Zero and Negative Exponents

**6.0 Review of Exponents**

**I. For every nonzero number *a*, *a*0 = 1.**

**II. For every nonzero number *a* and integer *n*,  In other words, when the exponent is negative, raise the reciprocal of the base to the opposite of the exponent.**

Write each expression as an integer, a simple fraction, or an expression that contains only positive exponents. Simplify**.**

|  |  |
| --- | --- |
| **1.** 2.30 | **2.** 10-4 |
| **3.** 2*a–*5 | **4.** 113.70 |
| **5.** 19*–*1 | **6.** |
| **7.** (7*q*) *–*1 | **8.**  |
| **9.** 1.8*c*0 | **10.** (–9.7)0 |
|  |  |

Write each expression so that it contains only positive exponents. Simplify**.**

|  |  |
| --- | --- |
| **11.** –6–3 | **12.** –2*rs-*5 |
| **13.** 7*x–*8 *y*0 | **14.** |
| **15.** (–8*v*)–2 *w*3 | **16.** |
| **17.** (3*xy*)0 *z* | **18.** |

**III. When multiplying powers with the same base, you add the exponents. \*\* This is true for numerical and algebraic expressions**

What is each expression written as a single power?

**a.** 34 **·** 32 **·** 33

All three powers have the same base, so this expression can be written as a single power by adding the exponents.

|  |  |
| --- | --- |
| 34 **·** 32 **·** 33 = 34+2+3 | All powers have the same base. Add the exponents. |
| =39 | Simplify the exponent. |

34 represents 4 factors of 3, 32 represents 2 factors of 3, and 33 represents 3 factors of 3. This is a total of 9 factors of 3, so the answer is reasonable.

Even when some of the exponents are negative, exponents can be added when the bases are the same in a product of powers.

|  |  |
| --- | --- |
| **b.** 11−3 **·** 114 **·** 11−5 |  |
| 11−3 **·** 114 **·** 11−5 = 11−3 + 4 + (−5) | All powers have the same base. Add the exponents. |
| = 11−4 | Simplify the exponent. |

**Simplify each expression.**

|  |  |  |
| --- | --- | --- |
| **19.** *a*2*a*3 | **20.** 3*n*3*n*5 | **21.** 8*k*3 · 3*k*6 |
| **22.** (8*p*5)(6*p*4) | **23.** 21*d*7 · 2*d*3 | **24.** (−6.1*m*4)(3*m*2) |
| **25.** *h*5 ·*h*2 ·*h*10 | **26.** (−9*q*−8)(6*q*11) | **27.** (16*r*−7)( −2*r*) |
| **28.** (*y*3*z*13)(*y*2*z*−6) | **29.** (−3*x*2)(5*w*8)(4*x*3) | **30.** (15*fg*2)(*f* 3*g*−3)( −8*f*−*1g*6) |
| **31.** *m*−6 ·*m*3 ·*n*−2 | **32.** −6*j*−3*k* · 7*jk*5 | **33.** −2*uvw*−1· 3*u*2*v*−2*w* |

**IV. When a power is raised to another power, like (*xy*)*z*, multiply the exponents**.

a. What is the simplified form of (*d*3)4?

|  |  |
| --- | --- |
| (*d*3)4 = *d*3·4 | The expression is a power, *d*3, raised to another power, 4. Multiply the exponents. |
| = *d*12 | Simplify. |

 b.What is the simplified form of (*n*–3)6*n*4?

Using the order of operations, first simplify the power (*n*–3)6.

(*n*–3)6*n*4 = (*n*–3**·**6)*n*4 = *n*–18*n*4

Next, multiply. The two powers have the same base, so simplify by adding the exponents.

*n*–18*n*4 =*n*–18+4 = *n*–14

Finally, write the expression using positive exponents. Rewrite the expression using the reciprocal of the base and the opposite of the exponent.



**Simplify each expression.**

|  |  |  |  |
| --- | --- | --- | --- |
| **34.** (*y*2)3 | **35.** (*v*9)6 | **36.** (*h*4)5 | **37.** (*n*4)11 |
| **38.** (*p–*1)5 | **39.** (*z*3)–6 | **40.** (*x*–4)–5*x* | **41.** (*f* 5)–1*f* 8 |
| **42.** (3*a*)4 | **43.** (6*c*)–3 | **44.** (7*k*)0 | **45.** (10*s*–3)2 |
| **46.** (2*y*–5)3(*x*11*y*–10)2 | **47.** *u*–9(*u*–1*v*)4*u*–5 | **48.** (*x*13*y*6)–2(*y*–5*x*10)6 | **49.** 4*m*0*n*0(6*m*5)2 |

**\*\*\*Simplifying powers may require you to use multiple properties of exponents. You should follow the order of operations when simplifying**

**V. Division properties of exponents work whether the bases in the problem are constants or variables. When you divide powers with the same base, subtract the exponents**.

a. How can you use the division property of exponents to show thatwhen *x ≠* 0?

In this example, *x*5 and *x*3 are powers with the same base and when you divided them, the result was *x*2 = *x*5–3

**Simplify each expression.**

|  |  |
| --- | --- |
| **50.** | **51.** |
| **52.** | **53.** |
| **54.**  | **55.** |
| **56.** | **57.** |
| **58.** | **59.** |