Exponent Laws

1. Write as a power.

a) $(3^2)^4$ b) $(6^3)^3$ c) $(5^3)^1$
d) $(7^0)^6$ e) $-(8^2)^2$ f) $[(-3)^4]^2$

2. Simplify $(2^4)^2$ and $(2^2)^4$. What do you notice? Explain the results.

3. Write each expression as a product or quotient of powers.

a) $[3 \times (-5)]^3$ b) $-(2 \times 4)^5$
c) $\left(\frac{2}{3}\right)^4$ d) $\left(\frac{-7}{-2}\right)^2$
e) $-[(-10) \times 3]^3$ f) $(16 \div 9)^2$

4. Why is the value of $(-5^2)^3$ negative?

5. Simplify each expression, then evaluate it. For each expression, state the strategy you used and why.

a) $(3 \times 2)^3$ b) $[(-2) \times 4]^2$ c) $\left(\frac{9}{-3}\right)^3$
d) $\left(\frac{8}{2}\right)^2$ e) $(12^8)^0$ f) $[(-4)^2]^2$

6. Why is the value of $[(-2)^3]^4$ positive but the value of $[(-2)^3]^5$ is negative?

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

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

i) 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.

a) $(4 \times 3)^3$ b) $[(-2) \times (-5)]^2$ c) $\left(\frac{6}{2}\right)^4$
d) $\left(\frac{14}{2}\right)^0$ e) $[(-5)^2]^2$ f) $(2^5)^3$

9. Simplify, then evaluate. Show your work.

a) $(3^2 \times 3^1)^2$ b) $(4^6 \div 4^4)^2$
c) $[(-2)^0 \times (-2)^3]^2$ d) $(10^6 \div 10^4)^3$
e) $(10^3)^2 \times (10^2)^3$ f) $(12^2)^4 \div (12^3)^2$
g) $(5^2)^6 \div (5^3)^4$ h) $[(-2)^2]^3 \times (-2)^3$

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

a) $(3^2 \times 2^2)^3 = (6^4)^3$
$= 6^{12}$
$= 2\,176\,782\,336$

b) $[(-3)^2]^3 = (-3)^5$
$= -243$

c) $\left(\frac{6^2}{6^1}\right)^2 = 6^4$
$= 1296$

d) $(2^6 \times 2^2 \div 2^4)^3 = (2^3)^3$
$= 2^9$
$= 512$

e) $(10^2 + 10^3)^2 = (10^5)^2$
$= 10^{10}$
$= 10\,000\,000\,000$

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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) $(10^5 \div 10^2)^2 + (3^3 \div 3^1)^4$

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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) $[(-2)^3 \times (-2)^2]^2 + [(-3)^3 \times (-3)^2]^2$

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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

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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.

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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) 32×64

ii) $16 \times 8 \times 32$

iii) $1024 \div 128$

iv) $\frac{16 \times 256}{1024}$

v) $(8 \times 4)^3$

vi) $\left(\frac{256}{64}\right)^4$