers (e.g., $(-2)^4$, (-2^4) and -2^4)	Which of the following are equal: -3^2, (-3^2), $-(3)^2$, $(-3)^2$ Explain your reasoning.	5,7	
Demonstrate, using patterns, that a^0 is equal to 1 for a given value of a ($a \neq 0$)	Solve for x and evaluate: $\frac{2^3}{2^3} = 2^x =$ ____ . Determine a pattern to explain the value of 2^0. $2^4 =$, $2^3 =$, $2^2 =$, $2^1 =$ & $2^0 =$	20	
Evaluate powers with integral bases (excluding base 0) and whole number exponents	Evaluate. 5^4=, Evaluate. $(-2)^3$=, Evaluate. -2^2=	6	
Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents:	Use an example to clearly explain each exponent law. $m^x \times m^y = m^{x+y}$, $m^x \div m^y = m^{x-y}, x > y$, $\left(m^x\right)^y = m^{xy}$, $(mn)^x = m^x n^x$, $\left(\frac{m}{n}\right)^x = \frac{m^x}{n^x}, n \neq 0$, $m^0 = 1$	25	
Evaluate a given expression by applying the exponent laws	Evaluate. $-19^{20} \div (-19)^{18}$=, Evaluate. $\frac{2^5 \times 2}{2^2} \times \frac{2^2 \times 2^4}{2^5} =$ Evaluate. $\frac{2^2 \times 2^8 \left(2^5\right)^2}{2^3\left(2^2\right)^6} =$	16,17 &21	
Determine the sum of two given powers (e.g., $5^2 + 5^3$) and record the process	Evaluate 5^2+3^3= and record the process.	9	
Determine the difference of two given powers (e.g., $4^3 - 4^2$) and record the process	Evaluate -3^2-2^3= and record the process.	9	
Identify the error(s) in a given simplification of an expression involving powers.	Spot the error. $(5\text{-}3 \times 2)^2 =$ $=(2 \times 2)^2$ $=(4)^2=16$	Spot the error. $\frac{m^{14}}{m^7} = m2$	Spot the error. $m^5 \times m^6 \times m \times m^3 =$ $=m^{5+6+0+3}$ $= m^{14}$	9,15 & 16	

*Face it. When you have mastered the content draw a ☺ OR if you are unsure, draw a ☹ and ask for help.

Score:_____36

Practice Test

- Write this test and do not look at the answers until you have completed the entire test.
- Mark the test and decide whether or not you are happy with the result. FACE IT!
- Successful students will go back in the guidebook and review any questions they got wrong on this test.

Knowledge:

1. Express 7^5 as a repeated multiplication.	2. Express (-9)(-9)(-9)(-9) as power.	3. $m^{10}m^8 =$
4. $m^{10} \div m^4 =$	5. $\left(m^{10}\right)^8 =$	6. $m^0 =$
7. $\left(2m^{10}n\right)^3 =$	8. $\left(\frac{m^2}{n^3}\right)^3 =$	9. $2^2 + 2^2 =$

Understanding

10. Explain the difference between 2^6 and 6^2.	11. Give an example and explain the exponent law $m^x \times m^y = m^{x+y}$.	12. Does $\left(-2\right)^4 = -2^4$? Explain.

Calculator skills

13. Evaluate $\left(1.2\right)^{20} =$ Round your answer to 2 decimals.	14. Evaluate $\sqrt{729} =$	15. Write 16384 as a power of 2.

Evaluate:

16. $\left(-5\right)^4 =$

17. $-2^2 =$

18. $\left(-1\right)^{401}\left(-1\right)^{5000} =$

19. $-\left(-1\right)^{70} =$

Evaluate:

20. $2^4 - 2^2 =$

21. Does $3^2 + 3^3 = 6^2$? Explain.

22. $5 - 3\left(3 - 2^2\right)^{51} =$

Simplify.

23. $m^{20}m^{14}m^{10} =$

24. $2m^{14}\left(5m^4\right) =$

25. Write $19^{30} \times 19^5 \times 19^0 \times 19$ as a single power.

26. $-\left(-7m^4\right)\left(-3m^2\right) =$

27. Write $\dfrac{91^{12} \times 89^{10}}{91^{10} \times 89^5}$ as a single power.

28. $\dfrac{15n^{15}}{5n^5} =$

Write as a single power.

29. $\dfrac{3^{50} \times 3^{30}}{3^{40}} \times \dfrac{3^{20} \times 3^{40}}{3^{30}} =$

30. $-\dfrac{15m^7}{12m^4} \times \dfrac{-8m^8m^4}{10m^3} =$

Simplify:

31. $\frac{m^{50}m^{30}}{n^{40}} \times n^{20}m^{40} =$

32. $\left(m^{30}\right)^2\left(1576m\right)^0\left(m^5\right)^3 =$

33. $\frac{\left(2m^3\right)^2}{2\left(m^2\right)^2} =$

34. $\left(m^2\left(m^3n^7\left(m^5\right)^{20}\right)^0\right)^8 =$

35. The Richter scale represents a 10-fold increase in intensity for every 1 unit of magnitude on the Richter scale. That means that a Richter scale rating of 2 is ten times more intense than a Richter scale rating of 1. How much greater is a Richter scale rating of 7 compared to a Richter scale rating of 2? Write your answer first as a power and then evaluate it.

36. A population of bacteria doubles in size every day. If the bacteria began with a population of two bacteria how large would the population be after 20 days?

Exponents Answers

1. Class conversation… option 2 is worth more in the long run.
2. 10, \$102400, 10, 2^n, 2, n
3. (5)(5)(5)(5)
4. A^3
5. (7)(7)
6. $(-3)^4$
7. (8)(8)(8)(8)(8)
8. n^7
9. (-2)(-2)(-2)(-2)
10. m^5
11. AAABB
12. m^4G^3
13. BBB
14. A^5B^4
15. Personal preference. I like exponential better because it is faster
16. A,B&C because the negative is not squared in any of them. They all equal -9.
17. 2^3=8 and 3^2=9. They are not equal.
18. All of them are positive.
19. All are negative.
20. B,D & F are positive.
21. 1
22. -1
23. 1
24. -1
25. 1
26. -1
27. -1
28. -1
29. -1
30. -1
31. -1
32. 1
33. 1
34. 1
35. -1
36. 8
37. 625
38. 27
39. -9
40. 9
41. -8
42. -4
43. 16
44. -1
45. -9
46. 8
47. 1
48. 2^5=2x2x2x2x2 and 5^2=5x5
49. DCAB
50. BACD
51. CBAD
52. No→ $-2^4=-2x2x2x2=-16$ $-16\neq(-2)^4=(-2)(-2)(-2)(-2)=16$
53. Yes→ $-2^4=-2x2x2x2=-16=(-4)^2=-4x4=-16$
54. Yes→$-3^3=-(3x3x3)=-27$and $(-3)^3=(-3)(-3)(-3)=-27$
55. No $2^3=2x2x2=8$ and $3^2=3x3=9$
56. $A=y^2$
57. $25cm^2$
58. $6x^2$
59. $600cm^2$
60. Negative
61. Negative
62. Negative
63. Negative
64. 128 million or 1000000×2^7
65. \$32000 or 1000×2^5
66. 10000 or 10^4
67. 1
68. -1
69. -1
70. -1
71. 1
72. -1
73. 1
74. -1

Order of operations

75. 1
76. -10
77. brackets
78. exponents
79. division
80. multiplication
81. addition
82. subtract
83. In order from left to right.
84. Same as 83.
85. 1
86. 52
87. 1
88. 17
89. -17
90. -17
91. -17
92. 1
93. -1
94. 49
95. 1
96. 1
97. -10
98. 16
99. 4
100. 0
101. $\left(6+3\right)^2\div3=27$
102. $\left(9-5-2\right)^3\times\left(3+2\right)^2=200$
103. $\left[30-\left(3+2\right)^2\right]\times10^2=500$
104. False $2^3+2^2=12$ and $2^3x2^2=32$
105. True. Both sides equal 320
106. A, C & D
107. exponents
108. Subtraction

109. B
110. 2
111. 2
112. 3
113. 5
114. 32
115. 625
116. 256, -256
117. 32
118. 625
119. 256
120. -256
121. 64
122. -16
123. 5
124. 1
125. 16
126. 243
127. 4
128. -32
129. -64
130. -2
131. -343
132. 30
133. -25
134. 25
135. -10
136. -24
137. -47
138. -89
139. 51
140. 1
141. 2^{12}
142. 2^{12}
143. 2^{6}
144. 2^{3}
145. 2^{8}
146. 2^{5}
147. 4
148. 3
149. 2
150. 9
151. 2
152. 5
153. 1
154. 0
155. $11742.93
156. 2097152
157. $1500
158. 8^2-5^2
159. $39cm^2$
160. $6y^2-6x^2$
161. $96cm^2$
162. $\left[\left(5+2\right)^2-40\right]^2=81$
163. $5+\left(2^3\times5-30\right)^2=105$
164. $405-5-\left(2\times10\right)^2=0$
165. $510926783km^2$
166. $10,737,418.23
167. $1,006,265.69
168. 14 YEARS
169. 2^7
170. 2^2
171. Add the exponents.
172. Subtract 4 from 12.
173. m^7
174. m^8
175. m^6
176. m^9
177. m^7
178. m^8
179. m^6
180. m^9
181. Add the exponents
182. $m^am^b=m^{a+b}$
183. added
184. $\frac{m^a}{m^b}=m^{a-b}$
185. Subtracted
186. 1
187. m^2
188. m^3
189. 1
190. 1
191. m^2
192. m^3
193. 1
194. 1
195. m^2
196. m^3
197. 1
198. Subtract the exponents
199. m^{27}
200. m^7
201. m^{11}
202. m^7
203. 7^{11}
204. $(-11)^{56}$
205. m^{64}
206. -9^{18}
207. $-m^3$
208. m^{10}
209. $(-11)^{10}$
210. 8^{10}
211. $(-4)^{100}$
212. $(-11)^{22}$
213. -8^{100}
214. 1
215. m^{16}
216. 10^{70}
217. m^{10}
218. m^{15}
219. m^{11}
220. 5^{10}
221. -19^2 or -361
222. 41
223. $7^{10}x7^6$
224. $(-6)^{17}\div(-6)^{15}$
225. $-m^7xm^5$
226. $-11^{70}\div11^{50}$
227. $(-2)^2x(-2)^3=(-2)^5=-32=-2^5$
228. $(-1)^5x(-1)^3=(-1)^8=1\neq-1=-1^8$
229. $2^3+2^2=12\neq32=2^5$
230. FTFT
231. FFFF
232. 8^4
233. 9^{13}
234. $(-7)^4$
235. $(-5)^2$
236. 32
237. 81
238. m^{12}
239. m^8
240. $10m^{11}$
241. $3m^4$

242. $10m^{11}$
243. $12m^{11}$
244. $3m^4$
245. $20m^{11}$
246. $-15m^{10}$
247. $30m^{62}$
248. $-8m^{56}$
249. $3m^4$
250. $2m^{20}$
251. $2m^5$
252. $4m^{15}$
253. $\frac{3m}{2}$
254. $8m^{14}$
255. $\frac{3m^6}{2}$
256. $-12m^{12}$
257. $-12m^{10}$
258. $-20m^{29}$
259. m^5
260. m^4
261. m^8

262. m^5
263. m^4
264. m^3
265. 2^{3X}
266. 2^X
267. 2^{3X}
268. 2^{9X}
269. 2^{X+y}
270. 2^y
271. 2^{3X+1}
272. 2^{9X}
273. 2^{3y+4X}
274. 2^{8X+6y}
275. $m^2 + m^8$
276. m^{10}
277. $3m^2$
278. $m^{30} - m^5$
279. m^{25}
280. mn
281. n
282. m^2n^2
283. mn
284. n
285. m^2n^2
286. mn^{22}
287. mn
288. $2m^6$
289. $2m^4$
290. $3m^9$
291. n^6
292. 3^x
293. 3^{2x-5}
294. 3^{2x+5}
295. 3^{3x}
296. 3^{4x+3}
297. 3^7
298. 3^{-4x+2}
299. 2^{300}
300. $(2^5)^2=(2^5)\ (2^5)= 2^{10}\neq 2^7$
301. Yes. They both equal 1.
302. X=0 and $2^0=1$
X=0 and $5^0=1$
303. 16,8,4,2,1
304. m^{10}
305. m^9
306. 7^8
307. m^{10}
308. m^9
309. 7^8
310. Multiply the exponents
311. $\left(m^a\right)^b = m^{ab}$
312. multiplied
313. $m^0=1$
314. 1
315. n^6
316. n^6
317. n^{15}
318. n^{14}
319. n^{18}
320. n^8
321. n^{16}
322. $n^0=1$
323. 9^{25}
324. 9^{100}
325. 9^9
326. 9^{20}
327. 7^{45}
328. 7^{5x+5}
329. 7^{45}
330. 7^{207}
331. 7^{44}
332. 7^{60}
333. 7^{60}
334. 32
335. 27
336. $\frac{2M^7}{3}$
337. 11^{5x+5}
338. 11^{2x+4}
339. 11^{6x+18}
340. 11^{2x+8}
341. 11^{6x+2}
342. 11^{4x-8}
343. 11^{4x-8}
344. 11^{6x-10}
345. 1
346. -1
347. 1
348. 1
349. 1
350. -1
351. 2
352. -4
353. x=2 and y=2
354. x=2 and y=2
355. $\left(m \times n\right)^a = m^a n^a$
356. The same exponent
357. $\left(\frac{m}{n}\right)^a = \frac{m^a}{n^a}$
358. The same exponent
359. $5^3 2^3$
360. m^5n^5
361. $m^{10}n^5$
362. $5^3 2^3$
363. m^5n^5
364. $m^{10}n^5$
365. Each number has the same exponent.
366. $\frac{2^5}{3^5}$
367. $\frac{m^3}{n^3}$

368. $\left(\frac{16m}{625n^4}\right)^4$

369. $\frac{2^5}{3^5}$

370. $\frac{m^3}{n^3}$

371. $\left(\frac{16m}{n^4}\right)^4$

372. Each number is raised to that exponent.

373. exponents are added

374. exponents are subtracted

375. exponents are multiplied

376. equals 1

377. $(2^3)^2=(2^3)(2^3)=2^6\neq 2^5$

378. m^2n^2

379. m^3n^3

380. $25n^2$

381. $8n^3$

382. m^5n^5

383. m^7n^7

384. $4n^2$

385. $-8n^3$

386. $\frac{8}{27}$

387. $\frac{1}{32}$

388. $\frac{49}{4}$

389. $\frac{1}{16}$

390. $\frac{8m^3}{n^3}$

391. $\frac{4m^2}{25n^2}$

392. $\frac{m^2}{25}$

393. $\frac{-1}{m^5}$

394. m^6n^3

395. m^6n^9

396. $-8m^6n^9$

397. $m^{20}n^8$

398. $\frac{4m^6}{25n^4}$

399. $\frac{-8m^9}{27n^{15}}$

400. $\frac{-m^{15}}{n^{15}}$

401. $\frac{-m^{90}}{n^{150}}$

402. $m^{26}n^7$

403. $m^{14}n^{13}$

404. $-8m^{12}n^{18}$

405. $-m^{35}n^{14}$

406. $m^{14}n^4$

407. 25

408. $m^{20}n^{13}$

409. $m^{20}n^3$

410. $100m^6n^4$

411. $-4m^5n^{10}$

412. -200

413. $-\frac{2m^4n^5}{9}$

414. When powers are multiplied, the exponents are added. See page 3 for example

415. When powers are divided, the exponents are subtracted. See page 3 for example

416. When a power is raised to an exponent, the exponents are multiplied. See page 3 for an example.

417. When a product is raised to an exponent, the exponent raises each variable to that exponent. See page 3 for an example.

418. When a quotient is raised to an exponent, the exponent raises each variable to that exponent. See page 3 for an example.

419. Anything to the power 0 equals 1.

420. Yes $4^3=64=8^2$

421. No because 10=2x5 and there is no way a multiple of 5 could equal a 2.

422. $(m^3)^2=(m^3)(m^3)=m^6\neq m^5$

Exponents Practice Test Answers

1. 7x7x7x7x7
2. $(-9)^4$
3. m^{18}
4. m^6
5. m^{80}
6. 1
7. $8m^{30}n^3$
8. $\frac{m^6}{n^9}$
9. 8
10. $2^6=2x2x2x2x2x2$ and $6^2=6x6$
11. $5^2x5^3=5^5$
    $=(5x5)x(5x5x5)$
    $=5x5x5x5x5$
    $=5^5$
12. NO:
    $(-2)^4=(-2)(-2)(-2)(-2)=16$ and $-2^4=-(2^4)=-(2x2x2x2)=-16$
13. 38.34
14. 27
15. 2^{14}
16. 625
17. -4
18. -1
19. -1
20. 12
21. Yes. Both equal 36.
22. 8
23. m^{44}
24. $10m^{18}$
25. 19^{36}
26. $-21m^6$
27. $91^2 \times 89^5$
28. $3n^{10}$
29. 3^{70}
30. m^{12}
31. $m^{120}n^{-20}$ or $\frac{m^{120}}{n^{20}}$
32. m^{75}
33. $2m^2$
34. m^{16}
35. $10^5 \rightarrow$100000 times more intense.
36. 2097152 bacteria

