

Important Concepts . . .

Preview Review



Mathematics Grade 9 TEACHER KEY
W1 - Lesson 2: Exponents

Important Concepts of Grade 9 Mathematics

| | |
|----------------------|----------------------------------|
| W1 - Lesson 1 | Powers |
| W1 - Lesson 2 | Exponents |
| W1 - Lesson 3 | Rational Numbers |
| W1 - Lesson 4 | Order of Operations |
| W1 - Lesson 5 | Square Roots of Rational Numbers |
| W1 - Review | |
| W1 - Quiz | |
| W2 - Lesson 6 | Graphing Linear Relations |
| W2 - Lesson 7 | Solving Linear Relations |
| W2 - Lesson 8 | Linear Inequalities |
| W2 - Lesson 9 | Polynomials |
| W2 - Lesson 10 | Surface Area of 3D Objects |
| W2 - Review | |
| W2 - Quiz | |
| W3 - Lesson 11 | Properties of Circles |
| W3 - Lesson 12 | Polygons and Scale Diagrams |
| W3 - Lesson 13 | Rotational Symmetry |
| W3 - Lesson 14 | Representing Data |
| W3 - Lesson 15 | Probability |
| W3 - Review | |
| W3 - Quiz | |

Materials Required

Paper
Pencil
Calculator

**No Textbook
Required**

**This is a stand-
alone course.**

Mathematics Grade 9

Version 6

Preview/Review W1 - Lesson 2

ISBN: 978-1-927090-00-8

Publisher: Alberta Distance Learning Centre

Written by: Lynee Fyfe

Reviewed by: Danielle Winter

Project Coordinator: Danielle Winter

Preview/Review Publishing Coordinating Team: Julie Reschke



Alberta Distance Learning Centre has an Internet site that you may find useful. The address is as follows: <http://www.adlc.ca>

The use of the Internet is optional. Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

ALL RIGHTS RESERVED

Copyright © 2011, by Alberta Distance Learning Centre, 4601-63 Avenue, Barrhead, Alberta, Canada, T7N 1P4. Additional copies may be obtained from Alberta Distance Learning Centre.

No part of this courseware may be reproduced or transmitted in any form, electronic or mechanical, including photocopying (unless otherwise indicated), recording, or any information storage and retrieval system, without the written permission of Alberta Distance Learning Centre.

Every effort has been made both to provide proper acknowledgement of the original source and to comply with copyright law. If cases are identified where this effort has been unsuccessful, please notify Alberta Distance Learning Centre so that appropriate corrective action can be taken.

IT IS STRICTLY PROHIBITED TO COPY ANY PART OF THESE MATERIALS UNDER THE TERMS OF A LICENCE FROM A COLLECTIVE OR A LICENSING BODY.

Preview/Review Concepts for Grade Nine Mathematics

Teacher Key



W1 - Lesson 2:

Laws of Exponents

OBJECTIVES

By the end of this lesson, you will be able to:

- Explain, using examples, the exponent laws of powers with integral bases (excluding base 0) and whole number exponents.
- Evaluate a given expression by applying the exponent laws.

GLOSSARY

Product Law: $x^a x^b = x^{a+b}$

Power of a Product Law: $(x^a)^b = x^{ab}$

Division law: $\frac{x^a}{x^b} = x^a x^{-b} = x^{a-b}$

Zero Exponent Law: $x^0 = 1$ (if $x \neq 0$)

W1 – Lesson 2: Laws of Exponents

Materials required:

- Paper, Pencil, and Calculator

Part 1: Multiplication of Powers – The Product Law

In the expression $(x^5)(x^6)$, notice that the bases are the same. This expression can be simplified into one exponent instead of two: the key is to count factors.

So,

$$x^5 = (x)(x)(x)(x)(x) \text{ and } x^6 = (x)(x)(x)(x)(x)(x)$$

Multiply them together:

$$(x^5)(x^6) = (x)(x)(x)(x)(x)(x)(x)(x)(x)(x)(x) = x^{11}$$

There are five x factors from x^5 , and six x factors from x^6 , which yields 11 x factors in total.

The **Product Law** can then be written as:

$$x^a x^b = x^{a+b}$$

Example 1

Simplify $(5^4)(5^3)$

$$\begin{aligned}
 &= (5)(5)(5)(5) \quad (5)(5)(5) \\
 &= (5)(5)(5)(5)(5)(5)(5) \\
 &= 5^7
 \end{aligned}$$

Note: The rule above does not work when multiplying powers with a different base. For instance,

$$(x^3)(y^4) = (x)(x)(x)(y)(y)(y)(y)$$

When writing out the powers, there is no way to combine them.

However, if the bases are different but the exponents are the same, then they can be combined.

Example:

$$(x^3)(y^3) = (x)(x)(x)(y)(y)(y) = (xy)^3$$

So combining powers with different bases can be written as:

$$x^a x^a = (xy)^a$$

Example 1

Simplify $(4)^3 (5)^3$

$$\begin{aligned} &= (4)(4)(4) (5)(5)(5) \\ &= (4 \times 5)^3 \\ &= 20^3 \end{aligned}$$

Practice Questions

1. Simplify each of the following.

a. $(x^3)(x^6)$

$$\underline{x^9}$$

b. $(3^5)(3^2)$

$$\underline{3^7}$$

c. $-(8^4)(8^3)$

$$\underline{-8^7}$$

d. $(9^6)(9^5)$

$$\underline{9^{11}}$$

2. Simplify each of the following.

a. $(d^3)(f^5)$

$$\underline{(df)^5}$$

b. $(8^4)(6^4)$

$$\underline{48^4}$$

c. $(5^6)(3^6)$

$$\underline{15^6}$$

d. $(6^4)(7^4)$

$$\underline{42^4}$$

Part 2: Division of Powers

When dividing exponents, subtract the exponents when the bases are the same.

To simplify $x^8 \div x^6$, subtract the exponents.

$$x^8 \div x^6 = x^{8-6} = x^2$$

So the **Division Law** can be written as: $\frac{x^a}{x^b} = x^a x^{-b} = x^{a-b}$

Example 1

Simplify $(6^6) \div (6^3)$

$$\begin{aligned} &= (6)(6)(6)(6)(6)(6) \div (6)(6)(6) \\ &= (6)^{6-3} \\ &= 6^3 \end{aligned}$$

When dividing powers with different bases but a common exponent, this exponent can be applied to both the numerator and denominator. For instance, $x^3 \div y^3$.

$$\begin{aligned} &= \frac{(x)(x)(x)}{(y)(y)(y)} \\ &= \left(\frac{x}{y}\right)\left(\frac{x}{y}\right)\left(\frac{x}{y}\right) \text{ which is } \left(\frac{x}{y}\right)^3. \end{aligned}$$

$$\frac{x^a}{y^a} = \left(\frac{x}{y}\right)^a$$

Example 2

Simplify $(4)^6 \div (5)^6$

$$\begin{aligned} &= \frac{4^6}{5^6} \\ &= \left(\frac{4}{5}\right)^6 \end{aligned}$$

Practice Questions

1. Simplify each of the following.

a. $(j^5) \div (j^4)$

$$\underline{\mathbf{j}}$$

b. $(2^5) \div (2^2)$

$$\underline{\mathbf{2^3}}$$

c. $-(5^5) \div (5^3)$

$$\underline{\mathbf{-5^2}}$$

d. $(9^9) \div (9^5)$

$$\underline{\mathbf{9^4}}$$

2. Simplify each of the following.

a. $(h^5) \div (k^5)$

$$\underline{\left(\frac{\mathbf{h}}{\mathbf{k}}\right)^5}$$

b. $(3^4) \div (6^4)$

$$\underline{\left(\frac{\mathbf{3}}{\mathbf{6}}\right)^4}$$

Part 3: Power of a Power

With an expression like $(x^5)^4$, the rule can be worked out by counting.

$$(x^5)^4 = (x^5)(x^5)(x^5)(x^5)$$

Write this as an array:

$$\begin{array}{l} x^5 = (x) (x) (x) (x) (x) \\ x^5 = (x) (x) (x) (x) (x) \\ x^5 = (x) (x) (x) (x) (x) \\ x^5 = (x) (x) (x) (x) (x) \end{array}$$

There are 20 factors of x , therefore, $(x^5)^4 = x^{20}$

So the **Power of a Power Rule** can be written as:

$$(x^a)^b = x^{ab}$$

Note the difference between the **Power Rule**.

$$x^5 x^4 = (xxxxx)(xxxx) = x^9$$

Example 1

$$\begin{aligned} &\text{Simplify } (4^3)^5 \\ &= (4^3) (4^3) (4^3) (4^3) (4^3) \text{ or } 4^{3 \times 5} \\ &= 4^{15} \end{aligned}$$

Example 2

$$\begin{aligned} &\text{Simplify } (-5^3)^2 \\ &= (-5^3) (-5^3) \text{ or } (-5)^{3 \times 2} \\ &= (-5)^6 \end{aligned}$$

Lesson 2 Assignment

1. Evaluate each of the following.

a. $-(5)^6$

-15 625

b. 4^6

4096

2. Simplify each of the following.

a. $(3^3)(3^4)$

3^7

b. $(4^5)(4^6)$

4^{11}

c. $(h^7) \div (h^5)$

h^2

d. $(6^6) \div (6^4)$

6^2

3. Evaluate the following powers, then circle the lesser value in each set.

a. $\textcircled{2}(2^2)^3$ or $3(2^3)^2$

$(2)(2)^6$ or $(3)(2)^6$

128 or 192

b. $\textcircled{6^3 \times 6^4}$ or $3^6 \times 3^6$

6^7 or 3^{12}

279 936 or 531 441

4. Simplify the following.

a. $(5^4)^5$

5^{20}

b. $(4^6)^5$

4^{30}

5. Simplify the following.

$$\text{a. } \frac{(8^2)(8^5)(8^{-3})}{(8^2)}$$

$$= \left(\frac{8^4}{8^2} \right) = 8^2$$

$$\text{b. } \frac{(6^7)(6^2)}{(6^2)}$$

$$= \left(\frac{6^9}{6^2} \right) = 6^7$$

$$\text{c. } \frac{[(-5)^2]^4}{(-5)^3}$$

$$= \frac{(-5)^8}{(-5)^3} = (-5)^5$$

$$\text{d. } [(a^2)(a^3)]^2$$

$$= (a^5)^2 = a^{10}$$

6. Write the following as a single power and then evaluate the expression.

$$\text{a. } 2^5 \times 2^7$$

$$= 2^{12}$$

$$= 4096$$

$$\text{b. } 3(mn)^4 \text{ where } m = 6 \text{ and } n = 5$$

$$= 3m^4n^4 = 3(6)^4(5)^4 = (3)(1296)(625) = 2\,430\,000$$

$$\text{c. } 8(3^5)^2$$

$$= (8)(3^{10}) = 472\,392$$

