

**N**: #4 (a-c), #5 (a-c), #6, #8, #14 (a-d), #15 (a,b)    **A**: #6, 8, 12, 14, 15, 16 (a,b,e)

**Practice**

**E**: #12, 14, 15, 16, 19 (a,e,f), 20 (a)

Complete any six questions from the lists above.

**Check**

- Write each expression as a product of powers.
  - $(6 \times 4)^3$
  - $(2 \times 5)^4$
  - $[(-2) \times 3]^5$
  - $(25 \times 4)^2$
  - $(11 \times 3)^1$
  - $[(-3) \times (-2)]^3$
- Write each expression as a quotient of powers.
  - $(8 \div 5)^3$
  - $(21 \div 5)^4$
  - $[(-12) \div (-7)]^5$
  - $\left(\frac{10}{3}\right)^3$
  - $\left(\frac{1}{3}\right)^2$
  - $\left(\frac{27}{100}\right)^4$
- Write as a power.
  - $(3^2)^4$
  - $(6^3)^3$
  - $(5^3)^1$
  - $(7^0)^6$
  - $-(8^2)^2$
  - $[(-3)^4]^2$
- Simplify  $(2^4)^2$  and  $(2^2)^4$ . What do you notice? Explain the results.
- Write each expression as a product or quotient of powers.
  - $[3 \times (-5)]^3$
  - $-(2 \times 4)^5$
  - $\left(\frac{2}{3}\right)^4$
  - $\left(\frac{-7}{-2}\right)^2$
  - $-[(-10) \times 3]^3$
  - $(16 \div 9)^2$

**Apply**

- Why is the value of  $(-5^2)^3$  negative?
- Simplify each expression, then evaluate it. For each expression, state the strategy you used and why.
  - $(3 \times 2)^3$
  - $[(-2) \times 4]^2$
  - $\left(\frac{9}{-3}\right)^3$
  - $\left(\frac{8}{2}\right)^2$
  - $(12^8)^0$
  - $[(-4)^2]^2$
- Why is the value of  $[(-2)^3]^4$  positive but the value of  $[(-2)^3]^5$  is negative?

- Compare the values of  $-(4^2)^3$ ,  $(-4^2)^3$ , and  $[(-4)^2]^3$ .  
What do you notice? Explain the results.

**13. Assessment Focus** For each expression below:

- Evaluate it in two different ways:
  - do the operation in brackets first
  - use the exponent laws

ii) Compare the results.

Which method do you prefer?

Was it always the same method each time? Explain.

- $(4 \times 3)^3$
- $[(-2) \times (-5)]^2$
- $\left(\frac{6}{2}\right)^4$
- $\left(\frac{14}{2}\right)^0$
- $[(-5)^2]^2$
- $(2^5)^3$

14. Simplify, then evaluate. Show your work.

- $(3^2 \times 3^1)^2$
- $(4^6 \div 4^4)^2$
- $[(-2)^0 \times (-2)^3]^2$
- $(10^6 \div 10^4)^3$
- $(10^3)^2 \times (10^2)^3$
- $(12^2)^4 \div (12^3)^2$
- $(5^2)^6 \div (5^3)^4$
- $[(-2)^2]^3 \times (-2)^3$

15. Find any errors in this student's work. Copy the solution and correct the errors.

a) $(3^2 \times 2^2)^3 = (6^4)^3$	b) $[(-3)^2]^3 = (-3)^5$
$= 6^{12}$	$= -243$
$= 2\ 176\ 782\ 336$	
c) $\left(\frac{6^2}{6^1}\right)^2 = 6^4$	d) $(2^6 \times 2^2 \div 2^4)^3 = (2^3)^3$
$= 1296$	$= 2^9$
	$= 512$
e) $(10^2 + 10^3)^2 = (10^5)^2$	
$= 10^{10}$	
$= 10\ 000\ 000\ 000$	

16. Simplify, then evaluate each expression.

- a)  $(4^2 \times 4^3)^2 - (5^4 \div 5^2)^2$
- b)  $(3^3 \div 3^2)^3 + (8^4 \times 8^3)^0$
- c)  $(2^3)^4 + (2^4 \div 2^3)^2$
- d)  $(6^2 \times 6^0)^3 + (2^6 \div 2^4)^3$
- e)  $(5^3 \times 5^3)^0 - (4^2)^2$
- f)  $(10^5 \div 10^2)^2 + (3^3 \div 3^1)^4$

17. Simplify, then evaluate each expression.

- a)  $[(-2)^3 \times (-2)^2]^2 - [(-3)^3 \div (-3)^2]^2$
- b)  $[(-2)^3 \div (-2)^2]^2 - [(-3)^3 \times (-3)^2]^2$
- c)  $[(-2)^3 \times (-2)^2]^2 + [(-3)^3 \div (-3)^2]^2$
- d)  $[(-2)^3 \div (-2)^2]^2 + [(-3)^3 \times (-3)^2]^2$
- e)  $[(-2)^3 \div (-2)^2]^2 - [(-3)^3 \div (-3)^2]^2$
- f)  $[(-2)^3 \times (-2)^2]^2 + [(-3)^3 \times (-3)^2]^2$

18. Use grid paper. For each expression below:

- i) Draw a rectangle to represent the expression.
- ii) Use the exponent laws to write the expression as a product of squares.
- iii) Draw a rectangle to represent the new form of the expression.
- iv) Compare the two rectangles for each expression.

How are the rectangles the same?

How are they different?

Use these rectangles to explain how the square of a product and the product of squares are related.

- a)  $(2 \times 3)^2$
- b)  $(2 \times 4)^2$
- c)  $(3 \times 4)^2$
- d)  $(1 \times 4)^2$

19. Simplify, then evaluate each expression.

- a)  $(2^3 \times 2^6)^2 - (3^7 \div 3^5)^4$
- b)  $(6 \times 8)^5 + (5^3)^2$
- c)  $[(-4)^3 \times (-4)^2]^2 + (4^3 \times 4^2)^2$
- d)  $[(-2)^4]^3 + [(-4)^3]^2 - [(-3)^2]^4$
- e)  $[(-3)^4]^2 \times [(-4)^0]^2 - [(-3)^3]^0$
- f)  $[(-5) \times (-4)]^3 + [(-6)^3]^2 - [(-3)^9 \div (-3)^8]^5$

### Take It Further

20. a) Write 81:

- i) as a power of 9
- ii) as a power of a product
- iii) as a power of 3

b) Write 64:

- i) as a power of 8
- ii) as a power of a product
- iii) as a power of 2

c) Find other numbers for which you can follow steps similar to those in parts a and b.

21. a) List the powers of 2 from  $2^0$  to  $2^{12}$  in standard form.

b) Use your list from part a to write each number in the expressions below as a power of 2. Evaluate each expression using the exponent laws and the list in part a.

i)  $32 \times 64$       ii)  $16 \times 8 \times 32$

iii)  $1024 \div 128$       iv)  $\frac{16 \times 256}{1024}$

v)  $(8 \times 4)^3$       vi)  $\left(\frac{256}{64}\right)^4$

## Reflect

Design and create a poster that summarizes all the exponent laws you have learned. Provide an example of each law.

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4. a)  $6^3 \times 4^3$       b)  $2^4 \times 5^4$   
 c)  $(-2)^5 \times 3^5$       d)  $25^2 \times 4^2$
5. e)  $11^1 \times 3^1$       f)  $(-3)^3 \times (-2)^3$   
 a)  $8^3 \div 5^3$       b)  $21^4 \div 5^4$   
 c)  $(-12)^5 \div (-7)^5$       d)  $\frac{10^3}{3^3}$   
 e)  $\frac{1^2}{3^2}$       f)  $\frac{27^4}{100^4}$
6. a)  $3^8$       b)  $6^9$       c)  $5^3$   
 d)  $7^0$       e)  $-8^4$       f)  $(-3)^8$
7.  $(2^4)^2 = 2^8$ ;  $(2^2)^4 = 2^8$ ; The results are the same because each expression is the product of 8 factors of 2.
8. a)  $3^3 \times (-5)^3$       b)  $-2^5 \times 4^5$   
 c)  $\frac{2^4}{3^4}$       d)  $\frac{(-7)^2}{(-2)^2}$   
 e)  $-(-10)^3 \times 3^3$       f)  $16^2 \div 9^2$

12.  $-(4^2)^3 = -4096$ ;  $(-4^2)^3 = -4096$ ;  $[(-4)^2]^3 = 4096$

14. a) 729      b) 256  
 c) 64      d) 1 000 000  
 e) 1 000 000 000 000      f) 144  
 g) 1      h) -512
15. a) The student multiplied the bases and multiplied the powers.  
 $(3^2 \times 2^2)^3 = 3^6 \times 2^6 = 729 \times 64 = 46\ 656$   
 b) The student added the exponents instead of multiplying them.  $[(-3)^2]^3 = (-3)^6 = 729$   
 c) The student might have thought that  $6^1$  is 1.  
 $\left(\frac{6^2}{6^1}\right)^2 = (6^1)^2 = 6^2 = 36$   
 d) The student did not simplify the powers in the brackets correctly.  
 $(2^6 \times 2^2 \div 2^4)^3 = (2^{6+2-4})^3 = (2^4)^3 = 2^{12} = 4096$   
 e) The student multiplied the powers in the brackets instead of adding them.  
 $(10^2 + 10^3)^2 = (100 + 1000)^2 = 1100^2 = 1\ 210\ 000$
16. a) 1 047 951      b) 28  
 c) 4100      d) 46 720  
 e) -255      f) 1 006 561

19. a) 255 583      b) 254 819 593  
 c) 2 097 152      d) 1631  
 e) 6560      f) 54 899
20. a) i)  $9^2$       ii)  $(3 \times 3)^2$       iii)  $3^4$   
 b) i)  $8^2$       ii)  $(2 \times 4)^2$       iii)  $2^6$

Answer  
 Key!

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Please check  
 your progress  
 as you go.