Unit 1.1 – Basic Properties of Exponents

Student Learning Targets:

- I can understand the properties of exponents and how to use them.
- I can simplify algebraic terms with common base exponents.

Properties of exponents

Properties	General Form	Application	Example
Product Rule *Same base add exponents*	$a^m a^n$	a^{m+n}	$x^5x^3 = x^{5+3} = x^8$
Quotient Rule *Same base subtract exponents*	$\frac{a^m}{a^n}$	a^{m-n}	$\frac{x^9}{x^5} = x^{9-5} = x^4$
Power Rule I *Power raised to a power multiply exponents.*	$(a^m)^n$	a^{mn}	$(x^3)^4 = x^{3 \cdot 4} = x^{12}$
Power Rule II *Product to power distribute to each base*	$(ab)^m$	$a^m a^n$	$(4x^3)^2 = 4^2x^{3 \cdot 2} = 16x^6$
Negative Exponent I *Flip and change sign to positive*	a^{-m}	$\frac{1}{a^m}$	$x^{-3} = \frac{1}{x^3}$
Negative Exponent II *Flip and change sign to positive*	$\frac{1}{a^{-m}}$	a^m	$\frac{1}{x^{-5}} = x^5$
Zero Exponent *Anything to the zero power (except 0) is one*	a^0	$a^0 = 1$	$(-4x)^0 = 1$

- It is important to note that none of these applications can occur if the bases are not the same.
  For example, $\frac{x^5}{y^3}$ cannot be simplified.

An **exponent** refers to the number of times a number is multiplied by itself. For example, 2 to the 3rd (written like this: 2^3) means: **2 x 2 x 2 = 8**

Referring to 2^3, 2 is called the **Base** and 3 is called the **exponent.**

Notes(1.1):

Assignment 1.1
Evaluate using the properties of exponents.

1. $3^3 \cdot 3^2$

2. $(4^{-2})^3$

3. $\frac{5^2}{5^5}$

4. $\left(\frac{3}{5}\right)^4$

5. $\frac{3^4}{3^{-2}}$

6. $\left(\frac{2}{3}\right)^{-5}\left(\frac{2}{3}\right)^4$

Simplify the expression.

7. $(2^2y^3)^5$

8. $(3a^3b^5)^{-3}$

9. $(w^3x^{-2})(w^6x^{-1})$

10. $(5s^{-2}t^4)^{-3}$

11. $\frac{w^{-2}}{w^6}$

12. $\frac{3c^3d}{9cd^{-1}}$

13. $\frac{x^2y^{-3}}{3y^2} \cdot \frac{y^2}{x^{-4}}$

14. $\frac{x^{-1}y^2}{x^2y^{-1}}$

Unit 1.2 – Use the Properties of Rational and Irrational Numbers

Student Learning Targets:

- I can simplify radical expressions.
- I can add, subtract, and multiply real numbers
- I can explain why adding and multiplying two rational numbers results in a rational number.
- I can explain why adding a rational number to an irrational number results in an irrational number.
- I can explain why multiplying a nonzero number to an irrational number results in an irrational number.

A **rational number** can be written as a terminating or repeating decimal. **Irrational numbers** are non-terminating, non-repeating decimals.

Notes:

Notes (Continued for 1.2):

Assignment 1.2

Simplify each radical expression.

1. $\sqrt{125}$

2. $\sqrt{50}$

3. $\sqrt{200}$

4. $\sqrt[3]{-162x^2y^3}$

5. $\sqrt{108x^3y}$

6. $\sqrt[3]{27x^5y^7}$

Find each sum or difference.

7. $2\sqrt{5} - 5\sqrt{3} - 2\sqrt{3}$

8. $-3\sqrt[4]{3} + 3\sqrt{3} + 2\sqrt{3}$

9. $4\sqrt[4]{10} - \sqrt[4]{10} - 2\sqrt[4]{10}$

10. $6\sqrt{3} - 7\sqrt[3]{5} + 2\sqrt[3]{5} - 2\sqrt{3}$

11. $3\sqrt{8} + 4\sqrt{16} - \sqrt{2} + 5$

12. $6\sqrt{9} + 2\sqrt{20} - 3\sqrt{5} - \sqrt{25}$

Assignment 1.2 (Continued)

Find each product. Simplify each expression fully.

13. $\sqrt{10}\left(\sqrt{6}+\sqrt{10}\right)$

14. $\sqrt{3}\left(4\sqrt{6}+5\right)$

15. $\sqrt{5}\left(3\sqrt{10}+4\right)$

16. $\sqrt{6}\left(2+3\sqrt{2}\right)$

17. $(-2\sqrt[4]{3}+5)(4\sqrt[4]{3}+4)$

18. $\left(1+\sqrt{2}\right)\left(-3-2\sqrt{2}\right)$

19. $\left(\sqrt[3]{2}+\sqrt[3]{5}\right)\left(\sqrt[3]{2}-\sqrt[3]{5}\right)$

20. $(\sqrt{2}+3\sqrt{5})(\sqrt{2}-3\sqrt{5})$

Additional Problems: UM2: Page 248 #17-34; Page 254 #1-25
MA2: Page 424 #32-40, 52-55

Unit 1.3 – Extend the Properties of Exponents to Rational Exponents

Student Learning Targets:

- I can convert radical notation to rational exponent notation, and vice-versa.
- I can extend the properties of integer exponents to rational exponents and use them to simplify expressions.

$$Let\ a^{1/n}\ be\ the\ nth\ root\ of\ a, and\ let\ m\ be\ a\ positive\ integer, then\ \left(\sqrt[n]{a}\right)^m = \left(a^{1/n}\right)^m = a^{m/n}$$

Notes:

Notes (continued for 1.3):

Assignment 1.3

Write each expression in radical form.

1. $8^{3/5}$
2. $19^{7/2}$
3. $x^{1/4}$

Write each expression in exponential form.

4. $\left(\sqrt[3]{4}\right)^5$
5. $\left(\sqrt[7]{w}\right)^6$
6. $\sqrt{5}$

Simplify each expression using the properties of rational exponents.

7. $7^{1/4} * 7^{1/2}$
8. $(6^{1/2} * 4^{1/4})^2$
9. $(4^5 * 3^5)^{-1/5}$
10. $\frac{5}{\sqrt[4]{5}}$
11. $\left(\frac{42^{1/3}}{6^{1/3}}\right)^2$
12. $(125x^{-6})^{1/3}$
13. $\left(\frac{2x^5}{32x^{25}}\right)^{3/4}$
14. $\frac{x^{3/2}y^{-9/2}}{x^{5/2}y^{7/2}x^{-7/2}}$
15. $(\sqrt[5]{2x^4y^3})^{-10}$
16. $\left(\frac{a^{-3/2}b^{3/2}a^{1/2}b^2}{a^{1/3}b^{1/2}}\right)^4$
17. $\left(\sqrt[4]{w^{7/4}y^{16}r^{12}w^{-3/4}}\right)^2$
18. $\left(a^{3/2}b^{5/3}\right)^6\left(ba^{7/9}\right)^{18}$

Additional Problems: MA2: Page 417 #7-14, 21-32; Page 425 #3-22

Unit 1.4 – Perform Arithmetic Operations with Complex Numbers

Student Learning Targets:

- I can understand that the set of complex numbers includes the set of all real numbers and the set of imaginary numbers.
- I can express numbers in the form $a + bi$.
- I can add, subtract, and multiply complex numbers.

A **complex number** is any number in the form $a + bi$. The **imaginary unit *i*** is defined as $i = \sqrt{-1}$. We commonly use the fact $i^2 = -1$ to help us in simplifying expressions.

Notes:

Notes (Continued for 1.4):

Assignment 1.4

Simplify.

1. $\sqrt{-121}$
2. $\sqrt{-169}$
3. $\sqrt{-32}$
4. $\sqrt{-162}$

Write the expression as a complex number in standard form.

5. $\sqrt{-81}+\sqrt{16}$
6. $\sqrt{-144}+\sqrt{121}$
7. $\sqrt{-180}+\sqrt{98}$
8. $\sqrt{-75}+\sqrt{288}$

Write the expression as a complex number in standard form.

9. $(6-3i)+(5+4i)$
10. $(-1+4i)+(-9-2i)$
11. $(-14i-3)+(-7i+6)$
12. $(4i-10)+(7-8i)$
13. $(-2-6i)-(4-6i)$
14. $(-1+i)-(7-5i)$

Assignment 1.4 (Continued)

15. $(6i + 4) - (10i + 8)$

16. $(3i - 8) - (11 + 7i)$

17. $6i(3 + 2i)$

18. $-2i(-7i + 14)$

19. $i(4 - 10i)$

20. $(8 - 3i)(2 + 4i)$

21. $(3 + 2i)(-2 - 3i)$

22. $(-2 - i)(11 + 6i)$

23. $(2 + 2i)(2 - 2i)$

24. $(-5 - 3i)(-5 + 3i)$