Review of Exponential Notation

An exponent is used to show repeated multiplication of the base.

Definition of b^n Let b represent any real number and n represent a positive integer. Then $b^n = \underbrace{b \cdot b \cdot b \cdot b \cdot \ldots b}_{n \text{ factors of } b}$

Note: If no exponent is explicitly written for an expression, then the expression has an implied exponent of 1. For example, $x = x^1$.

Ex: $2^3 = 2(2)(2) = \boxed{8}$

For exercises 1 – 3, identify the base and the exponent.

1. f^5

Base: f
Exponent: 5

2. $(-3)^2$

Base: −3
Exponent: 2

3. g

Base: g
Exponent: 1

4. What is the exponent for the factor of 3 in the expression $3c^8$.

1

For exercises 5 – 7, write the expression using exponents.

5. $-3 \cdot m \cdot m \cdot m \cdot m$

$-3m^4$

6. $(5a)(5a)(5a)$

$(5a)^3$

7. $\dfrac{2 \cdot x \cdot x \cdot x}{(y+3)(y+3)}$

$\dfrac{2x^3}{(y+3)^2}$

Evaluating Expressions with Exponents

For exercises 8 and 9, evaluate the two expressions and compare the answers. Do the expressions have the same value?

8. $(-4)^2$ and -4^2

$(-4)^2 = (-4)(-4) = \boxed{16}$

Base: −4

$-4^2 = -(4)(4) = \boxed{-16}$

Base: 4
Exponent: 2

9. $\left(\dfrac{1}{2}\right)^3$ and $\dfrac{1}{2^3}$

Recall: Order of Operations
$0 - 3^2 = 0 - 9 = \boxed{-9}$

Note: $(-2)^6 = \underbrace{(-2)(-2)}_{+}\underbrace{(-2)(-2)}_{+}\underbrace{(-2)(-2)}_{+} = 4(4)(4) = 16(4) = \boxed{64}$

$(-2)^5 = \underbrace{(-2)(-2)}_{+}\underbrace{(-2)(-2)}_{+}\underbrace{(-2)}_{-} = 4(4)(-2) = \boxed{-32}$

Important: * If you raise a negative number to an even power, you get a positive.

* If you raise a negative number to an odd power, you get a negative

Know these powers:

$2^2 = 4$	$3^2 = 9$	$5^2 = 25$	$10^2 = 100$
$2^3 = 8$	$3^3 = 27$	$5^3 = 125$	$10^3 = 1000$
$2^4 = 16$	$3^4 = 81$	$5^4 = 625$	$\vdots$
$2^5 = 32$	$3^5 = 243$	$6^2 = 36$	$10^6 = 1000000$
$2^6 = 64$	$3^6 = 729$	$6^3 = 216$	etc
$2^7 = 128$	$4^2 = 16$	$7^2 = 49$	
$2^8 = 256$	$4^3 = 64$	$7^3 = 343$	
$2^9 = 512$	$4^4 = 256$	$8^2 = 64$	
$2^{10} = 1024$	$4^5 = 1024$	$8^3 = 512$	
		$9^2 = 81$	
		$9^3 = 729$	

Ex: $(-10)^2 = (-10)(-10) = \boxed{100}$

$-10^2 = -(10)(10) = \boxed{-100}$

For exercises 10 – 12, evaluate the expressions.

10. 22^1

$= \boxed{22}$

11. $(-1)^{50} = \boxed{1}$

Note: $1^{50} = \boxed{1}$

$(-1)^{49} = \boxed{-1}$

$1^{49} = \boxed{1}$

12. $-\left(\frac{2}{3}\right)^3 = -\frac{2}{3}\cdot\frac{2}{3}\cdot\frac{2}{3}$

$= \boxed{-\frac{8}{27}}$

For exercises 13 – 15, simplify using the order of operations.

13. $-2(-1)^5$

$= -2(-1)$

$= \boxed{2}$

14. $3^2 + 4^3$

$9 + 64$

$= \boxed{73}$

15. $3\cdot 2^3 - 4\cdot 3^2$

$3\cdot 8 - 4\cdot 9$

$= 24 - 36$

$= \boxed{-12}$

For exercises 16 – 19, evaluate each expression for $x = -3$ and $y = 4$.

16. $-3x^3$

$-3(-3)^3 = -3(-27)$

$= \boxed{81}$

$x = -3$

17. $(-5y)^2$

$(-5(4))^2$

$= (-20)^2 = \boxed{400}$

18. $x^2 - xy + y^2$

$(-3)^2 - (-3)(4) + (4)^2$

$= 9 - (-12) + 16$

$= 9 + 12 + 16$

$= 21 + 16 = \boxed{27}$

19. $(x-y)^3$

$(-3-4)^3 = (-7)^3 = \boxed{-343}$

$49 \times 7 = 343$

Multiplying and Dividing Expressions with Common Bases

Multiplication of Expressions with Like Bases

Assume that b is a real number and that m and n represent positive integers. Then, $b^m b^n = b^{m+n}$

Ex: $x^2 x^3 = (xx)(xxx) = x^5$

Division of Expressions with Like Bases

Assume that $b \neq 0$ is a real number and that m and n represent positive integers. Then, $\frac{b^m}{b^n} = b^{m-n}$

$\frac{x^7}{x^3} = \frac{\cancel{x}\cancel{x}\cancel{x}xxxx}{\cancel{x}\cancel{x}\cancel{x}} = x^4$

Also: $(b^m)^n = b^{mn}$ (power to a power you multiply the exponents:

$(x^2)^3 = (xx)^3 = (xx)(xx)(xx) = x^6$

For exercises 20 – 22, simplify the expressions. Write the answers in exponent form.

20. x^3x^5

$= x^{3+5} = \boxed{x^8}$

21. $3^2 \cdot 3^6$

$= 3^{2+6} = \boxed{3^8}$

22. $a^3 \cdot a \cdot a^5$

$a^3 \cdot a^1 \cdot a^5$

$= \boxed{a^9}$

For exercises 23 – 25, simplify the expressions. Write the answers in exponent form.

23. $\dfrac{g^5}{g^3} = g^{5-3}$

$= \boxed{g^2}$

24. $\dfrac{4^3}{4}$

$4^{3-1} = \boxed{4^2} = 16$

25. $\dfrac{y^3y^6}{y^4} = \dfrac{y^9}{y^4}$

$= y^{9-4} = \boxed{y^5}$

Ex: $\dfrac{3^{12}}{3^8} = 3^{12-8} = 3^4 = \boxed{81}$

Simplifying Expressions with Exponents

For exercises 26 – 29, use the commutative and associative properties of real numbers and the properties of exponents to simplify the expressions.

26. $(-2c^2d^3)(6c^3d)$

$\boxed{-12c^5d^4}$

27. $(3r^5)(-4r^2)(r)$

$-12r^5r^2r^1$

$= \boxed{-12r^8}$

28. $\dfrac{a^3a^{11}}{a^4a^5} = \dfrac{a^{3+11}}{a^{4+5}} = \dfrac{a^{14}}{a^9} = a^{14-9}$

$= \boxed{a^5}$

29. $\dfrac{\overset{5}{\cancel{15}}m^5n^{12}}{\underset{1}{\cancel{3}}m^4n^7}$

$= \dfrac{5m^5n^{12}}{m^4n^7} = 5m^{5-4}n^{12-7}$

$= \boxed{5mn^5}$