MPM2D
Ms. Kueh

Quadratics 1 Unit Outline

Solution

The schedule and homework assignments below are subject to change at the teacher's discretion.

	Day	Topic	Homework
Tu	1 A21	Perfect Squares and Square Roots Zero and Negative Exponents	Worksheet Optional Khan Academy: Approximating Square Roots Exponent Rules Review Optional Khan Academy: Using Exponent Rules to Evaluate Expressions Optional Khan Academy: Properties of Exponents
We	2 A22	Quadratic Relations	Worksheet
TH	3 A23	Factored Form of a Quadratic Relation	Optional Khan Academy Practice: Solving Quadratics by Factoring Worksheet
Mo	4 A27	Determine the a value in factored form	Worksheet
Tu	5 A28	Quadratics – Putting it all together	Worksheet
Wed	6 A29	Function Notation, Domain and Range,	Mid-unit Review
TH	7 A30	Applications of Factored Form	Worksheet
Fr	8 M1	Solving Quadratic Equations	Worksheet
Mo	9 M4	More Applications – Factor First	Worksheet
Tu Wed	10 M5 M6 →	Review Unit Test	Textbook pg. 326 # 6 pg. 329 # 8, 9 pg. 330 # 11, 12 pg. 332 # 14 pg. 335 # 16, 17, 19 **Chapter Test** pg. 337 #1-4, (5), (6), 7, 8, 9

April 21 MPM2D

Perfect Squares and Square Roots

Park

$\boxed{36}$, 4, 16
9, 25, 81 etc
Other examples of perfect square are:

A Perfect Square is the result of multiplying a whole number by itself.

For example 64 is a perfect square because it is 8×8 or 8^2

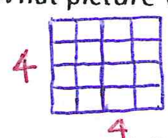
The square root of a number is what you multiply by itself to get the number.

For example, 8 is the square root of 64 because $\sqrt{64} = 8$

$\sqrt[2]{2^2} = 2$
$\sqrt[4]{3^4} = 3$
examples

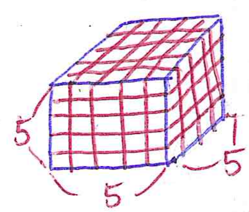
*Squaring and Square rooting are reverse operations!

Example 1 What picture would you draw to show why $\sqrt{16}$ is 4? → Yes $\sqrt{16} = 4$



$\sqrt{16}$ = If we have 16 units in a square, how many units (of 1□1) are there in width and length?

Example 2 What does 5^3 mean? What picture could you draw?



$5^3 = 5 \times 5 \times 5 = 125$

$\sqrt[3]{125} = 5$

Properties of Powers

*Powers of whole numbers grow very quickly. For example,

$$3^4 = 81$$
$$3^5 = 243$$
$$3^6 = 729$$

This is why there is the saying that something "grows exponentially" means that it increases faster and faster and faster

*Powers of fractions or decimals (which are) less than 1 shrink as the exponent increases. For example,

5^2: 2 → exponent or power; 5 → base

$$\left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1}{4}$$

$$\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)\left(\frac{1}{2}\right) = \frac{1^3}{2^3} = \frac{1}{8}$$

$$\left(\frac{1}{2}\right)^4 = \frac{1^4}{2^4} = \frac{1}{16}$$

*Powers of negative (base) numbers

$(-2)^2 = (-2)(-2) = 4$
$(-2)^3 = (-2)(-2)(-2) = -8$
$(-2)^4 = 16$
$(-2)^5 = -32$

* For even # exponents, you will get a positive number.

What conclusion can you make? (about powers of negative base numbers)
For odd # exponents, you will get a negative number.

Example 12

a) Order from least to greatest:

$\left(\frac{1}{3}\right)^3$ $\left(\frac{1}{3}\right)^4$ $\left(\frac{1}{3}\right)^2$ $\left(\frac{1}{3}\right)^5$ base = fraction < 1

Least amt → $\left(\frac{1}{3}\right)^5 < \left(\frac{1}{3}\right)^4 < \left(\frac{1}{3}\right)^3 < \left(\frac{1}{3}\right)^2$

b) Order from least to greatest:

2^3 2^4 2^2 2^5 base > 1

$2^2 < 2^3 < 2^4 < 2^5$

c) What do you notice if you compare the answers to a) and b) ?

Opposite order

Example 13

a) What is $\sqrt{49}$? $\sqrt{7^2} = 7$

b) Solve $x^2 = 49$

$\sqrt{x^2} = \sqrt{7^2}$

$x = 7$

c) Explain the difference between a) and b)

d) What is $\sqrt{-36}$? → No real # or No solution

Number systems:

N – Natural # 1, 2, 3, 4, 5 etc

Z – Integers -1, -2, 0, 1, 2, 3

Q – Rational # – all the integers + every fraction

R – Real # – // // + every decimal such as π and $\sqrt{2}$

C – Complex # – everything (above) + $\sqrt{-1} = i$

e) What is $\sqrt[3]{-8}$?

index # = "Cube root of −8" $\sqrt[3]{-8} = \sqrt[3]{(-2)^3} = -2$

f) Why can you cube root a negative number when you can't square root a negative number in the real number system?

Because of the conclusion we learned in previous page.

g) What n-th roots can you calculate in the real number system if you have a negative number? e.g) $\sqrt[5]{-32}$

index #

Answer: If n (index) is odd #, then you can "n"th root the base #.

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Negative and Zero Exponents

Exponent review:

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

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

$\frac{x^a}{x^b} = x^{a-b}$

$x^0 = 1$

$x^{-a} = \frac{1}{x^a}$

Example

a) 4^{-1}

$= \frac{1}{4^1} = \frac{1}{4}$

b) $8^0 = 1$

c) $(-2)^{-3}$

$= \frac{1}{(-2)^3} = \frac{1}{-8}$

d) $\left(-\frac{2}{3}\right)^{-2}$

$= \frac{1}{\left(-\frac{2}{3}\right)^2} = \frac{1}{\frac{(-2)^2}{3^2}}$

$= \frac{1}{\frac{4}{9}} = 1 \div \frac{4}{9} = 1 \times \frac{9}{4}$

$= \frac{9}{4}$

e) 0^{-2}

$= \frac{1}{0^2} = \frac{1}{0}$

undefined.

f) $(3x2yz + 2x)^0 = 1$

g) $(3^2)(3^5)$

$= 3^{2+5} = 3^7$

$= 2187$

h) $(2^2)^3$

$= 2^{2\times3}$

$= 2^6$

$= 64$

i) $\frac{x^5}{x^4} = x^{5-4} = x^1$

$= x$

Homework: Worksheet # C1, C2, C3, 1-4, 8
Exponent Rules Review Worksheet #4,5,6 Mandatory

Thinking #19

Communicate Your Understanding

C1 Explain why 2^{-3} is not a negative number.

C2 Explain why 5^0 has a value of 1.

C3 Explain why it is often better not to rely on a calculator to evaluate powers with a fractional base, such as $\left(\frac{7}{2}\right)^{-2}$.

Practise

For help with questions 1 to 3, see Example 1.

1. Rewrite each power with a positive exponent.

a) 3^{-2} b) 5^{-1} c) 10^{-4}

d) 7^{-3} e) $(-2)^{-4}$ f) $(-7)^{-1}$

2. Evaluate.

a) 6^{-2} b) 9^0 c) 7^{-1}

d) 10^{-3} e) $(-9)^{-1}$ f) $(-12)^{-2}$

g) $(-3)^0$ h) -89^0

3. Evaluate.

a) $\left(\frac{1}{3}\right)^{-2}$ b) 0^{-5} c) $\left(-\frac{1}{4}\right)^{-1}$

d) $\left(\frac{5}{6}\right)^{-2}$ e) $\left(-\frac{3}{8}\right)^{-4}$ f) $\left(\frac{9}{4}\right)^{-3}$

4. Evaluate using pencil and paper. Check your results using a calculator.

a) $6^0 + 6^{-2}$ b) $8 - 8^{-1}$

c) $(4 + 3)^0$ d) $4^0 + 3^0$

8. Determine the value of x that makes each statement true.

a) $x^{-3} = \frac{1}{27}$ b) $x^{-1} = \frac{4}{5}$

c) $2^x = \frac{1}{4}$ d) $\left(\frac{2}{5}\right)^x = \frac{125}{8}$

19. **Math Contest** Solve each equation for x.

a) $3^x = \frac{1}{81}$

b) $4(2^{3x}) = \frac{1}{16}$

Answers

1. a) $\frac{1}{3^2}$ b) $\frac{1}{5}$ c) $\frac{1}{10^4}$ d) $\frac{1}{7^3}$ e) $\frac{1}{(-2)^4}$ f) $\frac{1}{-7}$

2. a) $\frac{1}{36}$ b) 1 c) $\frac{1}{7}$ d) $\frac{1}{1000}$ e) $-\frac{1}{9}$ f) $\frac{1}{144}$
g) 1 h) -1

3. a) 9 b) undefined c) -4 d) $\frac{36}{25}$ e) $\frac{4096}{81}$ f) $\frac{64}{729}$

4. a) $\frac{37}{36}$ b) $\frac{63}{8}$ c) 1 d) 2

8. a) $x = 3$ b) $x = \frac{5}{4}$ c) $x = -2$ d) $x = -3$

9. a) $x = 4$ b) $x = -2$

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Exponent Rules Review

1. Write as a single power, then evaluate.
   a. $3^2 \times 3^3$
   b. $(-2)^3(-2)^2$
   c. $(5)^4(5)^3$
   d. $(3.2)^2(3.2)^2$
   e. $((y)^2)^3$
   f. $(3)^4 \div (3)^2$
   g. $((-2)^2)^5$
   h. $(-4.5)^3 \div (-4.5)$
   i. $\dfrac{3^5}{3^3}$
   j. $\dfrac{(-7)^3}{(-7)^2}$
   k. $-(1.2)^2$
   l. $(-0.6)^2$

2. Multiply.
   a. $(3a)(-2z^3)$
   b. $(-2r^2)(8s)$
   c. $-4c(5de)$
   d. $2xy \times 3xy$
   e. $(-3abm)(2bm)$
   f. $-u(5ut^2)$
   g. $(2a^2b^3c)(-3bc^2d)$
   h. $-5r^2st \times 2rs^2t^2$
   i. $(5x)(4y)(-3z)$
   j. $-2d(3d)(3e)$
   k. $(-k^2mn^2)(4mn)(-2kn^2)$

3. Simplify.
   a. $(3ty)^2$
   b. $(-2xz)^3$
   c. $(-2a^2b)^3$
   d. $(3r^3s)^2$
   e. $(5k^3m^2)^2$
   f. $(-3q^2r^2)^3$

4. Simplify.
   a. $(yz)^2(y^3z)$
   b. $(-2ab)(-ab)^2$
   c. $(5s^2t^2)^2(-st)$
   d. $(-4k^2m^3)^2(2km)^3$
   e. $(2r^2s^2t)(3rst)^2$
   f. $(4abc)^2(2a^2bc)(ab^3c^3)$
   g. $(m^2n^2p^2)^3(mnp)(-3nm^3p^3)$

5. Simplify.
   a. $(2a^4b^3) \div (a^2b)$
   b. $\dfrac{6q^3r^2}{3q^2r^2}$
   c. $(8x^6y^4) \div (-4x^3y^2)$
   d. $(-4w^3x^5) \div (-2w^2x^2)$
   e. $\dfrac{-9f^3g^5h^2}{6fg^2h}$
   f. $\dfrac{-12c^3d^5}{18c}$

6. Simplify.

a. $\dfrac{6k^2m^4}{3km^2}$

b. $4a^3b^2c \div 2bc$

c. $8x^5y^3 \div 2x^3y$

d. $\dfrac{-12s^7t^6}{8s^2t^2}$

e. $-9e^2f^4 \div (-6ef^2)$

f. $\dfrac{20d^5e^3f^5}{12d^2e^3f^4}$

Answers:

1.

a. $3^5 = 243$
b. $(-2)^5 = -32$
c. $5^7 = 78125$
d. 3.2^4
e. y^6
f. $3^2 = 9$
g. $(-2)^{10} = 1024$
h. $(-4.5)^2 = 20.25$
i. $3^2 = 9$
j. $(-7) = -7$
k. $-1.2^2 = -1.44$
l. $0.6^2 = 0.36$

2.

a. $-6az^3$
b. $-16r^2s$
c. $-20cde$
d. $6x^2y^2$
e. $-6ab^2m^2$
f. $-5u^2t^2$
g. $-6a^2b^4c^3d$
h. $-10r^3s^3t^3$
i. $-60xyz$
j. $-18d^2e$
k. $8k^3m^2n^5$

3.

a. $9t^2y^2$
b. $-8x^3z^3$
c. $-8a^6b^3$
d. $9r^6s^2$
e. $25k^6m^4$
f. $-27q^6r^6$

4.

a. y^5z^3
b. $-2a^3b^3$
c. $-25s^5t^5$
d. $128k^7m^9$
e. $18r^4s^4t^3$
f. $32a^5b^6c^6$
g. $-3m^{10}n^8p^{10}$

5.

a. $2a^2b^2$
b. $2q$
c. $-2x^3y^2$
d. $2wx^3$
e. $-\frac{3}{2}f^2g^3h$
f. $-\frac{2}{3}c^2d^5$

6.

a. $2km^2$
b. $2a^3b$
c. $4x^2y^2$
d. $-\frac{3}{2}s^5t^4$
e. $\frac{3}{2}ef^2$
f. $\frac{5}{3}d^3f$

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Properties of Quadratic Relations

The relation $ax^2 + bx + c$ is called a ________________________________,
where a, b, and c are real numbers and $a \neq 0$.

Investigation: How can you compare relations of the form $y = ax^2 + bx + c$?
Make a table of values for each relation from -3 to $+3$.

a) $y = x^2$

x	y

b) $y = 2x^2$

x	y

c) $y = x^2 + 2x + 3$

x	y

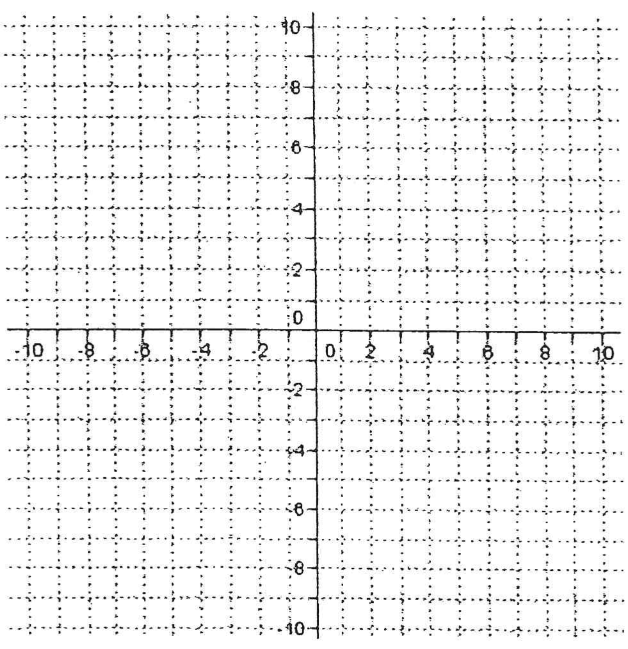
d) $y = -x^2$

x	y

e) $y = -0.5x^2 + 3$

x	y

Graph a) b) and c) on the grid below.



Graph d) and e) on the grid below.