Elementary Algebra
Skill-Builder # E – 2
Applying the Power Rule for Exponents

The following rule applies when raising an exponential expression to a positive integer.

For any nonzero real number *a* and positive integers *m* and *n*,

$$\left(a^m\right)^n = a^{mn}.$$

The rule says that to raise an exponential expression to a positive integer *n*, keep the base *a* and multiply the exponents.

Examples

1. $\left(x^3\right)^4 = x^{3\cdot 4} = x^{12}$

2. $\left(a^8\right)^9 = a^{8\cdot 9} = a^{72}$

We can combine the power rule and product rule in one problem.

3. Simplify: $a^5\left(a^2\right)^4$

Solution:

$$a^5\left(a^2\right)^4 = a^5 \cdot a^{2\cdot 4} = a^5 \cdot a^8 = a^{5+8} = a^{13}$$

4. Simplify: $2x^8\left(x^2\right)^2\left(x^3\right)^4$

Solution:

$$2x^8\left(x^2\right)^2\left(x^3\right)^4 = 2x^8 \cdot x^{2\cdot 2} \cdot x^{3\cdot 4} = 2x^8 \cdot x^4 \cdot x^{12} = 2x^{8+4+12} = 2x^{24}$$

We may also need to apply the commutative and associative properties.

5. Simplify: $\left(3ab^4\right)\left(a^2\right)^5 b^3\left(b^6\right)^2\left(a^4\right)^3$

Solution:

$$\begin{aligned}
&\left(3ab^4\right)\left(a^2\right)^5 b^3\left(b^6\right)^2\left(a^4\right)^3 \\
&= \left(3ab^4\right)a^{2\cdot 5}b^{6\cdot 2}a^{4\cdot 3} \\
&= \left(3ab^4\right)\cdot a^{10}\cdot b^3\cdot b^{12}\cdot a^{12} \\
&= 3\left(a\cdot a^{10}\cdot a^{12}\right)\left(b^4\cdot b^3\cdot b^{12}\right) \\
&= 3a^{1+10+12}b^{4+3+12} \\
&= 3a^{23}b^{19}
\end{aligned}$$

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Simplify the following using the power rule for exponents.

1. $\left(n^5\right)^7$
2. $\left(y^8\right)^3$
3. $\left(w^4\right)^{12}$
4. $\left(c^{30}\right)^8$

Simplify the following using the power and product rules for exponents. Apply the commutative and associative properties for multiplication, if necessary.

5. $\left(a^2\right)^5\left(a^3\right)^2$
6. $5x^{11}\left(x^2\right)^4\left(x^3\right)^3\left(x^3\right)^2$
7. $\left(a^3\right)^2 b^4\left(a^4\right)^3 a^2\left(b^3\right)^5$
8. $-6y^3\left(y^5\right)^2\left(z^4\right)^5\left(y^2\right)^4 z^{11}$

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Answer Key:

1. n^{35}

2. y^{24}

3. w^{48}

4. c^{240}

5. a^{16}

6. $5x^{34}$

7. $a^{20}b^{19}$

8. $-6y^{21}z^{31}$

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