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وتعليم

12 General MATH

TERM 2

2025-2026

NAME:_____

12 GEN _____

C2 & C3 GI

Mathematics Grade 12 GEN scope and sequence
term 2 / 2025-2026

	CHAPTER Title	LESSON	Lesson name	STATUS
CH 4	Inverses and Radical Functions	4.1	Operations on functions	
		4.2	Inverse Relations and Functions	
		4.3	nth Roots and Rational Exponents	
		4.4	Graphing radical function	
		4.5	Operations with radical expressions	
		4.6	Solving Radical Equations	
CH 6	Logarithmic Functions	6.1	Logarithms and Logarithmic functions	
		6.2	Properties of Logarithms	
		6.3	Common Logarithms	
		6.4	Natural Logarithms	
		6.5	Using Exponential and Logarithmic Functions	

Grade 12 GEN ASSESSMENTS
term 2 / 2025-2026

	Assessment tool		grade	Students mark	Parent signature and comments
Formative assessment 60%	Exam	Exam1	20%		
		Exam2	20%		
		Exam3	20%		
Continuous assessment 40%	Performance task 20%	Math task	20%		
	Written activities 20%	booklet	10%		
		Participation and H. W	10%		

Chapter 4: **Inverses and Radical Functions**

4.1: Operations on functions

Lesson objectives:

1. **Find the composition of functions**
2. **Find the sum, difference, product, and quotient of functions**

Lesson vocabulary:

- **Composition of functions**

Evaluate the following :

1) $3x + 5x^2 - x + 13x^2 - 1 =$

2) $(x - 4)(3x + 1) =$

3) $if \quad g(x) = 3x - 3, find\ g(-6) =$

Learn Operations on Functions

Key Concept • Operations on Functions

Operation	Definition	Example: Let $f(x) = 3x$ and $g(x) = 2x - 4$.
Addition	$(f + g)(x) = f(x) + g(x)$	$(f + g)(x) = 3x + (2x - 4)$ $= 5x - 4$
Subtraction	$(f - g)(x) = f(x) - g(x)$	$(f - g)(x) = 3x - (2x - 4)$ $= x + 4$
Multiplication	$(f \cdot g)(x) = f(x) \cdot g(x)$	$(f \cdot g)(x) = 3x(2x - 4)$ $= 6x^2 - 12x$
Division	$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, g(x) \neq 0$	$\left(\frac{f}{g}\right)(x) = \frac{3x}{2x - 4}, x \neq 2$

To graph the sum or difference of functions, graph each function separately. Then add or subtract the corresponding functional values.

Example 1 Add and Subtract Functions

Given $f(x) = -x^2 + 3x + 1$ and $g(x) = 2x^2 - 5$, find each function.

a. $(f + g)(x)$

b. $(f - g)(x)$

Example 2 Multiply and Divide Functions

Given $f(x) = 2x + 3$ and $g(x) = -x + 5$, find each function.

a. $(f \cdot g)(x)$

b. $\left(\frac{f}{g}\right)(x)$

Differentiation Activity:

Find $(f+g)(x)$, $(f-g)(x)$, $(f \cdot g)(x)$, and $\left(\frac{f}{g}\right)(x)$ for each $f(x)$ and $g(x)$.

LEVEL 1

$f(x) = 2x$

$g(x) = -4x + 5$

$f+g(x)$	$f.g(x)$
$f-g(x)$	$\frac{f}{g}(x)$

LEVEL 2

$f(x) = x - 2$

$g(x) = 2x - 7$

$f+g(x)$	$f.g(x)$
$f-g(x)$	$\frac{f}{g}(x)$

LEVEL 3

$f(x) = -x^2 + 6$

$g(x) = 3x - 5$

$f+g(x)$	$f.g(x)$
$f-g(x)$	$\frac{f}{g}(x)$

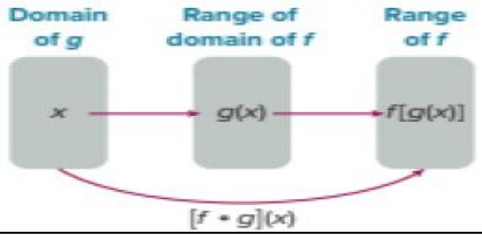
My score is 

in ____min

Learn Compositions of Functions

Key Concept • Composition of Functions

Suppose f and g are functions such that the range of g is a subset of the domain of f. Then the composition function $f \circ g$ can be described by $[f \circ g](x) = f[g(x)]$.



Example 4 Compose Functions by Using Ordered Pairs

Given f and g, find $[f \circ g](x)$ and $[g \circ f](x)$. State the domain and range for each.

$f = \{(1, 12), (10, 11), (0, 13), (9, 7)\}$ $g = \{(4, 1), (5, 0), (13, 9), (12, 10)\}$

Part A Find $[f \circ g](x)$ and $[g \circ f](x)$.

$[f \circ g](x)$:

$[g \circ f](x)$:

Part B State the domain and range.

$[f \circ g](x)$:

$[g \circ f](x)$:

Example 5 Compose Functions

Given $f(x) = 2x - 5$ and $g(x) = 3x$, find $[f \circ g](x)$ and $[g \circ f](x)$. State the domain and range for each.

Part A Find $[f \circ g](x)$ and $[g \circ f](x)$.

Part B State the domain and range.

Differentiation Activity:

LEVEL 1 For each pair of functions, find $f \circ g$ and $g \circ f$, if they exist. State the domain and range for each.

$f = \{(-8, -4), (0, 4), (2, 6), (-6, -2)\}$
$g = \{(4, -4), (-2, -1), (-4, 0), (6, -5)\}$

$[f \circ g](x)$:

Domain:
Range:

$[g \circ f](x)$:

Domain:
Range:

LEVEL 2 Find $[f \circ g](x)$ and $[g \circ f](x)$. State the domain and range for each.

$f(x) = 2x$
$g(x) = x + 5$

$[f \circ g](x)$:

Domain:
Range:

$[g \circ f](x)$:

Domain:
Range:

LEVEL 3 Find $[f \circ g](x)$ and $[g \circ f](x)$. State the domain and range for each.

$f(x) = x^2$
$g(x) = x - 6$

$[g \circ f](x)$:

Domain:
Range:

Domain:
Range:

My score is 6/6 in ____min

EXIT TICKET

MULTIPLE CHOICE Given $f(x) = 14x^3 - x^2 + x + 5$ and $g(x) = 7x^3 + 4x^2 - 2x - 1$, find $(f - g)(x)$. (Lesson 4-1)

A. $(f - g)(x) = 7x^3 + 3x^2 + x + 4$

B. $(f - g)(x) = 7x^3 - 5x^2 + 3x + 6$

C. $(f - g)(x) = 7x^3 + 3x^2 + 3x + 6$

D. $(f - g)(x) = 7x^3 - 5x^2 + x + 4$

Challange question

FIND THE ERROR Chris and Tobias are finding $(f \circ g)(x)$, where $f(x) = x^2 + 2x - 8$ and $g(x) = x^2 + 8$. Is either of them correct? Explain your reasoning.

Chris

$$(f \circ g)(x) = f[g(x)]$$
$$= (x^2 + 8)^2 + 2x - 8$$
$$= x^4 + 16x^2 + 64 + 2x - 8$$
$$= x^4 + 16x^2 + 2x + 56$$

Tobias

$$(f \circ g)(x) = f[g(x)]$$
$$= (x^2 + 8)^2 + 2(x^2 + 8) - 8$$
$$= x^4 + 16x^2 + 64 + 2x^2 + 16 - 8$$
$$= x^4 + 18x^2 + 72$$

Teacher's Feedback

Next step:

Chapter 4: **Inverses and Radical Functions**

4.2: Inverse Relations and Functions

Lesson objectives:

1. **Find the inverse of a function or relation.**
2. **Determine whether two functions or relations are inverses.**

Lesson vocabulary:

- **Inverse functions**
- **Inverse Relation**

OPEN RESPONSE Given $f(x) = 3x - 7$ and $g(x) = 4x + 5$, find $(f \circ g)(x)$. (Lesson 4-1)

Learn Inverse Relations and Functions

Two relations are **inverse relations** if one relation contains elements of the form (a, b) when the other relation contains the elements of the form (b, a).

Two functions f and g are **inverse functions** if and only if both of their compositions are the identity function.

Key Concepts • Inverse Functions

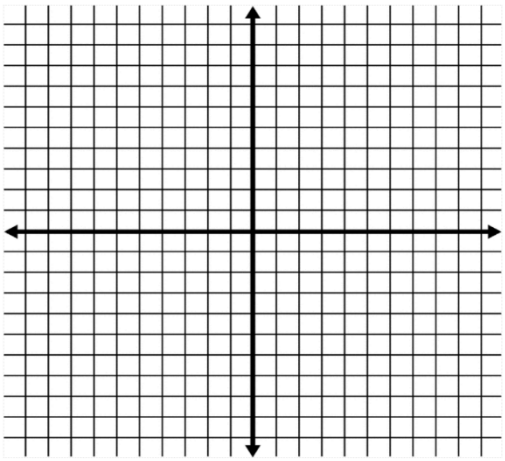
Words: If f and f^{-1} are inverses, then $f(a) = b$ if and only if $f^{-1}(b) = a$.

Example: Let $f(x) = x - 5$ and represent its inverse as $f^{-1}(x) = x + 5$.

Evaluate $f(7)$.	Evaluate $f^{-1}(2)$.
$f(x) = x - 5$	$f^{-1}(x) = x + 5$
$f(7) = 7 - 5$ or 2	$f^{-1}(2) = 2 + 5$ or 7

Example 1 Find an Inverse Relation

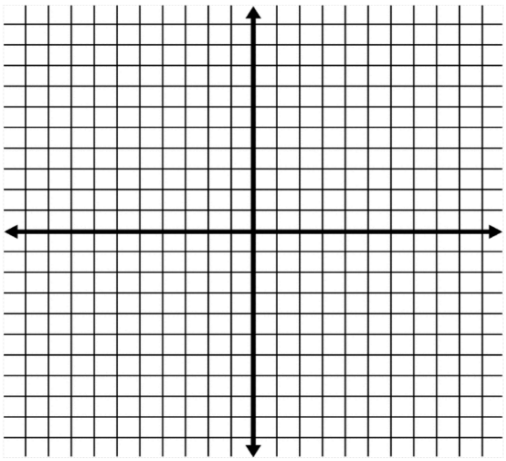
GEOMETRY **The vertices of $\triangle ABC$ can be represented by the relation {(2, 4), (−3, 2), (4, 1)}. Find the inverse of the relation. Graph both the original relation and its inverse.**



activity:

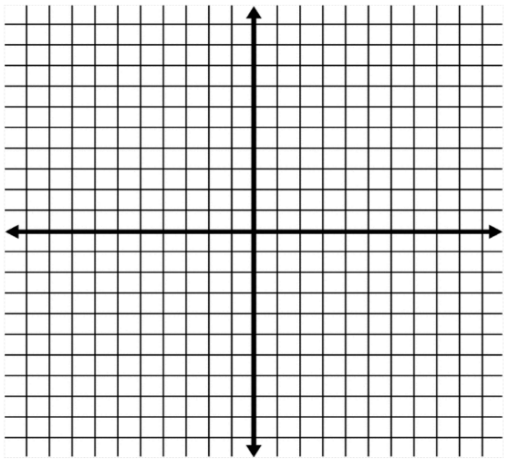
find the inverse of the relation then graph both the original relation and its inverse

$\triangle MNP$ with vertices at {(−8, 6), (6, −2), (4, −6)}



Example 2 Inverse Functions

Find the inverse of $f(x) = 3x + 2$. Then graph the function and its inverse.



Example 3 Inverses with Restricted Domains

Examine $f(x) = x^2 + 2x + 4$.

Part A Find the inverse of $f(x)$.

Part B If necessary, restrict the domain of the inverse so that it is a function.

Differentiation Activity:

Find the inverse of each function. Then graph the function and its inverse. If necessary, restrict the domain of the inverse so that it is a function.

LEVEL 1 $f(x) = x + 2$

LEVEL 2 $h(x) = \frac{x - 4}{3}$

LEVEL 3 $h(x) = x^2 + 4$

My score is 6/6 in ____min

Learn Verifying Inverses

Key Concept • Verifying Inverse Functions

Words: Two functions f and g are inverse functions if and only if both of their compositions are the identity function.

Symbols: $f(x)$ and $g(x)$ are inverses if and only if $[f \circ g](x) = x$ and $[g \circ f](x) = x$.

Example 5 Use Compositions to Verify Inverses

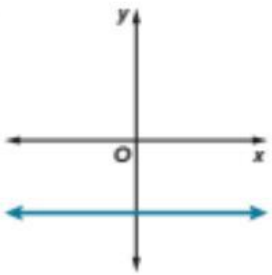
Determine whether $h(x) = \sqrt{x + 13}$ and $k(x) = (x - 13)^2$ are inverse functions.

Check

Determine whether $f(x) = \frac{x}{9} + \frac{4}{3}$ and $g(x) = 9x + 12$ are inverses.

Apply vertical and horizontal line test to state whether the graph represents a function and if the inverse is a function

41.



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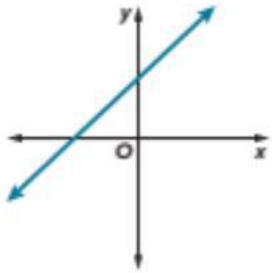

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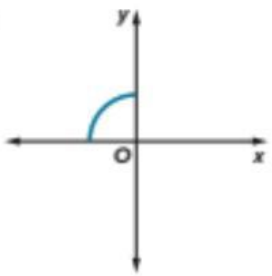

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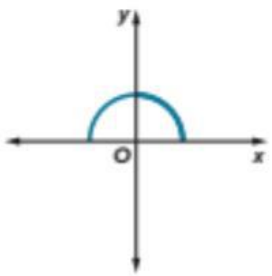


EXIT TICKET

Determine whether each pair of functions are inverse functions. Write *yes* or *no*.

$f(x) = 2x$

$g(x) = \frac{1}{2}x$

Challange question

OPEN RESPONSE Find the inverse of $f(x) = x^2 + 4x + 3$. Restrict the domain, if necessary. (Lesson 4-2)

Teacher's Feedback

Next step:

Home work1:

1) List of new words you learnt

- _____
- _____
- _____

2) $if\ f(x) = 3x, g(x) = x + 4, and\ h(x) = x^2 - 1$ find

- $f - g(x)$
- $f.h(x)$
- $\frac{g}{h}(x)$
- $h \circ f(x)$

3) Find the inverse of the function $f(x) = 2x - 1$

Self-Assessment Scale

1	2	3	4
Even with help I don't get it.	Help me a little, and I got it.	I need some more practice.	I need a challenge or can help someone else.

Chapter 4: Inverses and Radical Functions

4.3: nth Roots and Rational

Lesson objectives:

1. **Write expressions with rational exponents in radical form and vice versa.**

2. **Simplify expressions in exponential or radical form.**

Lesson vocabulary:

- **Nth root**
- **Index**
- **Radicand**
- **principal root**
- **rational exponent**

DO NOW!

Simplify simple radical expressions.

1. $\sqrt{40}$

2. $\sqrt{16}+\sqrt{49}$

3. $\sqrt{3}\cdot\sqrt{12}$

4. $\frac{5}{\sqrt{2}}\div\frac{5\sqrt{2}}{2}$

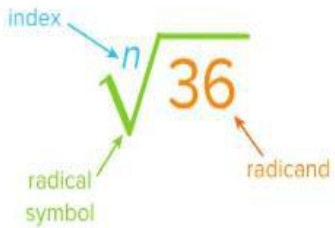
Learn *n*th Roots

Suppose n is an integer greater than 1, a is a real number, and a is an nth root of b.

a	n is even.	n is odd.
$a > 0$	1 unique positive and 1 unique negative real root: $\pm\sqrt[n]{a}$	1 unique positive and 0 negative real root: $\sqrt[n]{a}$
$a < 0$	0 real roots	0 positive and 1 negative real root: $\sqrt[n]{a}$
$a = 0$	1 real root: $\sqrt[n]{0} = 0$	1 real root: $\sqrt[n]{0} = 0$

A radical expression is simplified when the radicand contains no fractions and no radicals appear in the denominator.

An example of an nth root is $\sqrt[n]{36}$, which is read as *the nth root of 36*. In this example, n is the **index** and 36 is the **radicand**, or the expression under the radical symbol.



Example 1 Find Roots

Simplify.

a. $\pm\sqrt{25x^4}$

b. $-\sqrt{(y^2 + 7)^{12}}$

c. $\sqrt[3]{343a^{18}b^6}$

d. $\sqrt{-289c^8d^4}$

Example 2 Simplify Using Absolute Value

Simplify.

a. $\sqrt[4]{81x^4}$

b. $\sqrt[8]{256(y^2-2)^{24}}$

Differentiation Activity:

Simplify.

LEVEL 1 $\pm\sqrt{49x^4}$

LEVEL 2 $-\sqrt{16c^4d^2}$

LEVEL 3 $\sqrt[4]{81(x-4)^4}$

My score is 6/6 in ____min

Key Concept • Rational Exponents

For any nonzero number b and any integers x and y, with $y > 1$, $b^{\frac{x}{y}} = \sqrt[y]{b^x} = \left(\sqrt[y]{b}\right)^x$, except when $b < 0$ and y is even. When $b < 0$ and y is even, a complex root may exist.

Key Concept • Simplest Form of Expressions with Rational Exponents

An expression with rational exponents is in simplest form when all of the following conditions are met.

- It has no negative exponents.
- It has no exponents that are not positive integers in the denominator.
- It is not a complex fraction.
- The index of any remaining radical is the least number possible.

Example 3 Radical and Exponential Forms

Simplify.

a. Write $x^{\frac{4}{3}}$ in radical form.

b. Write $\sqrt[5]{x^2}$ in exponential form.

Fill out the table below:

Write each expression in radical form, or write each radical in exponential form.

13. $8^{\frac{1}{5}}$ **14.** $4^{\frac{2}{7}}$ **15.** $(x^3)^{\frac{3}{2}}$

16. $\sqrt{17}$ **17.** $\sqrt[3]{5xy^2}$ **18.** $\sqrt[4]{625x^2}$

Exponential form	Radical form

Example 5 Evaluate Expressions with Rational Exponents

Evaluate each expression.

21. $27^{\frac{1}{3}}$ **22.** $256^{\frac{1}{4}}$ **23.** $16^{-\frac{3}{2}}$

24. $81^{-\frac{1}{4}}$ **25.** $1024^{\frac{3}{5}}$ **26.** $16^{-\frac{5}{4}}$

Example 6 Simplify Expressions with Rational Exponents

Simplify each expression.

a. $x^{\frac{2}{3}} \cdot x^{\frac{1}{6}}$

b. $y^{-\frac{2}{3}}$

c. $z^{-\frac{1}{3}} \cdot z^{\frac{3}{4}}$

Watch Out!

Exponents Recall that when you multiply powers, the exponents are added, and when you raise a power to a power, the exponents are multiplied.

Differentiation Activity:

simplify

LEVEL 1 $a^{\frac{7}{4}} \cdot a^{\frac{5}{4}}$

LEVEL 2 $d^{-\frac{5}{6}}$

LEVEL 3 $\left(y^{-\frac{3}{5}}\right)^{-\frac{1}{4}}$

My score is 

in ____min

EXIT TICKET

MULTIPLE CHOICE Which of the following is the simplified form of $\sqrt[3]{729(x-7)^6}$? (Lesson 4-3)

A. $27(x-7)^3$

B. $27(x-7)^2$

C. $9(x-7)^3$

D. $9(x-7)^2$

Challange question

FIND THE ERROR Destiny and Kimi are simplifying $\sqrt[4]{16x^4y^8}$. Is either of them correct? Explain your reasoning.

Destiny

$$\sqrt[4]{16x^4y^8} = \sqrt[4]{(2xy^2)^4}$$
$$= 2|xy^2|$$

Kimi

$$\sqrt[4]{16x^4y^8} = \sqrt[4]{(2xy^2)^4}$$
$$= 2y^2|x|$$

Teacher's Feedback

Next step:

Chapter 4: **Inverses and Radical Functions**

4.4: Graphing Radical Functions

Lesson objectives:

1. **Graph and analyze square root functions.**
2. **Graph and analyze radical functions.**

Lesson vocabulary:

- **Radical function**
- **square root function**
- **cube root function**

MULTIPLE CHOICE Evaluate $256^{\frac{3}{8}} + 100{,}000^{-\frac{2}{5}}$. (Lesson 4-3)

A. 7.9

B. 7.99

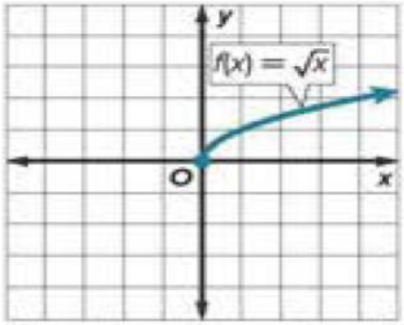
C. 8.01

D. 8.1

Key Concept • Parent Function of Square Root Functions

The parent function of the square root functions is $f(x) = \sqrt{x}$.

Domain:	$\{x \mid x \geq 0\}$
Range:	$\{f(x) \mid f(x) \geq 0\}$
Intercepts:	$x = 0$, $f(x) = 0$
End behavior:	As $x \to 0$, $f(x) \to 0$, and as $x \to \infty$, $f(x) \to \infty$.
Increasing/ decreasing:	increasing when $x > 0$
Positive/ negative:	positive for $x > 0$
Symmetry:	no symmetry



Example 1 Identify Domain and Range Algebraically

Identify the domain and range of $f(x) = \sqrt{2x - 6} + 1$.

activity:

Identify the domain and range of each function.

1. $y = \sqrt{x - 9}$

2. $y = \sqrt{x + 7}$

3. $y = -\sqrt{6x}$

4. $y = 5\sqrt{x + 2} - 1$

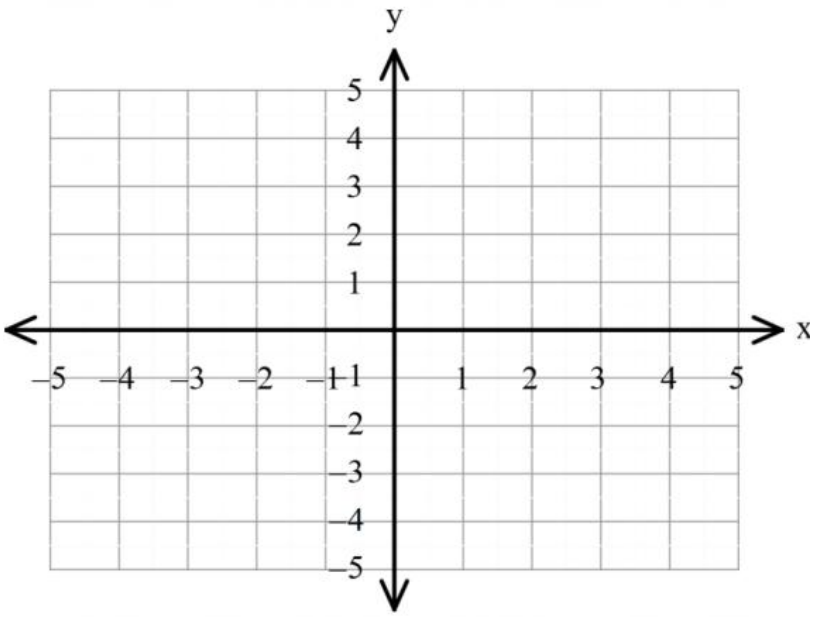
Example 2 Graph a Transformed Square Root Function

Graph $g(x) = -3\sqrt{x+1} + 2$, and identify the domain and range. Then describe how it is related to the graph of the parent function.

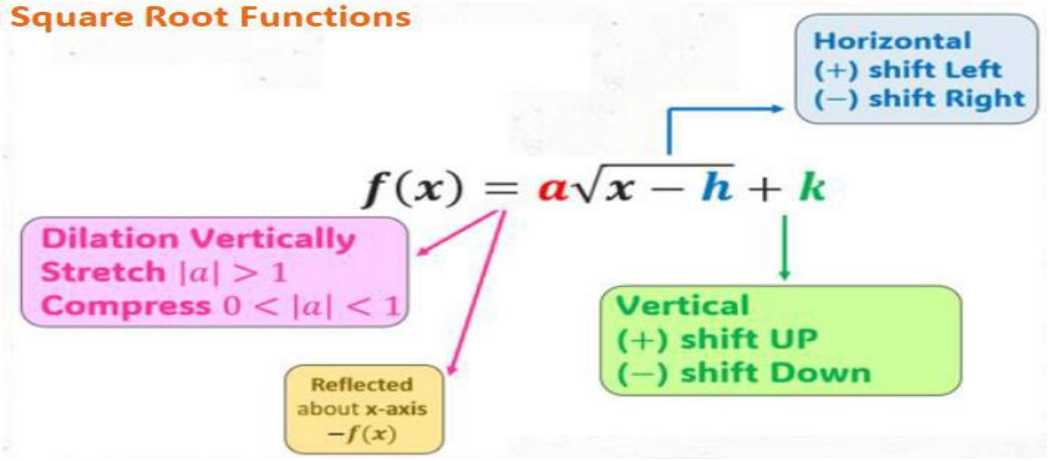
1.Domain:

2.table:

x	g(x)



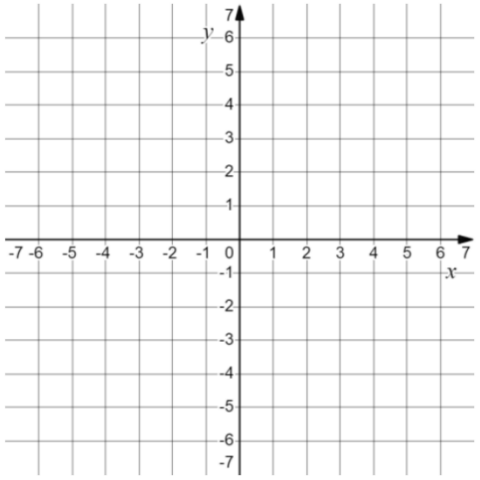
Learn Graphing Square Root Functions



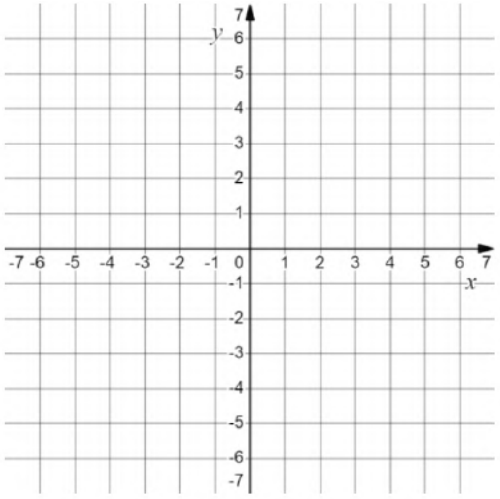
Differentiation Activity:

Check my understanding: Graph each function. State the domain and range of each function. Then describe how it is related to the graph of the parent function.

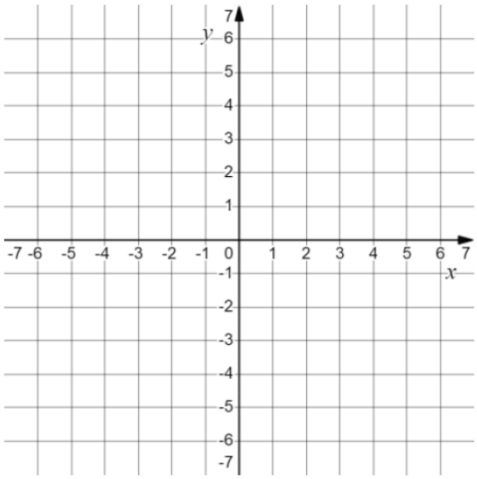
LEVEL 1 $y = \sqrt{x+4} - 2$



LEVEL 2 $y = 3\sqrt{x} - 5$



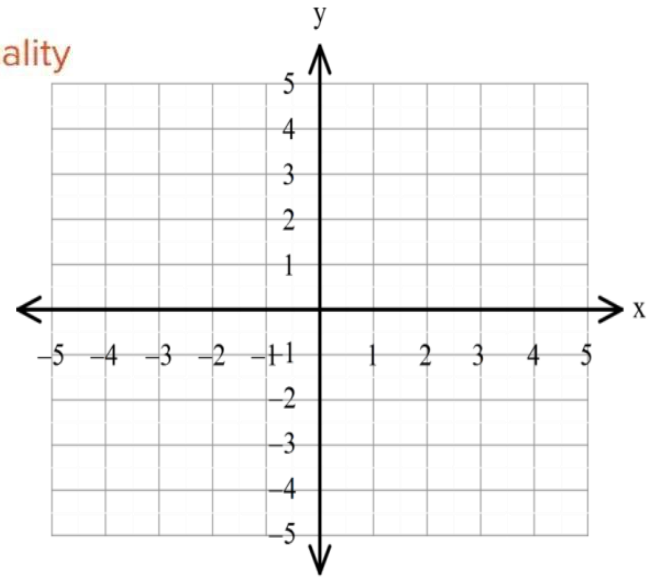
LEVEL 3 $y = -\sqrt{x-2} + 3$



My score is 6 in ____min

Example 4 Graph a Square Root Inequality

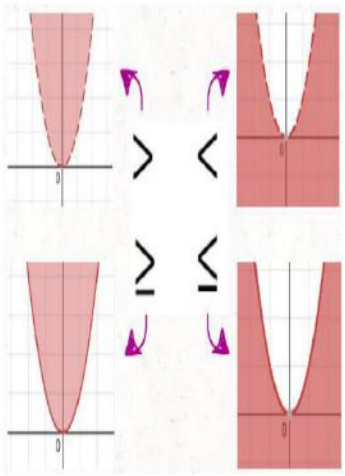
Graph $y < \sqrt{2x + 5}$.



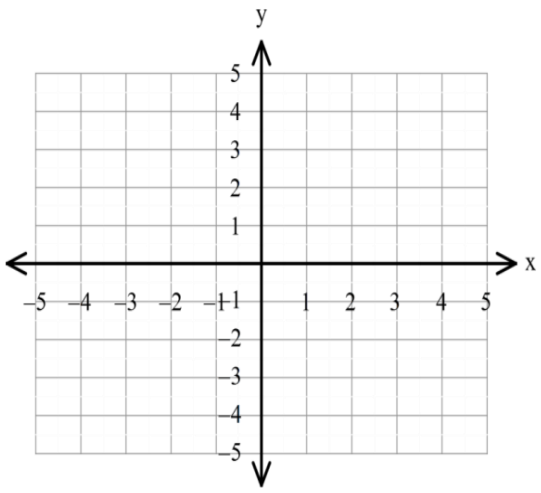
Activity

Graph each inequality.

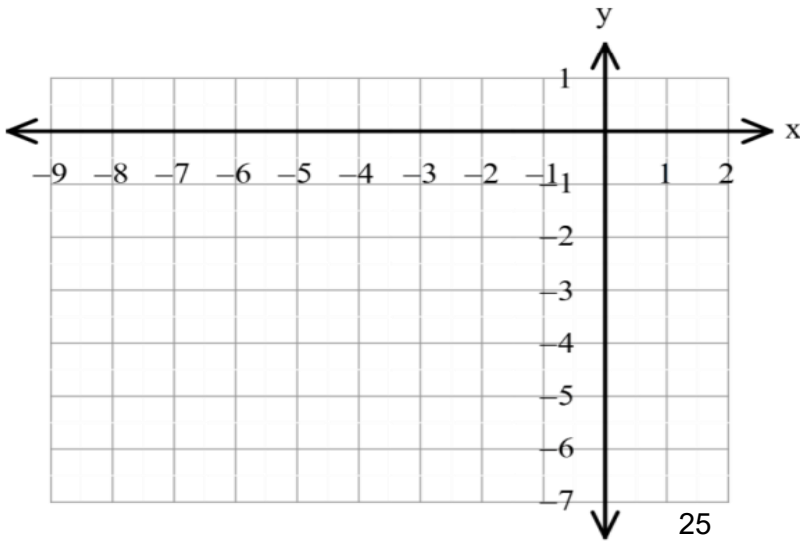
Remember:



1. $y < \sqrt{x - 5}$



2. $y \geq -4\sqrt{x + 3}$

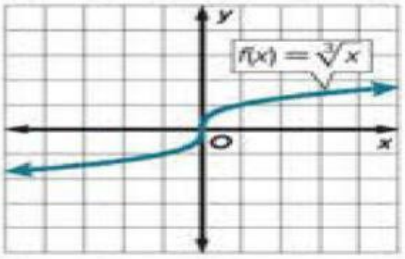


Cube root:

Key Concept • Parent Function of Cube Root Functions

The parent function of the cube root functions is $f(x) = \sqrt[3]{x}$.

Domain:	all real numbers
Range:	all real numbers
Intercepts:	$x = 0$, $f(x) = 0$
End behavior:	As $x \to -\infty$, $f(x) \to -\infty$, and as $x \to \infty$, $f(x) \to \infty$.
Increasing/ decreasing:	increasing as $x \to \infty$
Positive/ negative:	positive for $x > 0$ negative for $x < 0$
Symmetry:	symmetric about the origin

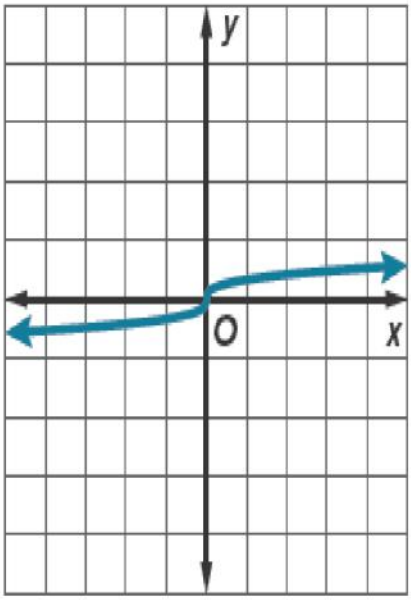


Example 5 Graph Cube Root Functions

Graph each function. State the domain and range.

a. $g(x) = \frac{1}{3}\sqrt[3]{x}$

Domain:	
Range:	
End behavior:	
Increasing/ decreasing:	
Positive/ negative:	

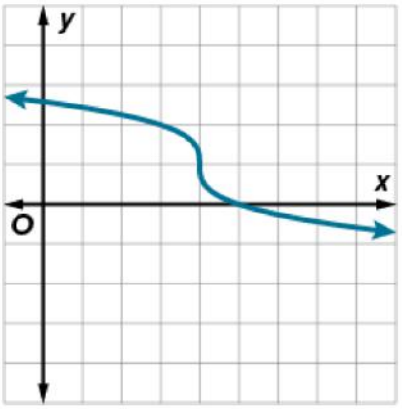


Differentiation Activity:

(Mastery) Example 5: Graph Cube Root Functions
Graph each function. State the domain and range.

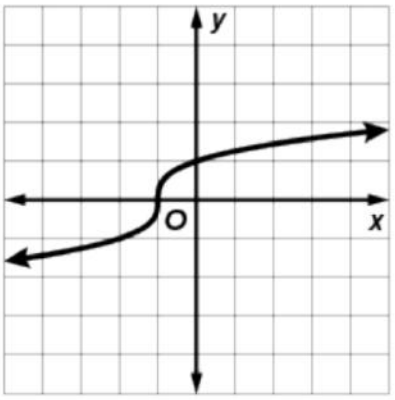
LEVEL 1 $c.\ q(x) = \sqrt[3]{4 - x} + 1$

Domain:	
Range:	
End behavior:	
Increasing/ decreasing:	
Positive/ negative:	



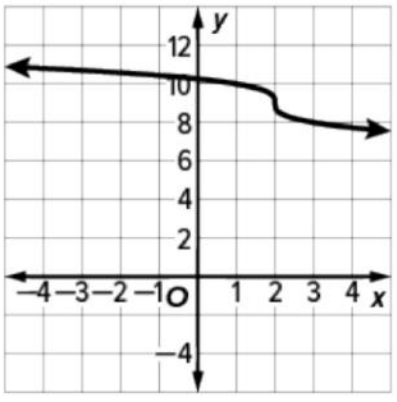
LEVEL 2 **20.** $f(x) = \sqrt[3]{x + 1}$

Domain:	
Range:	
End behavior:	
Increasing/ decreasing:	
Positive/ negative:	



LEVEL 3 **23.** $f(x) = -\sqrt[3]{x - 2} + 9$

Domain:	
Range:	
End behavior:	
Increasing/ decreasing:	
Positive/ negative:	

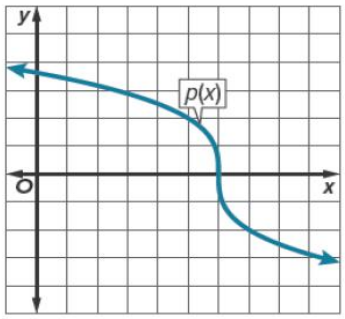


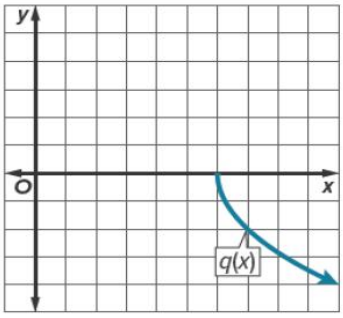
My score is 6 in ____min

Example 6 Compare Radical Functions

(Mastery) Example 6: Compare Radical Functions
Graph each function. State the domain and range.

Examine $p(x) = -2\sqrt[3]{x-6}$ and $q(x)$ shown in the graph.

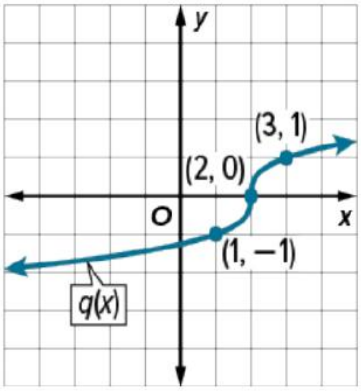


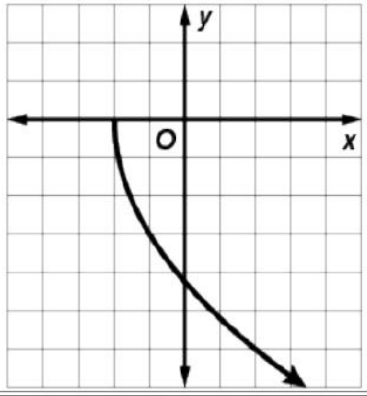


Compare the key features of the functions.

	$p(x)$	$q(x)$
Domain and Range		
Intercepts		
Increasing/Decreasing		
Positive/Negative		
End Behavior		

24. Examine $p(x) = -3\sqrt{x+2}$ and $q(x)$ shown in the graph.





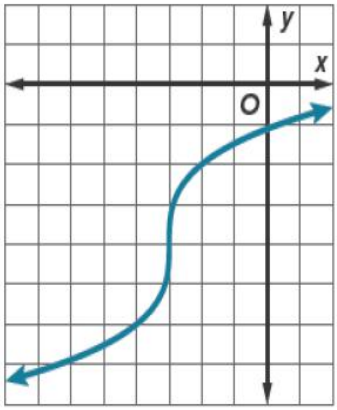
Compare the key features of the functions.

	$p(x)$	$q(x)$
Domain and Range		
Intercepts		
Increasing/Decreasing		
Positive/Negative		
End Behavior		

Example 7 Write a Radical Function

(Mastery) Example 7: Write a Radical Function

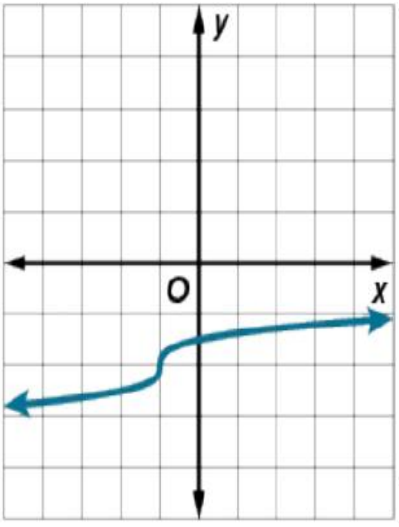
Write a radical function for the graph of $g(x)$.



ACTIVITY

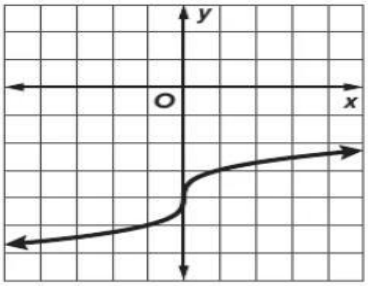
(Mastery) Example 7: Write a Radical Function

Write a radical function for the graph of $g(x)$.



EXIT TICKET

MULTIPLE CHOICE Which function is shown on the graph? (Lesson 4-4)



A. $g(x) = (x + 4)^{\frac{1}{3}}$

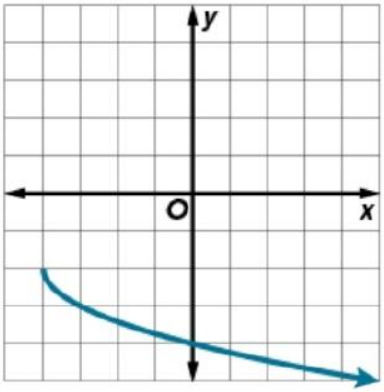
B. $g(x) = (x - 4)^{\frac{1}{3}}$

C. $g(x) = x^{\frac{1}{3}} - 4$

D. $g(x) = x^{\frac{1}{3}} + 4$

Challange question

Write a radical function for the graph of $g(x)$



Teacher's Feedback

Next step:

Homework 2:

1) Simplify:

$$\sqrt[4]{16(x-3)^{12}}$$

$$-\sqrt{16c^4d^2}$$

2) **Write each expression in radical form or write each radical in exponential form.**

$$\sqrt[5]{x^2} =$$

$$\sqrt{17} =$$

3) **Describe how it is related to the graph of the parent function.**

$$y = -\sqrt{x-2} + 3$$

Self-Assessment Scale

1	2	3	4
Even with help I don't get it.	Help me a little, and I got it.	I need some more practice.	I need a challenge or can help someone else.

Chapter 4: **Inverses and Radical Functions**

4.5 Operations with radical expressions

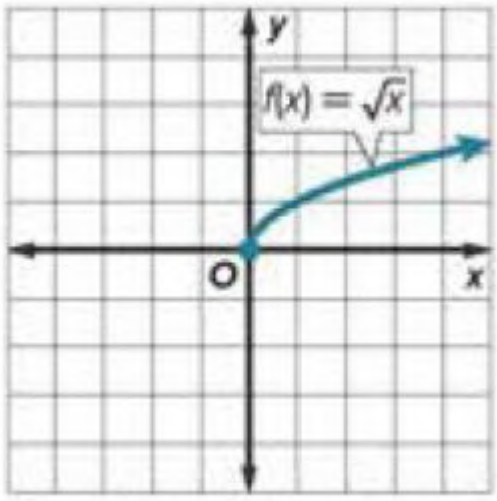
Lesson objectives:

3. **Simplify radical expressions**
4. **Add, subtract, multiply, and divide radical expressions**

Lesson vocabulary:

- **Like Radical expression-conjugates**

Use the graph to answer these questions



1) **This function is called: _____**

2) **Domain: _____**

3) **Range: _____**

4) **Intercepts: _____**

Key Concept • Product Property of Radicals

Words: For any real numbers a and b and any integer $n > 1$,

$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$, if n is even and $a, b \geq 0$, or if n is odd.

Examples: $\sqrt{12} \cdot \sqrt{3} = \sqrt{36}$ or 6 and $\sqrt[3]{4} \cdot \sqrt[3]{16} = \sqrt[3]{64}$ or 4

Key Concept • Quotient Property of Radicals

Words: For any real numbers a and $b \neq 0$ and any integer $n > 1$,

$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$, if all roots are defined.

Examples: $\sqrt{\frac{x^4}{25}} = \frac{\sqrt{x^4}}{\sqrt{25}} = \frac{x^2}{5}$ or $\frac{1}{5}x^2$ and $\sqrt[3]{\frac{27}{8}} = \frac{\sqrt[3]{27}}{\sqrt[3]{8}} = \frac{3}{2}$

Key Concept • Simplest Form of Radical Expressions

A radical expression is in simplest form when the following conditions are met.

- The index n is as small as possible.
- The radicand contains no factors (other than 1) that are nth powers of an integer or polynomial.
- The radicand contains no fractions.
- No radicals appear in the denominator.

Example 1 Simplify Expressions with the Product Property

Simplify each expression

$\sqrt[3]{-27a^6b^{14}}$

$\sqrt{75x^{12}y^7}$

Example 2 Simplify Expressions with the Quotient Property

Simplify each expression.

$\sqrt[3]{\frac{24a^6}{125}}$

$\sqrt[4]{\frac{80y^{14}}{256z^4}}$

Differentiation Activity:

LEVEL 1 $\sqrt[4]{64a^4b^4}$

LEVEL 2 $\sqrt[4]{4x^5y^{20}}$

LEVEL 3 $\sqrt[3]{\frac{432n^{12}}{64q^6}}$

My score is 6 in ____min

Example 3 Add and Subtract Radicals

Simplify $6\sqrt{45x} + \sqrt{12} - 3\sqrt{20x}$

Check:

Simplify $\sqrt{2} + \sqrt{8} + \sqrt{50}$

Example 4 Multiply Radicals

simplify $4\sqrt[5]{-10x^2y^6} \cdot 3\sqrt[5]{16x^4y^4}$.

Check:

Simplify $5\sqrt[5]{-9x^3y^5} \cdot 3\sqrt[5]{27x^4y^5}$

Differentiation Activity:

Simplify each expression

LEVEL 1 $\sqrt{12} - 2\sqrt{3} + \sqrt{108}$

LEVEL 2 $6\sqrt{3ab} \cdot 4\sqrt{24ab^3}$

LEVEL 3 $5\sqrt{x^8y^3} \cdot 5\sqrt{2x^5y^4}$

My score is 6/6 in ____min

If the denominator is:	Multiply the numerator and denominator by:	Examples
$\sqrt{b}$	$\sqrt{b}$	$\frac{4}{\sqrt{7}} = \frac{4}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}}$ or $\frac{4\sqrt{7}}{7}$
$\sqrt[n]{b^x}$	$\sqrt[n]{b^{n-x}}$	$\frac{3}{\sqrt[5]{2}} = \frac{3}{\sqrt[5]{2}} \cdot \frac{\sqrt[5]{2^4}}{\sqrt[5]{2^4}}$ or $\frac{3\sqrt[5]{16}}{2}$

Example 5 Rationalize the Denominator

Rationalize the Denominator (Simplify)

$\sqrt{\frac{20b}{3b^5}}$

$\sqrt[3]{\frac{250a^6}{7a}}$

Example 7 Use Conjugates to Rationalize the Denominator

Simplify $\frac{4x}{2\sqrt{7}-5}$.

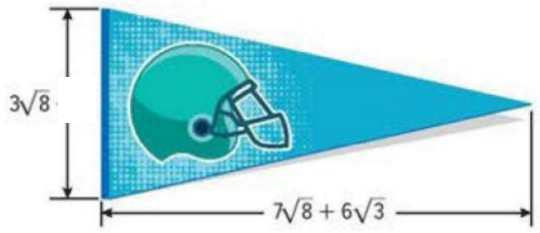
EXIT TICKET

Simplify (use conjugate to rationalize the denominator)

$$\frac{7x}{3-\sqrt{2}}$$

Challange question

A sports pennant has the dimensions shown. Find the area square inches.



Teacher's Feedback

NEXT

Next step:

Chapter 4: **Inverses and Radical Functions**

4.6 Solving Radical Equations

Lesson objectives:

1. **Solve radical equations**
2. **Solve radical equations with extraneous solutions**
3. **Solve radical equations by graphing systems of equations**

Lesson vocabulary:

- **Radical equations**

Solve each equation

1 $\sqrt{b-5}=4$

2 $\sqrt{3n+1}=5$

Key Concept • Solving Radical Equations

Step 1 Isolate the radical on one side of the equation.

Step 2 To eliminate the radical, raise each side of the equation to a power equal to the index of the radical.

Step 3 Solve the resulting polynomial equation. Check your results.

Example 1 Solve a Square Root Equation

Solve $\sqrt{3x-5}+2=6$.

$\sqrt{k-4}-1=5$

Example 2 Solve a Cube Root Equation

Solve $4(2x+6)^{\frac{1}{3}}-9=3$.

$4(5n-1)^{\frac{1}{3}}-1=0$

Example 3 Identify Extraneous Solutions

Solve $\sqrt{x+21} = 3 - \sqrt{x}$.

Differentiation Activity:

Solve each equation

LEVEL 1 $\sqrt[3]{3r-6} = 3$

LEVEL 2 $2 + \sqrt{3p+7} = 6$

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

My score is 6/6 in ____min

Example 4 Solve a Radical Equatior

Solve each equation. Identify any extraneous solutions.

$(3x + 7)^{\frac{1}{4}} - 3 = 1$

EXIT TICKET

Solve each equation. Identify any extraneous solutions.

$(2x - 1)^{\frac{1}{4}} - 2 = 1$

Challange question

WHICH ONE DOESN'T BELONG? Which equation does not have a solution? Justify your conclusion.

$\sqrt{x-1} + 3 = 4$	$\sqrt{x+1} + 3 = 4$	$\sqrt{x-2} + 7 = 10$	$\sqrt{x+2} - 7 = -10$

Teacher's Feedback

Next step:

Homework 3:

1) Simplify each expression

$\sqrt{75x^{12}y^7}$

$3\sqrt{5y} \cdot 8\sqrt{10yz}$

$\sqrt[3]{\frac{432n^{12}}{64q^6}}$

$\sqrt{135} + 5\sqrt{10d} - 3\sqrt{60}$

2) Solve the equation $\sqrt{x+22} = x+2$

Self-Assessment Scale

1	2	3	4
Even with help I don't get it.	Help me a little, and I got it.	I need some more practice.	I need a challenge or can help someone else.

Chapter 6: **Logarithmic Functions**

6.1 Logarithms and Logarithmic Functions

Lesson objectives:

1. **write logarithmic expressions in exponential form and write exponential expressions in logarithmic form.**

2. **Graph and analyze logarithmic functions.**

Lesson vocabulary:

- **Logarithm**
- **Logarithmic function**

Can you give an example for

Exponential form:

Logarithmic form

KeyConcept Relating Logarithmic and Exponential Forms

If $b > 0$, $b \neq 1$, and $x > 0$, then

Logarithmic Form		Exponential Form
$\log_b x = y$ (base b, exponent y)	if and only if	$b^y = x$. (base b, exponent y)

Example 1 Logarithmic to Exponential Form

Write each equation in exponential form.

$\log_3 \frac{1}{243} = -5$

$\log_9 3 = \frac{1}{2}$

$\log_{15} 225 = 2$

$\log_4 64 = 3$

Example 2 Exponential to Logarithmic Form

Write each equation in logarithmic form.

$7^6 = 117{,}649$

$8^{-3} = \frac{1}{512}$

$8^{\frac{2}{3}} = 4$

Example 3 Evaluate Logarithmic Expressions

Evaluate $\log_{216} 6$. $\log_2 64$

Differentiation Activity:

LEVEL 1 **Evaluate** $\log_8 512$

LEVEL 2 **Wrte in exponential form** $\log_4 32 = \frac{5}{2}$

LEVEL 3 **Wrte in exponential form** $7^{-2} = \frac{1}{49}$

My score is 6 in ____min

Example 4 Find Inverses of Exponential Functions

AIR PRESSURE **The air pressure outside of an aircraft can be determined by the equation $P = B\left(10^{\frac{-9h}{100}}\right)$, where B is the air pressure at sea level and h is the altitude in miles. If the air pressure at sea level is 14.7 pounds per square inch, write an equation to find the height of an aircraft when the air pressure is known.**

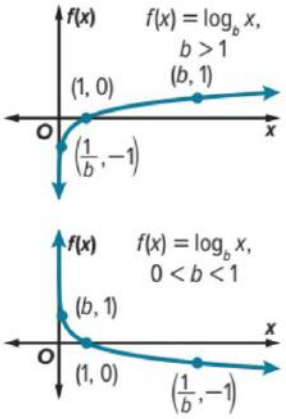
Practice:

TORNADOS The distance in miles that a tornado travels is $y = 10^{\frac{w-65}{93}}$ where w represents the speed of the wind in miles per hour.

Part A Write an equation to find the wind speed when the distance travelled is known.

Key Concept • Parent Function of Logarithmic Functions

Parent function	$f(x) = \log_b x$
Type of graph	continuous, one-to-one
Domain	$(0, \infty)$, $\{x \mid x > 0\}$, or all positive real numbers
Range	$(-\infty, \infty)$, $\{f(x) \mid -\infty < f(x) < \infty\}$, or all real numbers
Asymptote	y-axis
x-intercept	(1, 0)
Symmetry	none
Extrema	none



Key Concept • Transformations of Logarithmic Functions

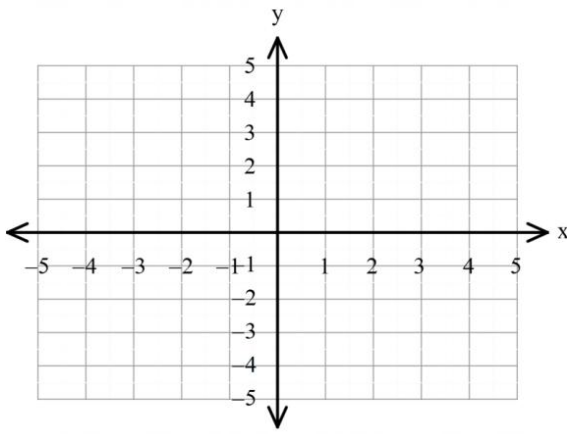
$$g(x) = a \log_b (x - h) + k$$

h – horizontal translation	If $h > 0$, the graph of $f(x)$ is translated h units right. If $h < 0$, the graph of $f(x)$ is translated $\lvert h \rvert$ units left.
k – vertical translation	If $k > 0$, the graph of $f(x)$ is translated k units up. If $k < 0$, the graph of $f(x)$ is translated $\lvert k \rvert$ units down.
a – reflection and dilation	If $a < 0$, the graph is reflected in the x-axis. If $\lvert a \rvert > 1$, the graph is stretched vertically. If $0 < \lvert a \rvert < 1$, the graph is compressed vertically.

Example 5 Graph Logarithmic Functions

Graph each function. $f(x) = \log_6 x$

Use the points $\left(\frac{1}{b}, -1\right)$, (1, 0), and (*b*, 1).

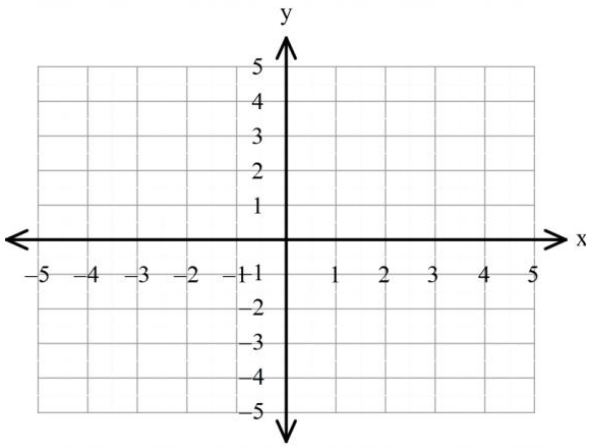


domain	
Range	
intercept	
End behavior	

practice:

Graph each function. $g(x) = \log_{\frac{1}{4}} x$

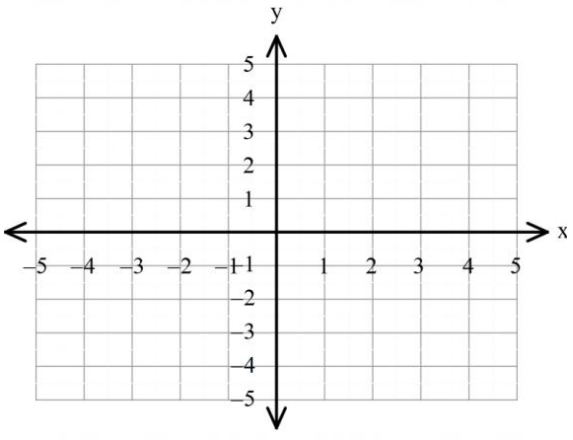
Use the points $\left(\frac{1}{b}, -1\right)$, (1, 0), and (*b*, 1).



domain	
Range	
intercept	
End behavior	

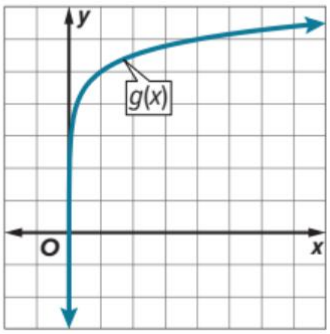
Example 6 Graph Transformations of Logarithmic Functions

Graph $g(x) = 2 \log_{10}(x + 3) - 1$.



Example 8 Write Logarithmic Functions From Graphs

Identify the value of *k*, and write a function for the graph as it relates to $f(x) = \log_4 x$.

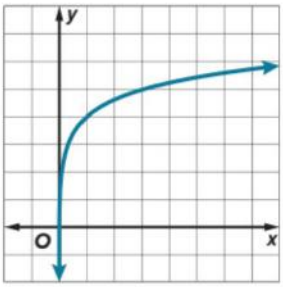


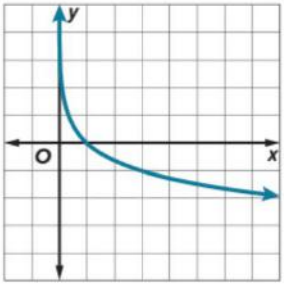
EXIT TICKET

Write a function for each graph as it relates to $f(x) = \log_3 x$.

24 $g(x) = f(x) + k$
$g(x) =$ _____

25 $g(x) = k \cdot f(x)$
$g(x) =$ _____





Challange question

INVESTING Maria invests $1000 in a savings account that pays 4% interest compounded annually. The value of the account *A* after *x* years can be determined from the equation $A = 1000(1.04^x)$. Solve the equation for *x*.

Teacher's Feedback

Next step:

6.2 properties of logarithms

Lesson objectives:

1. **solve logarithmic equations using properties of equality.**

2. **Simplify and evaluate expressions by using the properties of logarithm.**

Lesson vocabulary:

- **Logarithmic equations**

Write each equation in exponential form.

$$\log_3 \frac{1}{27} = -3$$

$a)\ \frac{1}{27} = 3^{-3}$

$b)\ \frac{1}{27} = 15^2$

$c)\ \frac{1}{27} = 5^{-2}$

$d)\ \frac{1}{27} = 3^5$

Key Concept • Property of Equality for Logarithmic Equations	
Symbols	If b is a positive number other than 1, then $\log_b x = \log_b y$ if and only if $x = y$.
Example	If $\log_3 x = \log_3 7$, then $x = 7$. If $x = 7$, then $\log_3 x = \log_3 7$.

Example 1 Solve a Logarithmic Equation by Using Definitions

Solve: $\log_4 x = \frac{5}{2}$.

Example 2 Solve a Logarithmic Equation by Using Properties of Equality

Step 1: Solve for x $\log_5 (2x^2 - 6) = \log_5 4x$.

Step 2: check for extraneous solutions

Differentiation Activity:

LEVEL 1 **solve:** $\log_{27} x = \frac{2}{3}$

LEVEL 2 **solve:** $\log_5 (x^2 - 6) = \log_5 x$

LEVEL 3 **solve** $\log_{13} (-5x) = \log_{13} (-2x^2 + 3)$.

My score is 6 in ____min

Key Concept • Product Property of Logarithms	
Words	The logarithm of a product is the sum of the logarithms of its factors.
Symbols	For all positive numbers b, m, and n, where $b \neq 1$, $\log_b mn = \log_b m + \log_b n$.
Example	$\log_5 8(4) = \log_5 8 + \log_5 4$

Key Concept • Quotient Property of Logarithms	
Words	The logarithm of a quotient is the difference of the logarithms of the numerator and the denominator.
Symbols	For all positive numbers b, m, and n, where $b \neq 1$ and $n \neq 0$, $\log_b \frac{m}{n} = \log_b m - \log_b n$.
Example	$\log_8 \frac{2}{3} = \log_8 2 - \log_8 3$

Key Concept • Power Property of Logarithms	
Words	The logarithm of a power is the product of the logarithm and the exponent.
Symbols	For any real number n, and positive numbers m and b, where $b \neq 1$, $\log_b m^n = n \log_b m$.
Example	$\log_2 3^7 = 7 \log_2 3$

Example 3 Product Property of Logarithms

Use $\log_3 5 \approx 1.465$ to approximate the value of $\log_3 405$.

Example 4 Quotient Property of Logarithms

Use $\log_3 5 \approx 1.465$ to approximate the value of $\log_3 \frac{9}{5}$.

Example 5 Power Property of Logarithms

Use $\log_2 6 \approx 2.585$ to approximate the value of $\log_2 1296$.

EXIT TICKET

Use $\log_5 3 \approx 0.6826$ and $\log_5 4 \approx 0.8614$ to approximate the value of each expression.

20 $\log_5 40$

21 $\log_5 \frac{3}{4}$

22 $\log_5 9$

23 $\log_5 16$

Challange question

Solve each equation. Check your solution.

$$\log_2 (4x) + \log_2 5 = \log_2 40$$

Teacher's Feedback

Next step:

Homework4:

1) **Write each equation in exponential form.**

$$\log_3 243 = 5$$

$a)\ 243 = 3^{-3}$

$b)\ 243 = 5^3$

$c)\ 243 = 5^{-2}$

$d)\ 243 = 3^5$

2) **Write each equation in logarithmic form.**

$$2^7 = 128$$

$a)\ \log_7 128 = 2$

$b)\ \log_2 7 = 128$

$c)\ \log_2 128 = -7$

$d)\ \log_2 128 = 7$

3) **FIND THE ERROR** Elisa and Matthew are evaluating $\log_{\frac{1}{7}} 49$. Is either of them correct? Explain your reasoning.

Elisa

$\log_{\frac{1}{7}} 49 = y$

$\left(\frac{1}{7}\right)^y = 49$

$(7^{-1})^y = 7^2$

$(7)^{-y} = 7^2$

$y = 2$

Matthew

$\log_{\frac{1}{7}} 49 = y$

$49^y = \frac{1}{7}$

$(7^2)^y = (7)^{-1}$

$7^{2y} = (7)^{-1}$

$2y = -1$

$y = -\frac{1}{2}$

Self-Assessment Scale

1	2	3	4
Even with help I don't get it.	Help me a little, and I got it.	I need some more practice.	I need a challenge or can help someone else.

6.3common logarithm

Lesson objectives:

1. **Solve exponential equations by using common logarithms.**

2. **Evaluate logarithmic expressions by using the Change of Base Formula.**

Lesson vocabulary:

- **Common logarithm**

Use your calculator to find

Log1=

Log10=

Log100=

$\log x = y$	means	$10^y = x$
$\log 1 = 0$	because	$10^0 = 1$
$\log 10 = 1$	because	$10^1 = 10$
$\log 100 = 2$	because	$10^2 = 100$
$\log 10^m = m$	because	$10^m = 10^m$

Example 1 Find Common Logarithms by Using Technology

Use a calculator to evaluate each expression to the nearest ten-thousandth.

1. log 18

2. log 39

3. log 120

4. log 5.8

5. log 42.3

6. log 0.003

Example 3 Solve an Exponential Equation by Using Logarithms

Solve $11^x = 101$. Round to the nearest ten-thousandth.

Differentiation Activity: **Solve each equation. Round to the nearest ten-thousandth.**

LEVEL 1 $4^{5k} = 37$

LEVEL 2 $5^{4x-2} = 120$

LEVEL 2 $2.4^{x+4} = 30$

My score is 6/6 in ____min

Example 4 Solve an Exponential Inequality by Using Logarithms

Solve each inequality, round to the nearest ten-thousandth

$6.5^{2x} \geq 200$

$7^{3x-1} \geq 21$

Key Concept • Change of Base Formula	
Symbols	For all positive numbers a, b, and n, where $a \neq 1$ and $b \neq 1$, $\log_a n = \frac{\log_b n}{\log_b a}$ ← log base b of the original number; ← log base b of old base
Example	$\log_8 17 = \frac{\log_{10} 17}{\log_{10} 8}$

Express each logarithm in terms of common logarithms. Then approximate its value to the nearest ten-thousandth.

$\log_4 22$

$\log_{12} 200$

EXIT TICKET

$\log_8 15$

$\log_5 0.4$

Challange question

BIOLOGY There are initially 1000 bacteria in a culture. The number of bacteria doubles each hour. The number of bacteria N present after t hours is given by $N = 1000(2)^t$. How long will it take the culture to increase to 50,000 bacteria?

Teacher's Feedback

Next step:

Chapter 6: **Logarithmic Functions**

6.4 Natural Logarithms

Lesson objectives:

1. **Evaluate expressions involving the natural base and natural logarithm**

2. **Solve exponential equations and inequalities using natural logarithms**

Lesson vocabulary:

- **Natural base**
- **exponential functions**
- **natural logarithms**

Solve for x:

a) $y = 3x + 7$

b) $y = \frac{x-4}{2}$

KeyConcept Basic Properties of Natural Logarithms

If x is a real number, then the following statements are true.

- $\ln 1 = 0$
- $\ln e = 1$
- $\ln e^x = x$
- $e^{\ln x} = x, x > 0$

} Inverse Properties

Example 1 Write Equivalent Logarithmic Equations

Write each exponential equation in logarithmic form.

1. $e^x = 14$

2. $e^7 = x$

Differentiation Activity:

Write each exponential equation in logarithmic form.

LEVEL 1	LEVEL 2	LEVEL 3
$e^3 = 4x$	$e^{4x} = 3$	$e^4 = x - 3$

My score is 

in ____min

Example 2 Write Equivalent Exponential Equations

Write each logarithmic equation in exponential form.

a) $\ln 9 = x$

b) $\ln x \approx 1.7347$

Activity: **Write each logarithmic equation in exponential form.**

$\ln 3x = 4$

$\ln 4 = 3x$

$\ln 5.34 = 2x$

$\ln (4x) = 9.6$

KeyConcept Properties of Logarithms

If b, x, and y are positive real numbers, $b \neq 1$, and p is a real number, then the following statements are true.

Product Property	$\log_b xy = \log_b x + \log_b y$
Quotient Property	$\log_b \frac{x}{y} = \log_b x - \log_b y$
Power Property	$\log_b x^p = p \log_b x$

$e^{\ln x} = x$ $\ln e^x = x$

Example 3 Simplify Logarithmic Expressions

Write $\frac{1}{3}\ln 8 - \ln 3 + \ln 9$ as a single logarithm.

Differentiation Activity:

Write each expression as a single logarithm.

LEVEL 1	LEVEL 2	LEVEL 3
$3\ln 3 - \ln 9$	$3\ln 4 + 3\ln 3$	$4\ln\frac{1}{3} - 6\ln\frac{1}{9}$

My score is 

in ____min

Example 4 Solve Exponential Equations with Base e

Solve $-2e^{x+3} + 8 = -14$. Round to the nearest ten-thousandth.

Activity:

Solve each equation. Round to the nearest ten-thousandth.

$2e^x - 1 = 11$

$5e^x + 3 = 18$

Example 5 Solve Natural Logarithmic Equations

Solve $\frac{1}{6} \ln 5x = 2$. Round to the nearest ten-thousandth.

EXIT TICKET

Solve each equation. Round to the nearest ten-thousandth.

$\ln 5x + \ln x = 7$

Challange question

Use the natural logarithm to solve each equation.

48. $3^x = 0.4$

49. $2^{3x} = 18$

Teacher's Feedback

Next step:

Homework 5:

1) **Write each logarithmic equation in exponential form.**

$$ln15 = x$$

$a)\ x = e^{15}$

$b)\ 15 = e^{x}$

$c)\ \ 15 = e^{2x}$

$d)\ 15 = e^{8}$

2) **Write each expression as a single logarithm.**

$$4ln16 - ln256$$

$a)\ 7ln10$

$b)\ 3ln12$

$c)\ \ 2ln16$

$d)\ -2ln2$

3) **Write each expression as a single logarithm.**

$$3ln4 + 3ln3$$

$a)\ 7ln10$

$b)\ 3ln12$

$c)\ \ 2ln16$

$d)\ -2ln2$

Self-Assessment Scale

1	2	3	4
Even with help I don't get it.	Help me a little, and I got it.	I need some more practice.	I need a challenge or can help someone else.

Chapter 6: **Logarithmic Functions**

6.5 Using Exponential and logarithmic functions

Lesson objectives

1. **Use logarithms to solve problems involving exponential growth and decay.**
2. **Solve problems involving exponential growth and decay.**

Lesson vocabulary:

- **Exponential**
- **Logarithmic**

1. Simplify:
   a) $(2x + 3) + (x - 5)$
   b) $(4x)(x - 2)$
2. Evaluate:
   If $f(x) = x^2 - 1$, find $f(3)$
3. Substitute:
   If $g(x) = 5x - 4$, find $g(-2)$

Key Concept • Continuous Exponential Growth

Exponential growth can be modeled by the function

$$f(x) = ae^{kt},$$

where a is the initial value, t is time in years, and k is a constant representing the rate of continuous growth.

Continuously Compounded Interest	Continuous Exponential Growth
$A = Pe^{rt}$	$y = ae^{kt}$
P = initial amount	a = initial population
A = amount at time t	y = population at time t
r = interest rate	k = rate of continuous growth

1 **In 2016, the population of Florida was 20.61 million people. In 2000, it was 15.98 million.**

Part A **Write an exponential growth equation.**

Part B **Predict when the population will reach 25 million people.**

practice:

2 **An experiment starts with 20 bacteria A cells. After 45 minutes, there are 710 bacteria A cells.**

Part A Write the equation that models the number of bacteria A cells y after t minutes. Round the value of k to the nearest thousandth

Part B After how many minutes will there be 1000 bacteria A cells? Round to the nearest tenth if necessary

Key Concept • Continuous Exponential Decay

Exponential decay can be modeled by the function

$$f(x) = ae^{-kt},$$

where a is the initial value, t is time in years, and k is a positive constant representing the rate of continuous decay.

The half-life of a radioactive substance is the time it takes for half of the atoms of the substance to disintegrate. The radioactive substance Thorium-230 is used to determine the ages of cave formations and coral. The half-life of Thorium-230 is 75,381 years.

Part A Determine the value of k and the equation of decay for Thorium-230

Part B How much of a 2-gram sample of Thorium-230 should be left after 1500 years?

practice:

HALF-LIFE Iodine-131, a radioactive isotope commonly used to treat thyroid cancer, has a half-life of 8.02 days.

Part A Write the continuous exponential decay equation for Iodine-131. Round the value of k to the nearest thousandth.

Part B How much of a 15-gram sample will be left after 20 days? Round to the nearest tenth if necessary.

EXIT TICKET

Carbon-14 has a decay constant k of 0.00012. Use this information to determine the age of the objects based on the amount of Carbon-14.

a. a fossil that has lost 95% of its Carbon-14

b. an animal skeleton that has 95% of its Carbon-14 remaining

Challange question

Consider a certain bacterium which is undergoing continuous exponential growth.

a. If there are 80 cells initially and 675 cells after 30 minutes, determine the value of k.

b. When will the bacteria reach a population of 6000 cells?

c. If a second type of bacteria is growing exponentially according to the model $y = 35e^{0.0978t}$, determine how long before the number of cells of these bacteria exceed the number of cells in the original bacteria.

Teacher's Feedback

Next step:

1st exam:

Teacher feedback	
Student feedback	
Parent feedback	

2nd exam:

Teacher feedback	
Student feedback	
Parent feedback	

3rd exam:

Teacher feedback	
Student feedback	
Parent feedback	

MY REWARDS

MY REWARDS
