



Big idea

In real life there are relationships that depend upon variables. For example, earnings versus time worked, or pressure under water versus depth, or distance travelled versus time. Not everything in real life can be modeled by a linear relations which look like: _____. Non-linear relations can look like _____ (quadratics – study this year) or _____ (exponentials – study next year). Since the last two types involve exponents we shall start this unit with laws of exponents. Exponents were invented as a shortcut of writing something that is repeated, or to avoid clumsy denominators that take up a lot of space.

*no calculators!
allowed
power table*



Feedback & Assessment of Your Success

Date	Pages	Topics	Finished assignment pages?	Summarized notes in a journal?	How many extra practice questions did you try in each topic?	Tentative TEST date:
			Made corrections?	Added your own explanations?	Questions to ask the teacher:	
2days	2-4	Exponent Laws of gr10 (MPM) Journal #1				_____
1.5days	5-6	Radicals (MCR) Journal #2				
3days	7-11	Exponent Laws of gr11 (MCR) Journal #3,4				
1.5days	12-14	Solve Equations (MPM + MCR + AP) Journal #5				

ASSIGNMENT Exponent Laws (MPM)

1. Review Gr.9 Laws of exponents

MULTIPLICATION	EXPAND & SIMPLIFY	SINGLE POWER	RULE
$a^4 \times a^5$	$a \times a \times a \times a \times a \times a \times a \times a \times a \times a$		$x^a \times x^b =$
$a^2 \times a^4$			
DIVISION			
$a^5 \div a^4$	$\frac{a \times a \times a \times a \times a}{a \times a \times a \times a}$		$x^a \div x^b =$
$a^4 \div a^2$			
POWER OF POWER			
$(a^4)^5$	$a^4 \times a^4 \times a^4 \times a^4 \times a^4$		$(x^a)^b =$
$(a^5)^2$			

2. Extend to many bases

LAW	EXPLANATION	EXAMPLE
Power of a Product or Quotient		$(5x^6y^2)^3$
		$\left(\frac{2x^4}{3^2y^3}\right)^5$
Power of Sum/Diff		$(2^3 + x)^2$

Practice:

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

4. $\frac{4^6}{4^3}$

5. $(5^2)^3$

6. $3x^3 \cdot 4x^4$

7. $\frac{8x^6}{12x^4}$

8. $(3xy^3)^4$

9. Explore what negative and zero exponents mean by filling in the table

<i>DIVISION</i>	<i>EXPAND & DIVIDE</i>		<i>USE EXPONENT LAW</i>
$2^3 \div 2^5$	$\frac{2 \times 2 \times 2}{2 \times 2 \times 2 \times 2 \times 2} = \frac{1}{2^2}$		$\frac{2^3}{2^5} = 2^{3-5} = 2^?$
$2^3 \div 2^4$			
$2^3 \div 2^3$			
<i>RULES</i>	$x^{-a} =$	$\frac{1}{x^a} =$	$x^0 =$
<i>EXAMPLES</i>	$\frac{3x^{-2}}{(2z^0y)^{-1}}$		$\frac{(4a)^{-1}}{5b^{-3}}$

Practice:

10. 4^{-3}

11. $\frac{1}{6^{-3}}$

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

13. $2x^{-3}$

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

15. $\frac{8^{-2}}{3}$

16. $(-4x^{-1}z^{-2})^{-2}$

17. $(5x^4y^{-3}z^2)(-2x^2y^4z^{-1})$

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

19. $\frac{x^3y^{-3}}{x^{-1}y^2}$

20. $\frac{(3a^{-1}b^{-2}c^4)^3}{(2a^{-1}b^2c^{-3})^2}$

21. $\frac{4^{-2} + 2^{-4}}{8^{-1}}$

Simplify, record answers with positive exponents, include restrictions where needed

22. $2x^3 \cdot 3x^2$

23. $-(2x^3)^4$

24. $(4x)^2 \times 4x^2$

25. $(3d^{-3})^3 \times 3d^{-2}$

26. $4(-2x^5y^0)^{-2} \times (2x^{-1}y^2)^{-3}$

27.
$$\frac{(-3c^4)^{-2}}{c^{-1} \times (3c^{-2})^{-2}}$$

28.
$$\left(\frac{(-2a^{-2})^3 a^3}{4a^{-4}} \right)^{-3}$$

29.
$$\frac{(-2xy^3 \times 3x^{-3}y^{-2})^3}{6x^0y^{-1}}$$

ASSIGNMENT Radicals (MCR)

Reduce roots and simplify

1. $3\sqrt{6} - 3\sqrt{5} - 3\sqrt{3} - 2\sqrt{6}$

2. $-2\sqrt{6} - 3\sqrt{6} - 3\sqrt{6}$

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

4. $\sqrt{147}$

5. $3\sqrt{32}$

6. $2\sqrt{48p^5}$

7. $\sqrt{200a^4b^3}$

8. $\sqrt{108n^4}$

9. $3\sqrt{12} \times 4\sqrt{6}$

10. $4\sqrt{5}(\sqrt{5} + 4)$

11. $\sqrt{3v^3} \cdot -\sqrt{20v}$

12. $\frac{3\sqrt{5}}{2\sqrt{20}}$

13. $3\sqrt{12} - \sqrt{18} - \sqrt{3}$

14. $\sqrt{12} + 2\sqrt{48} - 5\sqrt{175}$

15. $2\sqrt{18} - 3\sqrt{12} + 4\sqrt{50} + \sqrt{27}$

16. $-3\sqrt[3]{-3} + 2\sqrt[3]{162} + 3\sqrt[3]{81}$

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

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

Rationalize denominators and simplify

19.
$$\frac{2}{\sqrt{6}}$$

20.
$$\frac{2}{5\sqrt{3}}$$

21.
$$\frac{6\sqrt{5}}{7\sqrt{2}}$$

22.
$$\frac{\sqrt{3x^2y^3}}{4\sqrt{5x^3y}}$$

23.
$$\frac{\sqrt{5}-\sqrt{2}}{\sqrt{8}}$$

24.
$$\frac{\sqrt{5}}{3-\sqrt{3}}$$

25.
$$\frac{4}{\sqrt{2}+5\sqrt{3}}$$

26.
$$\frac{5-\sqrt{3}}{2\sqrt{3}+\sqrt{5}}$$

27.
$$\frac{4-\sqrt{2}}{5-\sqrt{5}}$$

ASSIGNMENT Gr.11 Rational Exponent Laws (MCR)

1. What does the word rational mean?

2. Use a calculator to complete the charts

For example, to find $4^{\frac{1}{2}}$, use the sequence $\boxed{4} \boxed{y^x} (\boxed{1} \boxed{\div} \boxed{2} \boxed{)} \boxed{=}$.

To find $\sqrt[4]{16}$ use $\sqrt[x]{}$ button: either $\boxed{16} \boxed{\sqrt[x]{}} \boxed{4}$ or $\boxed{4} \boxed{\sqrt[x]{}} \boxed{16}$ try BOTH to see which way you need to remember

$4^{\frac{1}{2}} =$	$\sqrt[2]{4} =$	$16^{\frac{1}{4}} =$	$\sqrt[4]{16} =$
$\sqrt[3]{27} =$	$27^{\frac{1}{3}} =$	$\sqrt[5]{3125} =$	$3125^{\frac{1}{5}} =$
$216^{\frac{1}{3}} =$	$\sqrt[3]{216} =$	$256^{\frac{1}{4}} =$	$\sqrt[4]{256} =$
$\sqrt{25} =$	$25^{\frac{1}{2}} =$	$\sqrt[4]{81} =$	$81^{\frac{1}{4}} =$
$36^{\frac{1}{2}} =$	$\sqrt{36} =$	$1296^{\frac{1}{4}} =$	$\sqrt[4]{1296} =$

a	$a^{\frac{1}{3}}$	$a^{\frac{2}{3}}$	$a^{\frac{3}{3}}$	$a^{\frac{4}{3}}$
8	$8^{\frac{1}{3}} = \sqrt[3]{8} = 2$	$8^{\frac{2}{3}} = \sqrt[3]{8^2} = 2^2 = 4$		
64				

3. Summarize the rules when the exponent is in a rational form $\frac{1}{n}$ and $\frac{m}{n}$

4. Simplify the following

a. $\sqrt{x^{10}}$

b. $\sqrt[4]{x^{15}}$

c. $\sqrt[3]{x^{11}}$

d. $\sqrt[7]{x^{14}}$

5. Substitute in $x = -1$ into both original and your final answer, are the results equivalent?

6. Summarize rules you need to watch out for with roots

Rewrite roots with rational exponents or vice versa, then evaluate without using calculator

7. $\sqrt[3]{\frac{27}{8}}$

8. $\left(\frac{16}{81}\right)^{-3/4}$

9. $32^{-3/5}$

10. $\left(\frac{1}{\sqrt{32}}\right)^{-2/5}$

11. $-49^{\frac{1}{2}}$

12. $(-125)^{-\frac{2}{3}}$

13. $\left(\frac{8}{27}\right)^{-\frac{1}{3}}$

14. $\frac{8 \times 8^{\frac{2}{3}}}{\sqrt[3]{8}}$

Simplify, record answers with positive exponents. At the end, ask yourself if absolute value should be inserted, or a restriction, or nothing.

15. $(27x)^{\frac{4}{3}}$

16. $\frac{\sqrt[3]{512y^3}}{\sqrt{4x^2z^4}}$

17. $(8x^6y^9)^{\frac{1}{3}}(27x^{-12}y^2)^{-\frac{1}{3}}$

18. $\left(\frac{64m^{15}}{343}\right)^{-\frac{2}{3}}$

19. $(256a^{12}b^{20})^{\frac{3}{4}}$

20. $\left(3a^{\frac{3}{2}}\right)\left(-7a^{\frac{1}{5}}\right)$

21. $(36x^6)^{\frac{1}{2}}$

22. $\sqrt[4]{(3x^2)^4}$

23. $(3m^{\frac{1}{2}} \cdot 27n^{\frac{1}{4}})^4$

24. $\frac{(3^7)(9^4)}{\sqrt{27^6}}$

hint: record everything as a base of 3 before simplifying

Simplify, record answers with positive exponents. At the end, ask yourself if absolute value should be inserted, or a restriction, or nothing.

25. $\sqrt[5]{160x^8z^4}$

26. $\sqrt{75x^2y^{-4}}$

27. $(27p^3q^6r^{-1})^{\frac{1}{3}}$

28. $\left(\frac{f^{-16}}{256g^4h^{-4}}\right)^{-\frac{1}{4}}$

29. $(2x^{\frac{1}{4}}y^{\frac{1}{3}})(3x^{\frac{1}{4}}y^{\frac{2}{3}})$

30. $\sqrt[6]{x^2(x^{\frac{3}{4}} + x^{-\frac{3}{4}})}$

31. $(8x^9y^{-3})^{-\frac{2}{3}}$

32. $11\sqrt{245x^3} - 9\sqrt{45x^3}$

Simplify, record answers with positive exponents. At the end, ask yourself if absolute value should be inserted, or a restriction, or nothing.

33.
$$\left(8x^4y^2\right)^{-\frac{1}{3}}$$

34.
$$\frac{25x^2}{\left(625x^4\right)^{\frac{1}{4}}}$$

35.
$$\frac{\left(\sqrt[3]{4a^2}\right)^2}{\sqrt[6]{4a^2}}$$

36.
$$\left[\left(x-9\right)^{18}\right]^{\frac{1}{9}}$$

37.
$$\left(5k^3\right)^{-1}-5k^{-1}$$

38.
$$\left(-2x^3+x^{-1}\right)^2$$

39.
$$\frac{2x^{-1}}{x^{-1}+x}$$

ASSIGNMENT Solve Equations

Solve for x in EXPONENT: (MPM + MCR)

1. $3^x = 243$

2. $\left(\frac{1}{3}\right)^x = \frac{1}{81}$

3. $\left(\frac{3}{4}\right)^x = \frac{64}{27}$

4. $6^x + 5 = 221$

5. $3^x + 2 = 10$

6. $2 \cdot \left(\frac{1}{64}\right)^x = \left(\frac{1}{2}\right)^{x+2.5}$

Solve for x in BASE: (MPM)

7. $x^2(x^3) = 1024$

8. $x^{\frac{3}{2}} = 8$

9. $x^{\frac{4}{5}} = 81$

10. $x^{-4} = \frac{1}{16}$

11. $37 = 1 + (6x)^{\frac{2}{3}}$

12. $16x^{-\frac{1}{2}} + 2 = 11$

Solve for the variable in ROOTS: (AP)

13.
$$\sqrt{-10 + 7p} = p$$

14.
$$\sqrt{2x + 7} - x = 2$$

15.
$$\sqrt{x-3} - \sqrt{x} = 3$$

16.
$$2 = \sqrt{3b-2} - \sqrt{10-b}$$

Solve for the variable, MIXED:

17.
$$724 = 15a^{\frac{5}{2}} + 12$$

18.
$$7^{2x} \cdot 7^{3-x} = 49^{x+5}$$

19.
$$3^{2x-5} = 1$$

20.
$$4^x \cdot \frac{1}{16} = 2^{3x+6}$$

21.
$$\left(\frac{1}{5}\right)^{-3x} \cdot 25^{x-1} = \frac{1}{125}$$

22.
$$\left(\frac{x^{10}}{x^7}\right)^3 \div x^6 = 125$$

23.
$$\sqrt{x-1} + 7 = x$$

24.
$$3(2)^{2m-1} + 2 = 14$$

25.
$$(x - 4)^{2/3} = 25$$