5.1 – Properties of Exponents

Properties of Exponents $\quad b^n \quad$ b = the base; n = the power or exponent

Product of Powers	$a^m a^n = a^{m+n}$	Quotient of Powers	$\frac{a^m}{a^n} = a^{m-n}$
Power of a Power	$(a^m)^n = a^{mn}$	Negative Power	$a^{-m} = \frac{1}{a^m}$
Zero Power	$a^0 = 1$	Power of a Product	$(ab)^m = a^m b^m$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$		

Example 1 Evaluate numerical Expressions

a. $(-4 \cdot 2^5)^2$

$= (-4)^2 (2^5)^2 = 16(2^{10})$

$= 16(1024) = 16{,}384$

b. $\left(\frac{11^5}{11^8}\right)^{-1} = \frac{11^{-5}}{11^{-8}} = \frac{11^8}{11^5}$

$= 11^{8-5} = 11^3 = 1331$

Example 2 Evaluate using scientific notation

85,000,000 × 1200

$= (8.5 \times 10^7)(1.2 \times 10^3)$

$= (8.5 \times 1.2)(10^7 10^3) = 10.2 \times 10^{10} = 1.02 \times 10^{11}$

Example 3 Simplify Expressions

a. $b^{-4}b^6b^7$

$= b^{-4+6+7}$

$= b^9$

b. $\left(\frac{r^{-2}}{s^3}\right)^{-3}$

$= \frac{r^6}{s^{-9}} = r^6 s^9$

c. $\frac{16m^4n^{-5}}{2n^{-5}}$

$= 8m^4 n^{-5-(-5)}$

$= 8m^4 n^0$

$= 8m^4$

You Try: $\frac{(x^{-3}y^3)^2}{x^5y^6} = \frac{x^{-6}y^6}{x^5y^6} = x^{-6-5}y^{6-6}$

$= x^{-11}y^0 = \frac{1}{x^{11}}$

HW: 3-35

EVALUATING NUMERICAL EXPRESSIONS **Evaluate the expression. Tell which properties of exponents you used.**

3. $3^3 \cdot 3^2$
4. $(4^{-2})^3$
5. $(-5)(-5)^4$
6. $(2^4)^2$
7. $\frac{5^2}{5^5}$
8. $\left(\frac{3}{5}\right)^4$
9. $\left(\frac{2}{7}\right)^{-3}$
10. $9^3 \cdot 9^{-1}$
11. $\frac{3^4}{3^{-2}}$
12. $\left(\frac{2}{3}\right)^{-5}\left(\frac{2}{3}\right)^4$
13. $6^3 \cdot 6^0 \cdot 6^{-5}$
14. $\left(\left(\frac{1}{2}\right)^{-5}\right)^2$

SCIENTIFIC NOTATION **Write the answer in scientific notation.**

15. $(4.2 \times 10^3)(1.5 \times 10^6)$
16. $(1.2 \times 10^{-3})(6.7 \times 10^{-7})$
17. $(6.3 \times 10^5)(8.9 \times 10^{-12})$
18. $(7.2 \times 10^9)(9.4 \times 10^8)$
19. $(2.1 \times 10^{-4})^3$
20. $(4.0 \times 10^3)^4$
21. $\frac{8.1 \times 10^{12}}{5.4 \times 10^9}$
22. $\frac{1.1 \times 10^{-3}}{5.5 \times 10^{-8}}$
23. $\frac{(7.5 \times 10^8)(4.5 \times 10^{-4})}{1.5 \times 10^7}$

SIMPLIFYING ALGEBRAIC EXPRESSIONS **Simplify the expression. Tell which properties of exponents you used.**

24. $\frac{w^{-2}}{w^6}$
25. $(2^2y^3)^5$
26. $(p^3q^2)^{-1}$
27. $(w^3x^{-2})(w^6x^{-1})$
28. $(5s^{-2}t^4)^{-3}$
29. $(3a^3b^5)^{-3}$
30. $\frac{x^{-1}y^2}{x^2y^{-1}}$
31. $\frac{3c^3d}{9cd^{-1}}$
32. $\frac{4r^4s^5}{24r^4s^{-5}}$
33. $\frac{2a^3b^{-4}}{3a^5b^{-2}}$
34. $\frac{y^{11}}{4z^3} \cdot \frac{8z^7}{y^7}$
35. $\frac{x^2y^{-3}}{3y^2} \cdot \frac{y^2}{x^{-4}}$