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2023 GED CONFERENCE

Grasping GED® Higher Order Math Concepts for Deeper Understanding

July 18, 2023

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Facilitator

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- Trainer and Content Developer, Florida IPDAE
- Statewide Trainer and Consultant for Delaware, Georgia, Maryland, Mississippi, and South Carolina

In this session, we will

- Discuss how to push high achieving students to score at a college ready or college ready + credit level on the mathematical reasoning test.
- Focus on critical performance gaps based on field testing data
- Explore strategies, resources and ideas to address these performance gaps.

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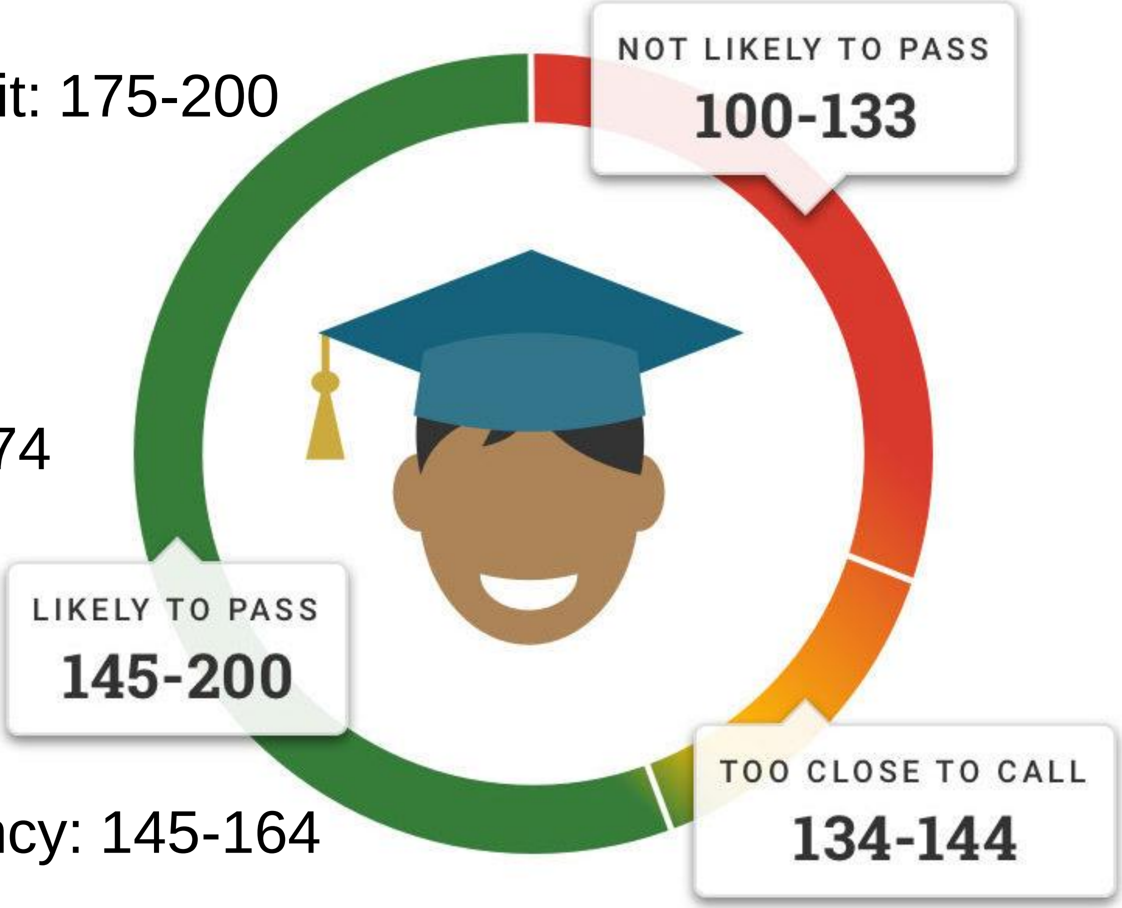
Three Score Level Indicators on GED Ready®

College Ready + Credit: 175-200

College Ready: 165-174

High School Equivalency: 145-164



How do we make high performing GED students perform even better?

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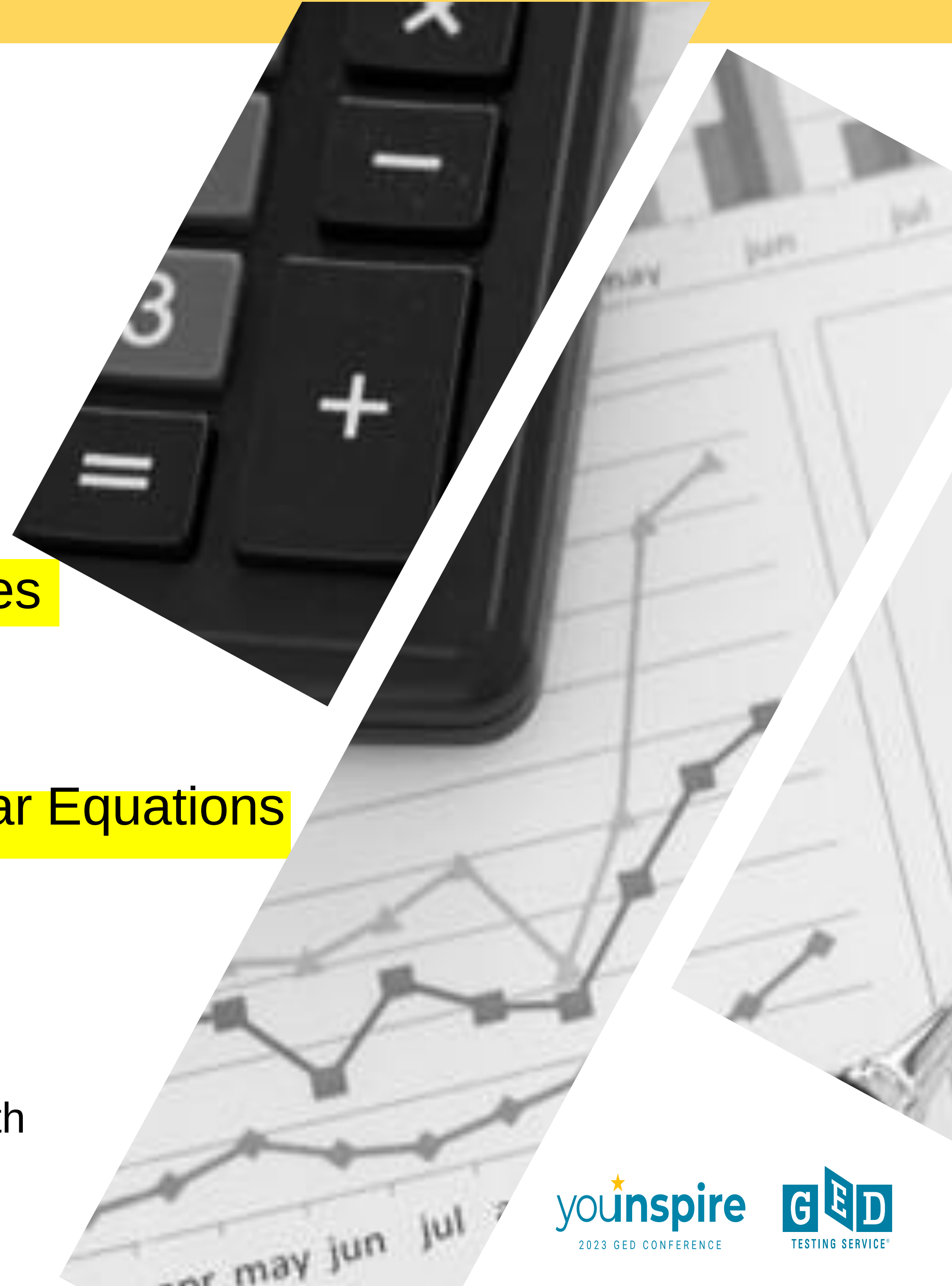
Performance Gaps

1. Non-Calculator Items
2. Exponents and Roots
3. Three-Dimensional Shapes
4. Algebraic Computations
5. Inequalities
6. Slope and Graphing Linear Equations
7. Multiple Correct Answers



Tuesdays for Teachers:
GED Knowledge & Skill Gaps - Math
Session 1 – Oct. 26, 2021
Session 2 – Nov. 16, 2021

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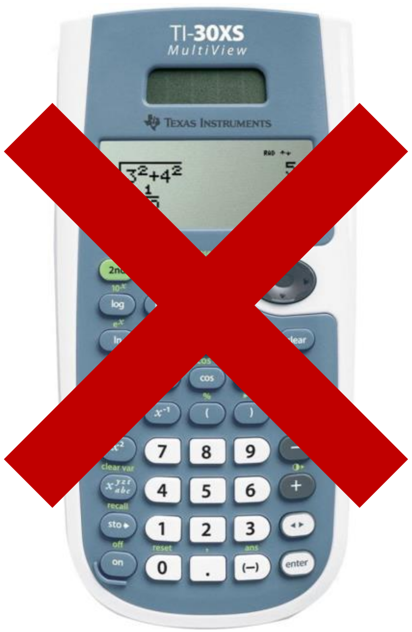
Calculator-Prohibited Indicators

Performance Gap 1

Non-Calculator Items



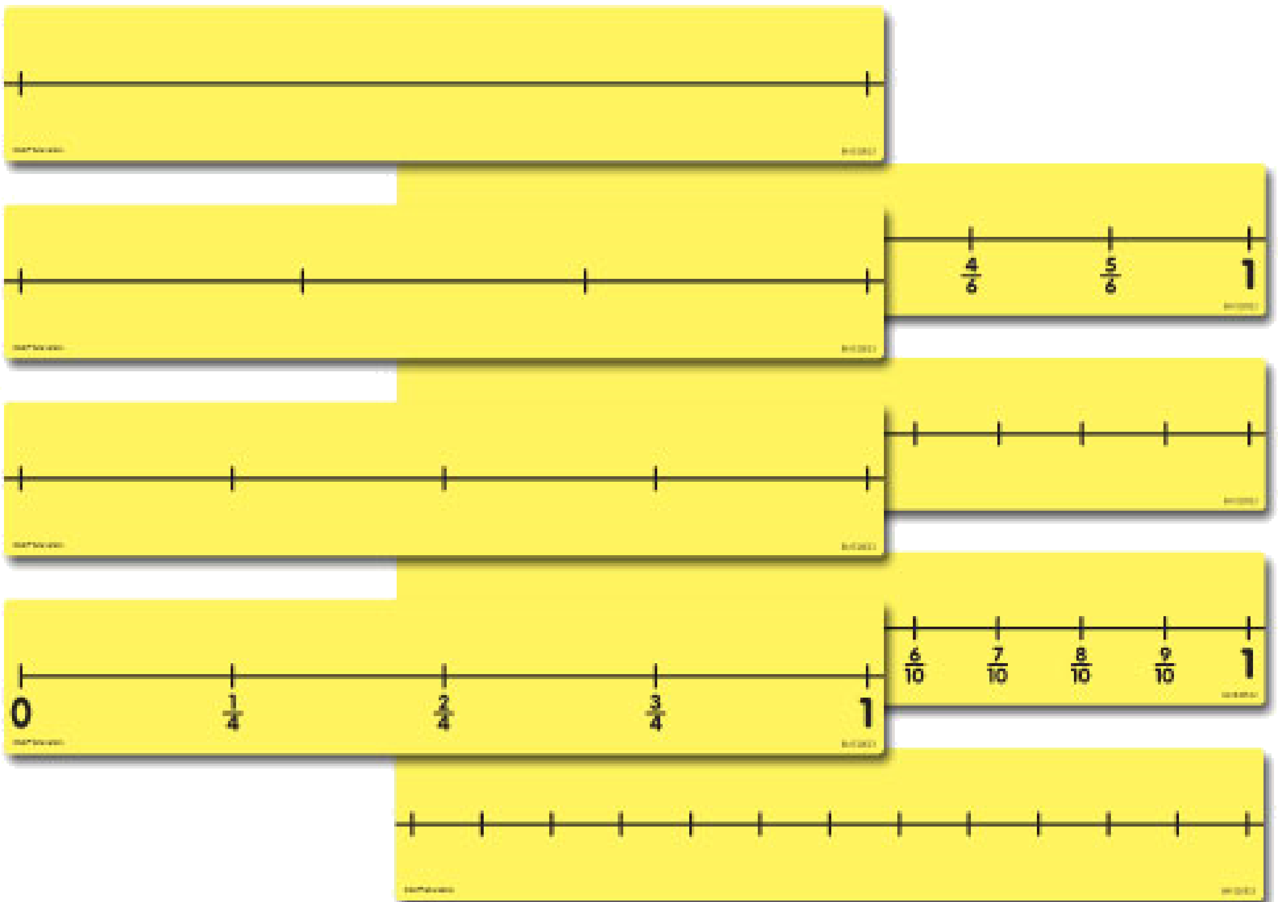
1. Ordering Rational Numbers
2. Factors and Multiples
3. Distance on a Number Line
4. Operations on Rational Numbers
5. Rules of Exponents
6. Squares and Square Roots of Positive Rational Numbers
7. Cubes and Cube Roots of Rational Numbers
8. Undefined Value Over the Set of Real Numbers

60 Second Challenge: Ordering Rational Numbers

Arrange the given numbers in ascending order.

$$\frac{5}{8},\ -3,\ 0.8314,\ \frac{1}{16},\ -\pi,\ 0.4823,\ \frac{5}{12}$$

Let's Try Again



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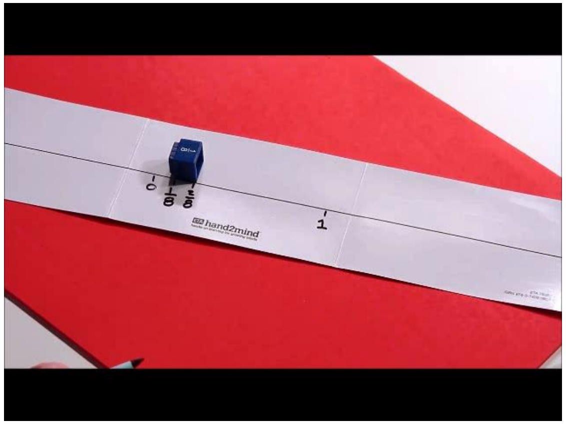
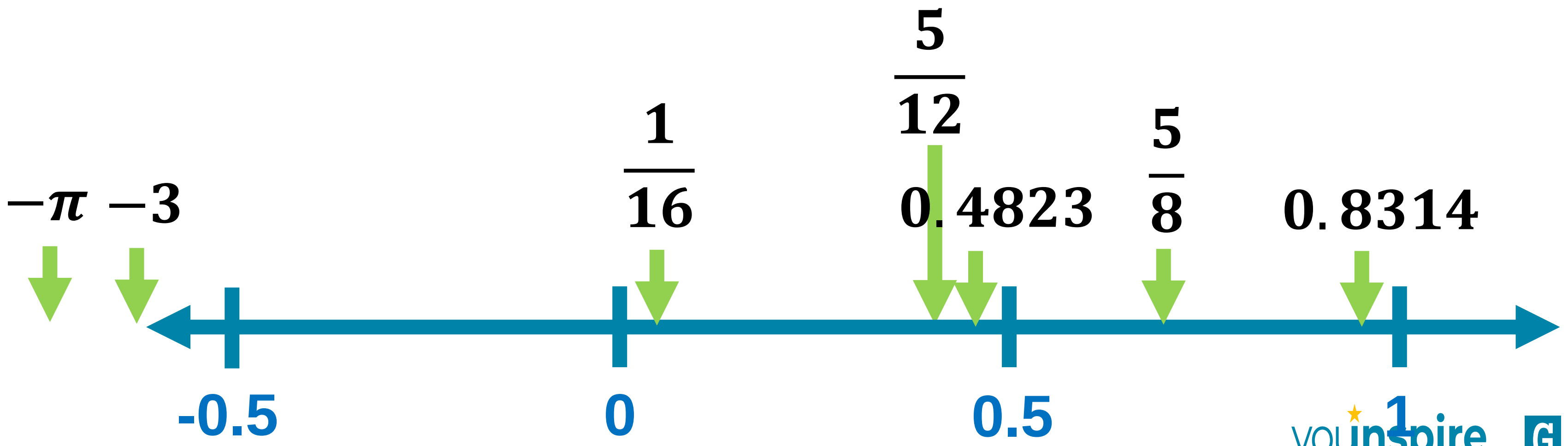
Ordering Rational Numbers: Use a Number Line

$$\frac{5}{8}, -3, 0.8314, \frac{1}{16}, -\pi, 0.4823, \frac{5}{12}$$



1. Draw a number line and mark benchmark numbers.
2. Plot the easiest given numbers in reference to benchmark numbers.
3. Compare and plot the last remaining numbers.



Factors and Multiples

- **Greatest Common Factor** – Used to simplify fractions

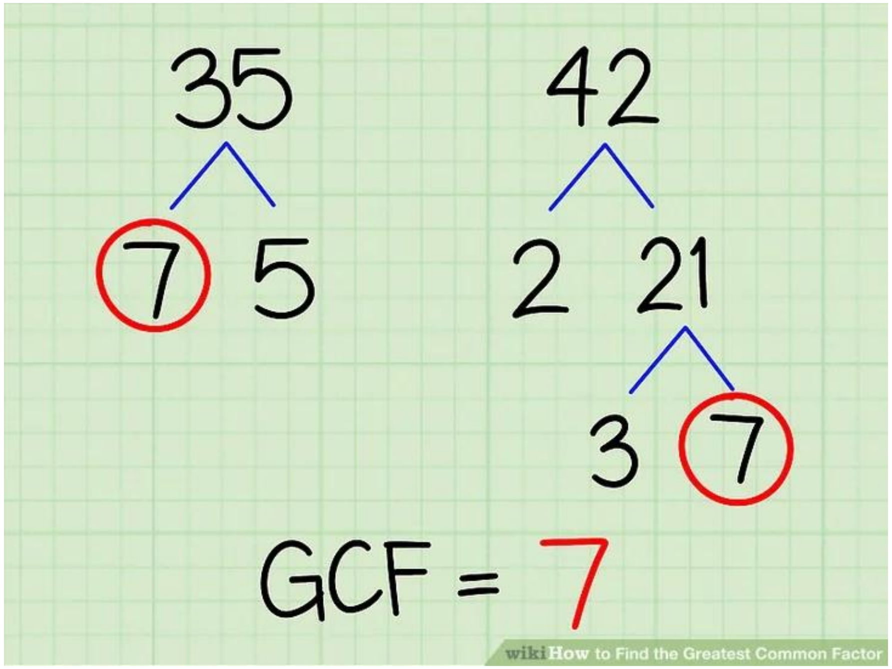
  Example: $\frac{22}{12} = \frac{22 \div 2}{12 \div 2} = \frac{11}{6}$

- **Least Common Multiple** (LCM) – Used to add/subtract fractions with unlike denominators.

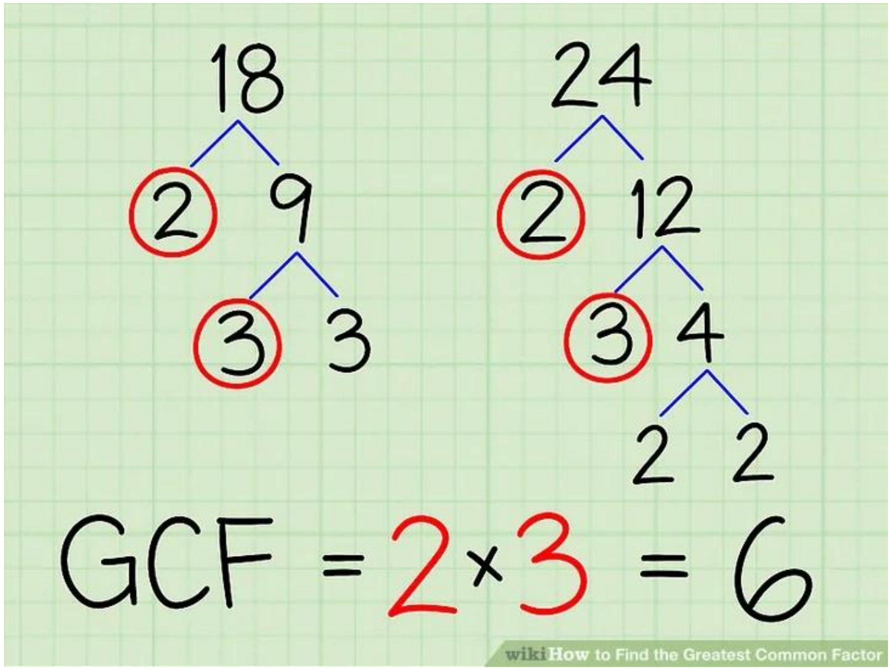
  Example: $\frac{7}{6} - \frac{1}{4} = \frac{14-3}{12} = \frac{11}{12}$

Greatest Common Factor

Example 1: Find the GCF of 35 and 42.



Example 2: Find the GCF of 18 and 24.



Least Common Multiple (LCM)

Example 1: Find the LCM of 8, 4, and 6.

Method 1: Listing Multiples

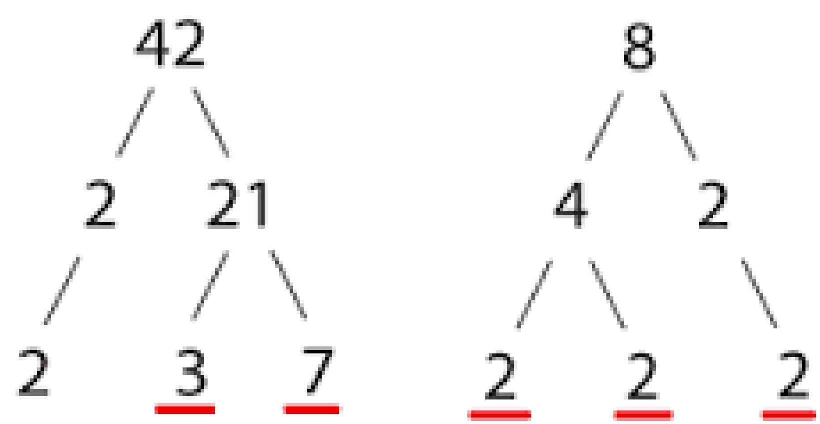
8 → 8, 16, $\boxed{24,}$ 32, 40, 48

4 → 4, 8, 12, 16, 20, $\boxed{24,}$ 28, 32

6 → 6, 12, 18, $\boxed{24,}$ 30, 36

LCM = 24

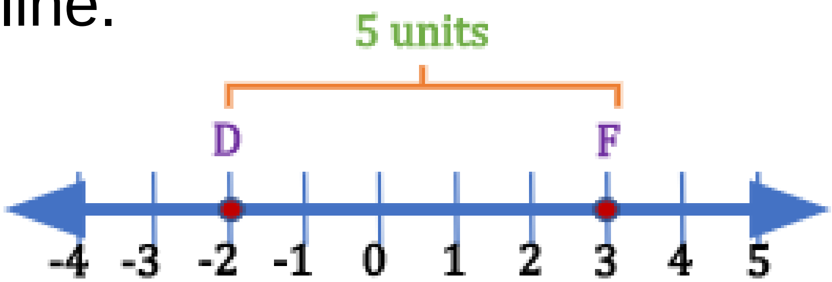
Example 2: Find the LCM that is necessary to perform the indicated operation: $\frac{3}{8} - \frac{1}{42} =$

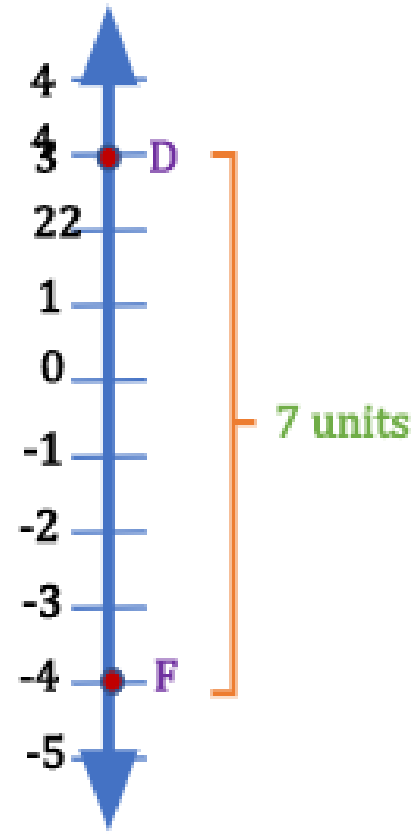


LCM = 2 * 2 * 2 * 3 * 7 = 168

Distance on a Number Line

The distance is how far apart points are on a number line.





Find the distance between -24 and 13 on a number line.

Distance on a Number Line

The distance between two points A and B on a number line is:

$$= |A - B|$$

Example:

Find the distance between -24 and 13 on a number line.

$$= |-24 - 13|$$
$$= |-37|$$
$$= 37$$

Absolute Value is the distance of a number from zero on a number line.

Operations on Rational Numbers

By MathTricks on Facebook Reels

https://www.facebook.com/reel/657776426087451/

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Exponents and Roots/Radicals

Performance Gap 2

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Rules of Exponents

Workbook P. 3

Name	Rule	Example
Product	$a^m \cdot a^n = a^{m+n}$	$x^3 \cdot x^4 = x^{3+4} = x^7$
Quotient	$a^m \div a^n = a^{m-n}$	$p^5 \div p^2 = p^{5-2} = p^3$
Power of a Power	$(a^m)^n = a^{mn}$	$(z^3)^2 = z^{3\cdot 2} = z^6$
Power of a Product	$(ab)^m = a^m b^m$	$(3y)^2 = 3^2 y^2 = 9y^2$
Power of a Quotient	$\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$	$\left(\frac{5}{3}\right)^2 = \frac{5^2}{3^2} = \frac{25}{9}$
Zero Exponent	$a^0 = 1$	$x^0 = 1;\ 6^0 = 1;\ 0^0 = 1$
Negative Exponent	$a^{-m} = \frac{1}{a^m}$	$b^{-3} = \frac{1}{b^3}; 5^{-2} = \frac{1}{5^2}$
Fractional Exponent	$a^{\frac{m}{n}} = \sqrt[n]{a^m}$	$4^{\frac{3}{2}} = \sqrt[2]{4^3} = \sqrt{64} = 8$

Square and Square Root Tricks (Part 1)

Combining of Similar Radicals

$$a\sqrt{b} + a\sqrt{b} = (a + a)\sqrt{b}$$

$$a\sqrt{b} - c\sqrt{b} = (a - c)\sqrt{b}$$

Example 1: $2\sqrt{5} + 6\sqrt{5} = (2 + 6)\sqrt{5} \quad = 8\sqrt{5}$

Example 2: $3\sqrt{2} - 5\sqrt{2} = (3 - 5)\sqrt{2} \quad = -2\sqrt{2}$

Workbook P. 3

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Square and Square Root Tricks (Part 2)

Splitting Products

$$\sqrt{x^3} = \sqrt{x^2 \cdot x} = \sqrt{x^2}\sqrt{x} = |x|\sqrt{x}$$

$$\sqrt{20} = \sqrt{4 \cdot 5} = \sqrt{4} \cdot \sqrt{5} = |2|\sqrt{5}$$

Splitting Quotients

$$\sqrt{\frac{x^2}{y^2}} = \frac{\sqrt{x^2}}{\sqrt{y^2}} = \frac{x}{y}$$

$$\sqrt{\frac{4}{25}} = \frac{\sqrt{4}}{\sqrt{25}} = \frac{|2|}{|5|}$$

Workbook P. 4

Square and Square Root Exercise

Workbook P. 3

Simplify $2\sqrt{2}\left(2\sqrt{3}+3\sqrt{3}\right)$

$$= \mathbf{2\sqrt{2}\left(5\sqrt{3}\right) = 10\sqrt{2\cdot 3} = 10\sqrt{6}}$$

Simplify $3\sqrt{24x^3}$

$$= \mathbf{3\sqrt{4\cdot 6\cdot x^2\cdot x} = 3\cdot 2\cdot x\sqrt{6x} = 6x\sqrt{6x}}$$

Simplify $\left(-4\sqrt{2}\right)^2$

$$= \mathbf{(-4)^2\left(\sqrt{2}\right)^2 = 16\cdot 2 = 32}$$

Simplify $\sqrt{\frac{12x^2}{4}}$ $= \mathbf{\frac{\sqrt{12x^2}}{\sqrt{4}} = \frac{\sqrt{4\cdot 3\cdot x^2}}{2} = \frac{2x\sqrt{3}}{2} = x\sqrt{3}}$

Cube and Cube Root Tricks (Part 1)

Combining of Similar Radicals

$$a\sqrt[3]{b} + a\sqrt[3]{b} = (a + a)\sqrt[3]{b}$$

$$a\sqrt[3]{b} - c\sqrt[3]{b} = (a - c)\sqrt[3]{b}$$

Example 1: $2\sqrt[3]{5} + 6\sqrt[3]{5} = (2 + 6)\sqrt[3]{5} = 8\sqrt[3]{5}$

Example 2: $3\sqrt[3]{2} - 5\sqrt[3]{2} = (3 - 5)\sqrt[3]{2} = -2\sqrt[3]{2}$

Workbook P. 5

Cube and Cube Root Tricks (Part 2)

Splitting Products

$$\sqrt[3]{x^4} = \sqrt[3]{x^3 \cdot x} = \sqrt[3]{x^3} \cdot \sqrt[3]{x} = x\sqrt[3]{x}$$

$$\sqrt[3]{16} = \sqrt[3]{8 \cdot 2} = \sqrt[3]{8} \cdot \sqrt[3]{2} = 2\sqrt[3]{2}$$

Splitting Quotients

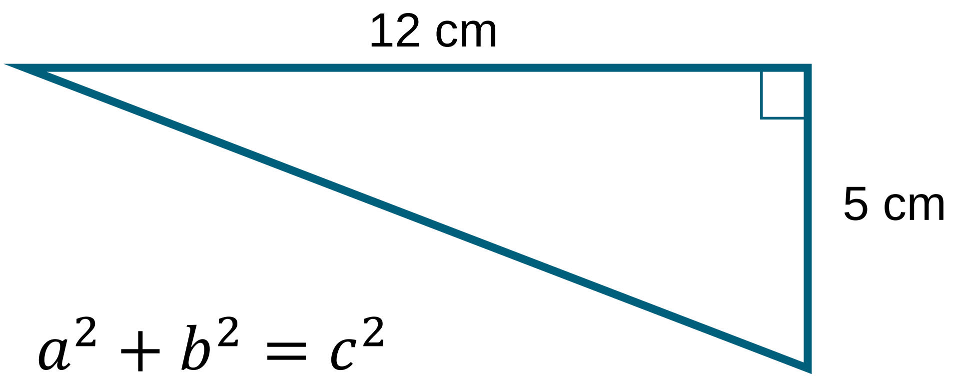
$$\sqrt[3]{\frac{x^3}{y^3}} = \frac{\sqrt[3]{x^3}}{\sqrt[3]{y^3}} = \frac{x}{y}$$

$$\sqrt[3]{\frac{27}{125}} = \frac{\sqrt[3]{27}}{\sqrt[3]{125}} = \frac{3}{5}$$

Workbook P. 5

More Examples: Exponents and Roots

1. Find the length of the hypotenuse of the right triangle.



$$a^2 + b^2 = c^2$$

$$(12)^2 + (5)^2 = c^2$$

$$(12)^2 + (5)^2 = c^2$$

$$144 + 25 = c^2$$

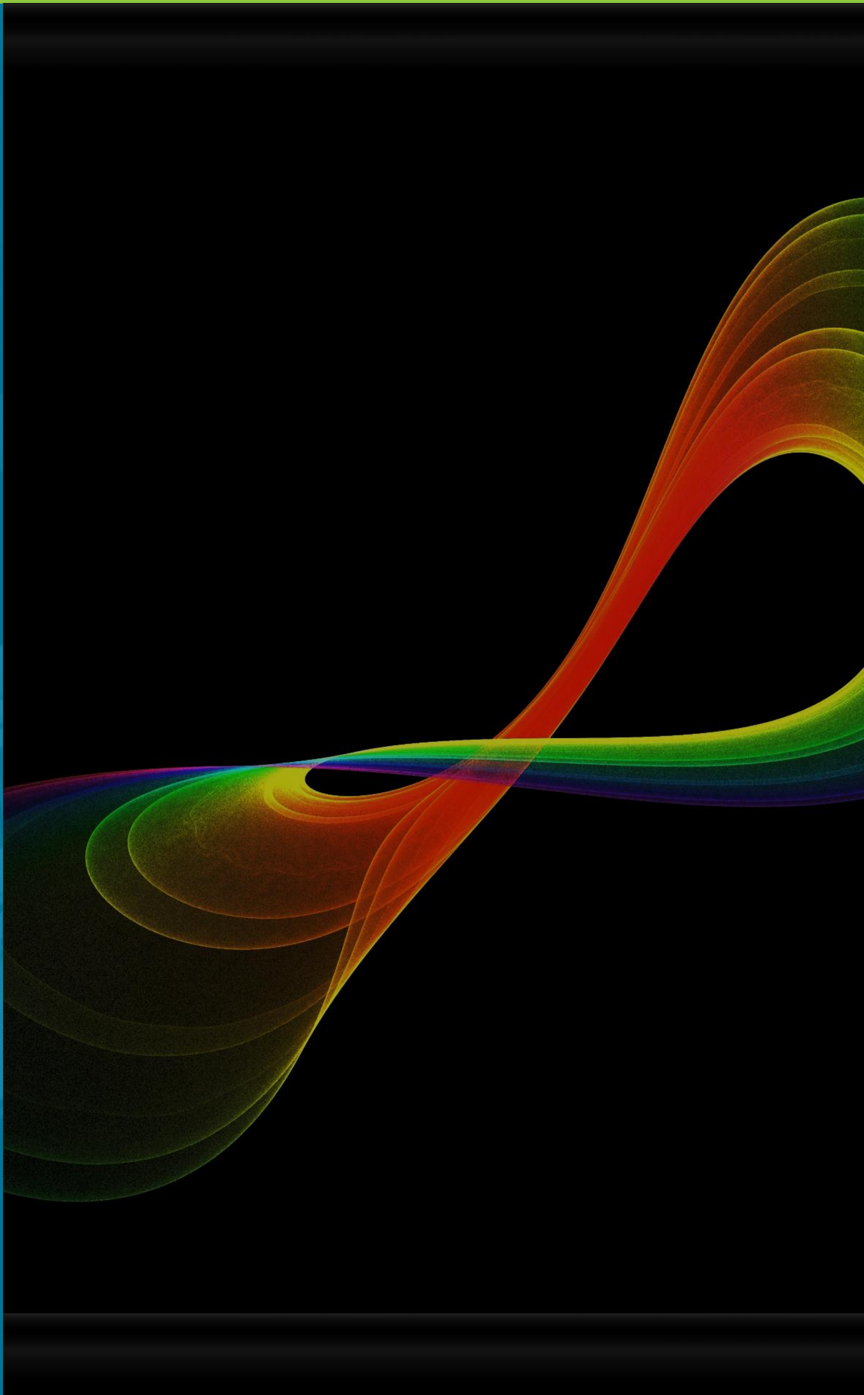
$$169 = c^2$$

$$\sqrt{169} = \sqrt{c^2} = 13$$

Students must memorize the first 12 perfect squares (1, 4, 9, …, 144).

Students must memorize the first 6 perfect cubes (1, 8, 27,…, 216).

Undefined Value Over the Set of Real Numbers



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Undefined Value Over the Set of Real Numbers

There are two types of expressions that are undefined over the set of real numbers:

- Fractions with zero in the denominator (or an expression equivalent to zero)

  Examples: $\frac{-3}{0}$; $\frac{0}{0}$; $\frac{x-3}{x+3}$, where $x = -3$

- Square roots of negative numbers (or expressions which, when simplified, result in negative numbers).

  Examples: $\sqrt{-1}$; $x^2 + 1 = 0$; $\sqrt{-3x^2}$; $\sqrt{x^3 - 2}$, where $x = -1$

The Incredible Zero

The Incredible Zero

- It is unique in representing nothingness.
- As a placeholder it gives our number system its power.
- It acquires different meaning based on its location. Think 30 versus 3,000.

The Origin of the Number Zero

http://www.smithsonianmag.com/history/origin-number-zero-180953392/#qagAYijydW3RXhhk.99

Properties of Zero

Property	Example
a + 0 = a	4 + 0 = 4
a − 0 = a	4 − 0 = 4
a × 0 = 0	6 × 0 = 0
0 / a = 0	0/3 = 0
a / 0 = undefined (dividing by zero is undefined)	7/0 = undefined
$0^a = 0$ (a is positive)	$0^4 = 0$
$a^0 = 1$	$7^0 = 1$

http://www.mathsisfun.com/numbers/zero.html

The Problem with Zero

$$\frac{a}{0} \qquad \frac{7}{0}$$

You can express a fraction with 0 in the denominator, but it has no meaning.

How many times can you throw nothing into no baskets?

Division by zero is undefined. Mathematicians have never defined the meaning because there is no good definition.

As many times as you want. It’s just not a real number.

To learn more: https://www.youtube.com/watch?v=NKmGVE85GUU

Imaginary Numbers

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Imaginary Numbers?

Try squaring numbers to see if we can get a negative result.

$1^2 = 1$ $\quad 0^2 = 0$ $\quad (-2)^2 = 4$ $\quad (0.2)^2$

"**Imagine**" there is such a number. Let's call this number ***i*** for imaginary. Then we can do this…

$$\boldsymbol{i^2 = i \cdot i = -1}$$

"**Imagine**" there is such a number, called ***i*** for imaginary. Then we can also do this…

$$\boldsymbol{\sqrt{i^2} = \sqrt{-1}}$$

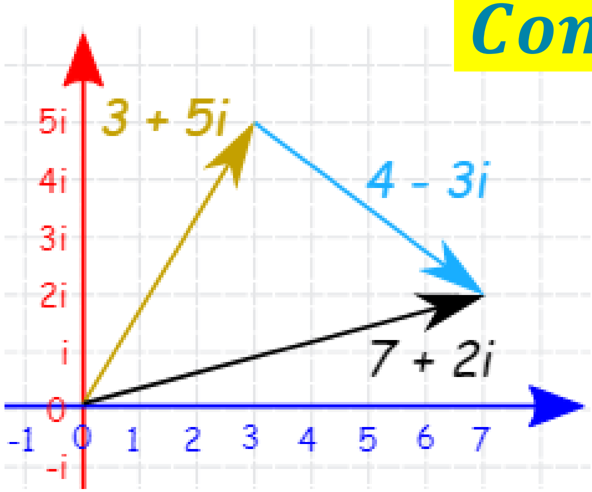
$$\boldsymbol{i = \sqrt{-1}}$$

Are imaginary numbers truly imaginary?

There was a point in time when they were thought to be impossible. But then people researched them more and discovered they were actually useful and important because they filled a gap in mathematics (but the word “imaginary” stuck).

The true power of imaginary number comes when combined with real numbers. This gave birth to a whole new mathematics…

Complex Numbers



$-1 + 6i$

$7 - 5i$

$2 + 3i$

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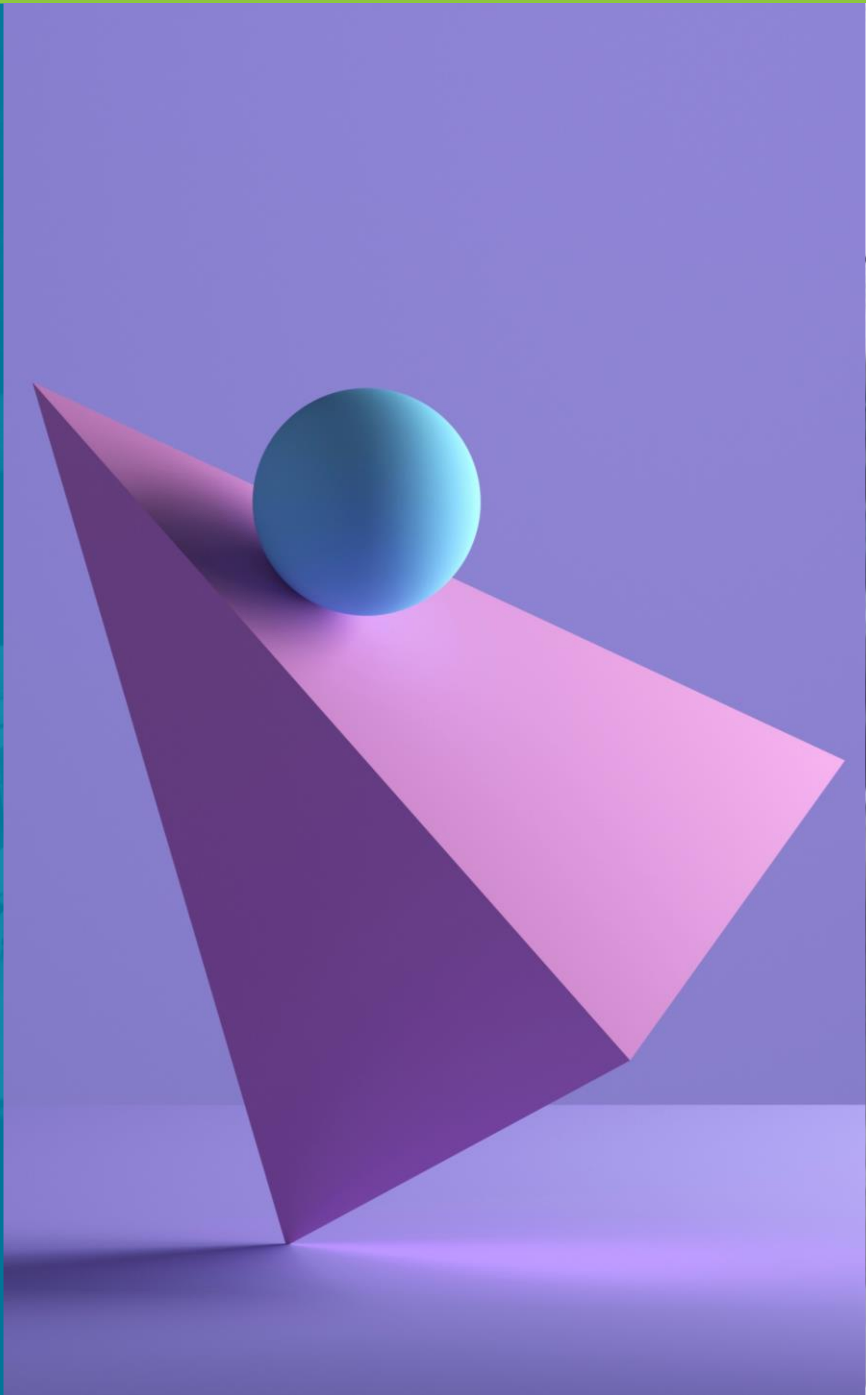
Do imaginary numbers serve any purpose?

https://youtu.be/tSamA58MhQ8

https://youtu.be/fFuVJd36iKg

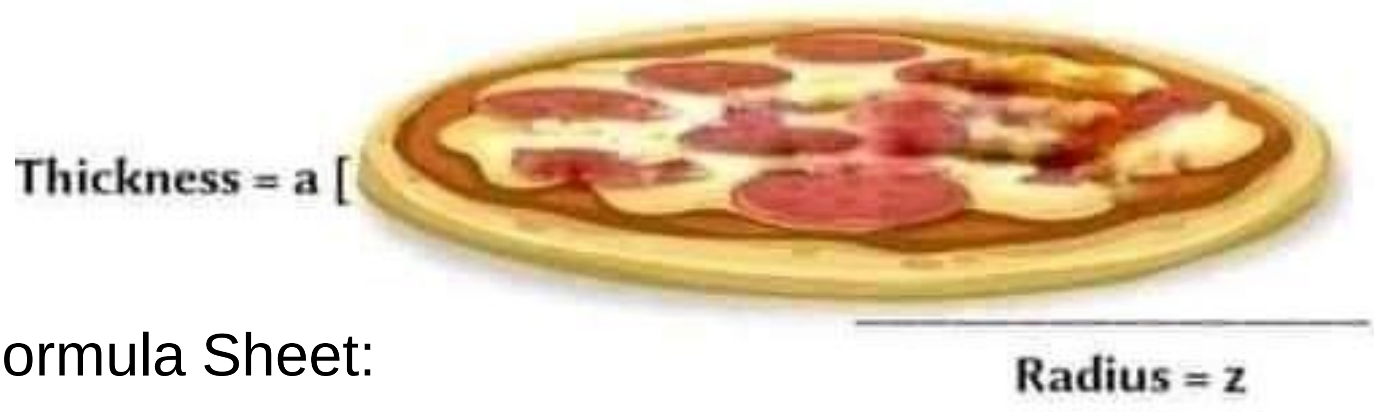
3-Dimensional Shapes

Performance Gap 3



Volume of a Cylinder

Find the volume of the pizza below.



From the Formula Sheet:

$$V = \pi r^2 h$$

Substitute given information.

$$V = \pi z^2 a$$

Notice anything?

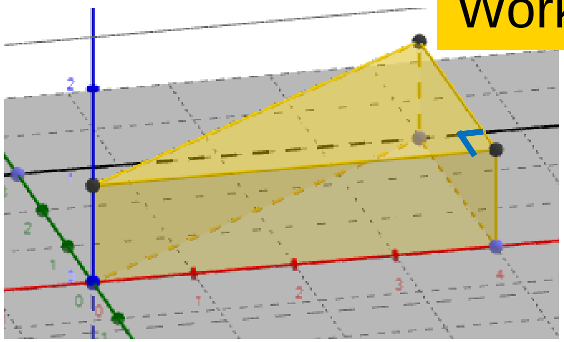
$$V = \mathrm{pi}(z \cdot z)a$$

This is why it's called pizza.

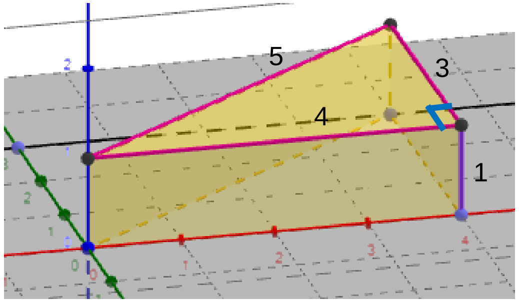
Anchor Chart: Surface Area of Right Triangular Prisms

Workbook P. 7

$$SA = ph + 2B$$



1 Perimeter of the Base and Height



p and h

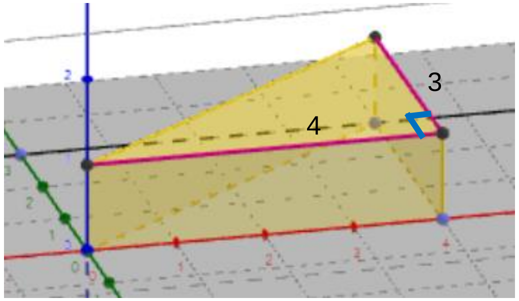
$$p = (3 + 4 + 5)$$

$$p = 12$$

$$h = 1$$

2 Area of the Base

B



$$B = \frac{1}{2}bh$$

$$B = \frac{1}{2}(3 \cdot 4)$$

$$B = \frac{1}{2}(12) = 6$$

3 Solve

$$SA = ph + 2B$$

$$SA = (12)(1) + 2(6)$$

$$SA = 12 + 12$$

$$SA = 24$$

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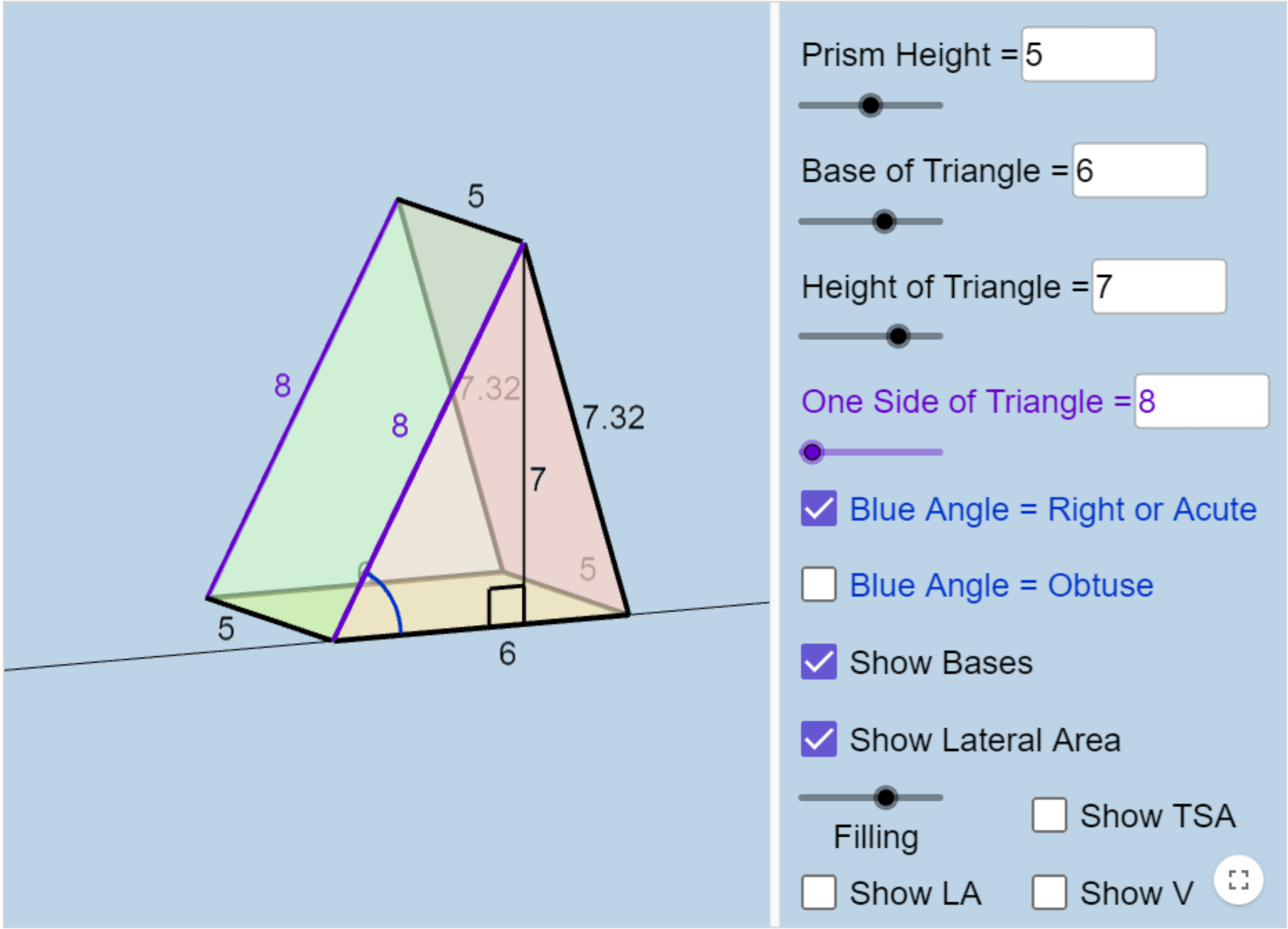
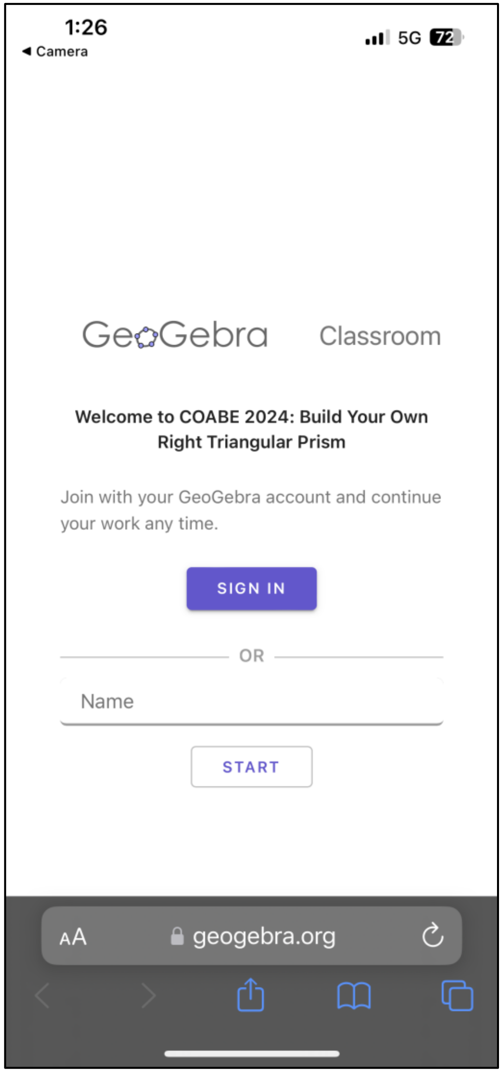
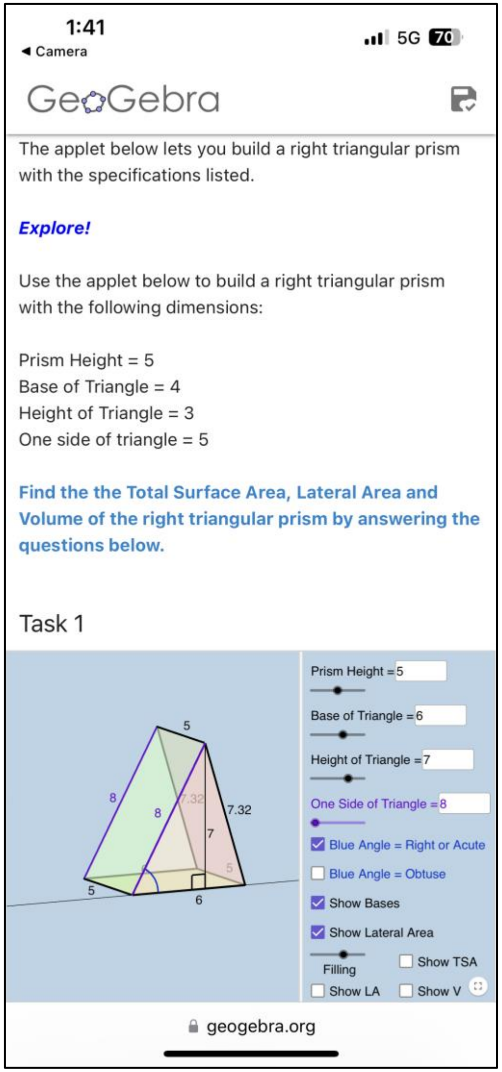
Examining a Right Triangular Prism



Build Your Own Right Triangular Prism

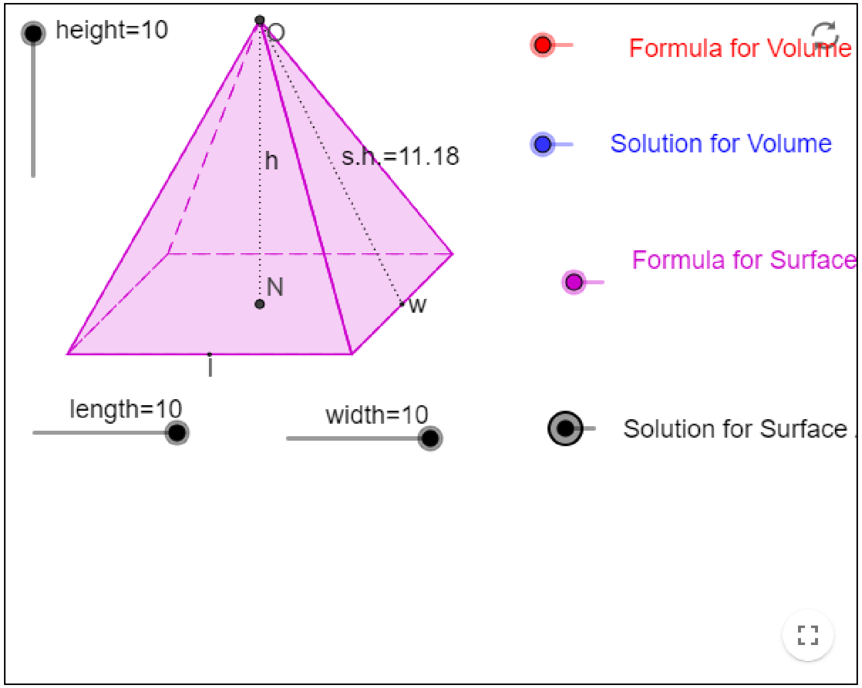
1. Enter your name or a proxy name.
2. Tap on “START.”
3. Follow the instructions to build the right triangular prism.
4. Answer the questions that follow.

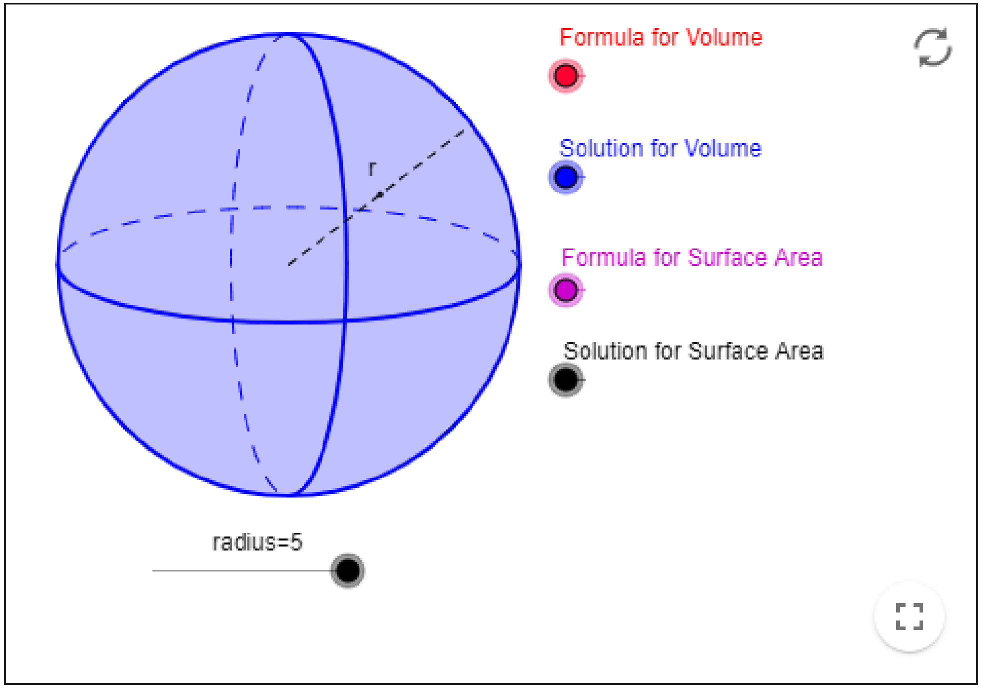




Build and Explore Your Own Solids

There are several other lessons/activities for various solids such as pyramids, cylinders, prisms, cones, and spheres, developed by other teachers and available under Classroom Resources.





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GeoGebra's Augmented Reality Feature

Available on the App Store

Get it on Google play

Solving Algebraic Inequalities

Performance Gap 5

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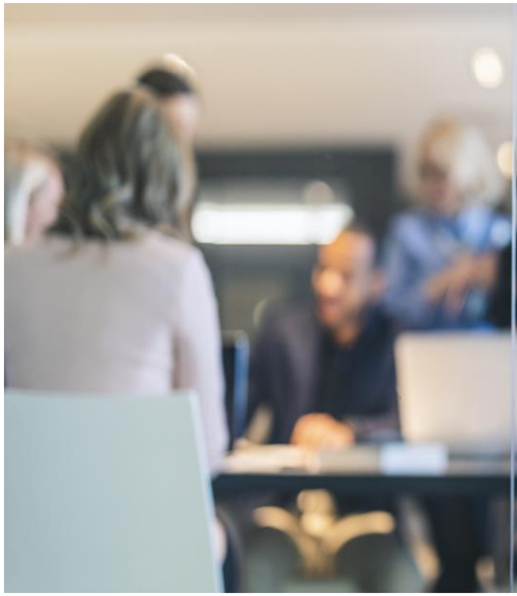
Focusing on High Impact Indicators - Inequalities

- **A.3** Write, manipulate, solve, and graph linear inequalities
  - **A.3.a** Solve linear inequalities in one variable with rational number coefficients.
  - **A.3.b** Identify or graph the solution to a one variable linear inequality on a number line.
  - **A.3.c** Solve real-world problems involving inequalities.
  - **A.3.d** Write linear inequalities in one variable to represent context.

Solve Real World Problems with Inequalities

Annie is planning a business meeting for her company. She has a budget of $1,325 for renting a meeting room at a local hotel and providing lunch. She expects 26 people to attend the meeting. The cost of renting the meeting room is $270. Write an inequality to show how to find the amount, x, Annie can spend on lunch for each person?



Establish the relationship:

Cost ≤ Budget or Budget ≥ Cost

$$\text{Budget} = \$1{,}325$$

$$\text{Cost} = 26x + \$270$$

Set-up the inequality.

Cost ≤ Budget

$$\$26x + \$270 \leq \$1{,}325$$

Solving Equations vs. Inequalities

$$3x + 15 = 24$$

$$3x + \cancel{15 - 15} = 24 - 15$$

$$\frac{\cancel{3}x}{\cancel{3}} = \frac{9}{3}$$

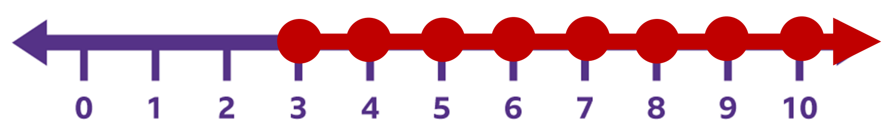
$$x = 3$$

$$3x + 15 \geq 24$$

$$3x + \cancel{15 - 15} \geq 24 - 15$$

$$\frac{\cancel{3}x}{\cancel{3}} \geq \frac{9}{3}$$

$$x \geq 3$$



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With Only One Exception…

When multiplying or dividing both sides of the inequality with a negative number, the inequality sign must be reversed for the solution to remain true.

For example:

$$-3x - 15 \geq 24$$

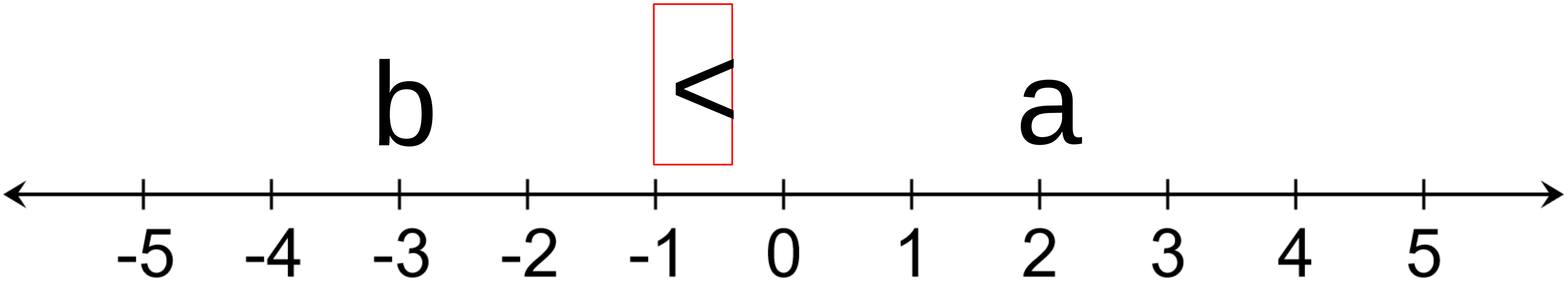
$$-3x - \cancel{15 + 15} \geq 24 + 15$$

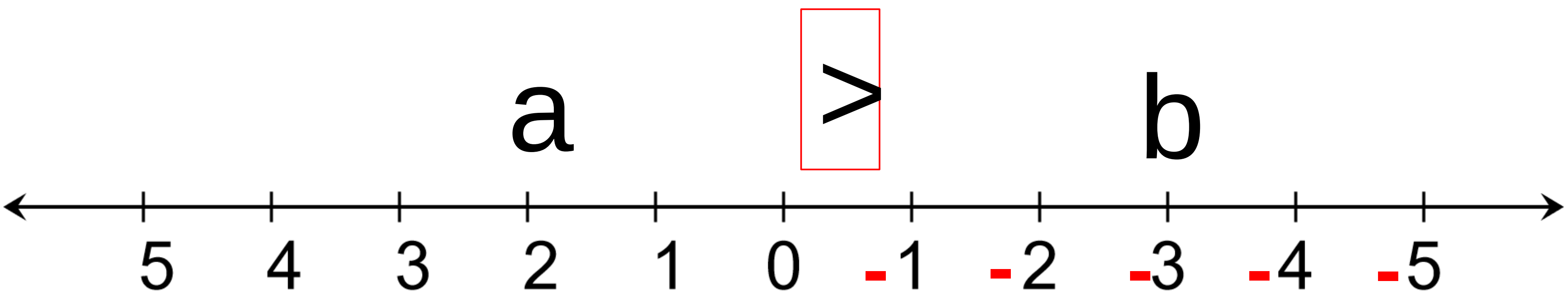
$$-3x \geq 39$$

$$\frac{\cancel{-}3x}{\cancel{-3}} \leq \frac{39}{-3}$$

$$\boxed{x \leq -13}$$

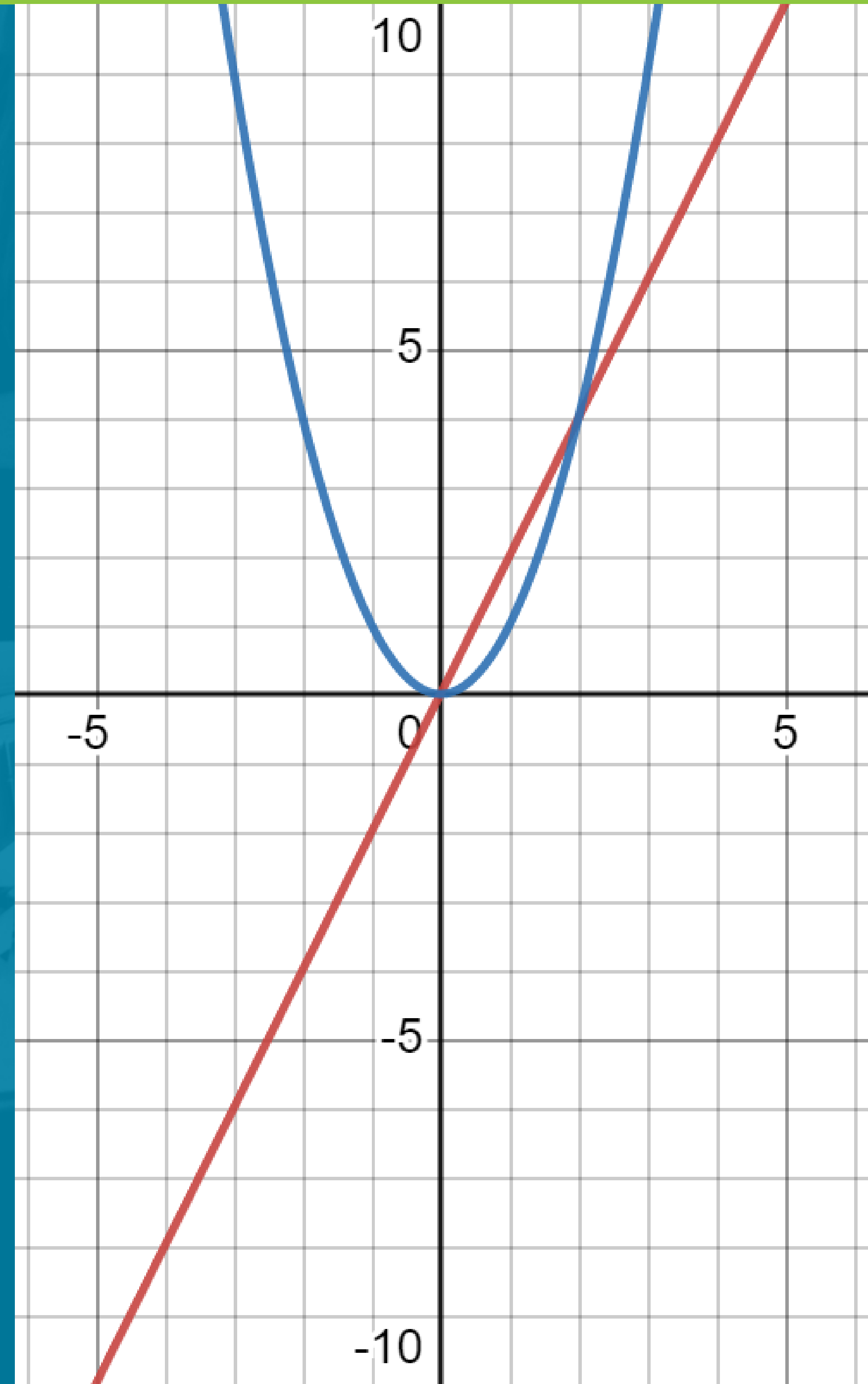
The Million Dollar Question





Slopes and Graphing Linear Equations

Performance Gap 6



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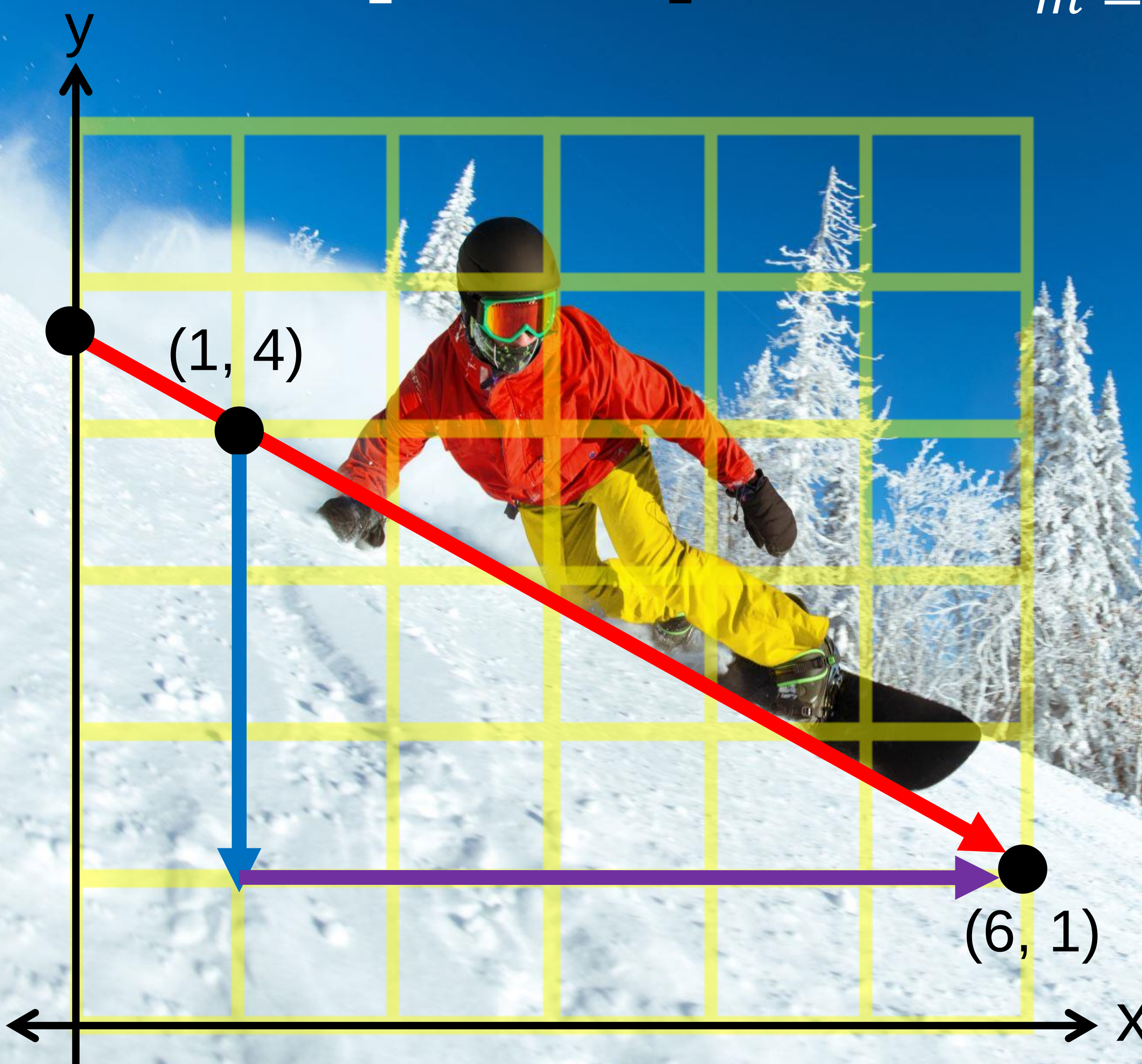
Focusing on Slopes and Graphing Linear Equations

Slopes and Graphing Linear Equations

- Determine the slope of a line from a graph, equation, or table
- Graph two-variable linear equations.
- Write the equation of a line with a given slope through a given point.
- Use slope to identify parallel and perpendicular lines and to solve geometric problems.
- Write the equation of a line passing through two given distinct points.

The Concept of Slope



$$m = \frac{\text{rise (change in } y\text{)}}{\text{run (change in } x\text{)}}$$

$$m = \frac{-3}{5}$$

$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

$$m = \frac{(1 - 4)}{(6 - 1)} = \frac{-3}{5}$$

$$\boldsymbol{y = -\frac{3}{5}x + 4.6}$$

x	y
0	4.6
1	4
6	1

Workbook P. 8

Is slope important?

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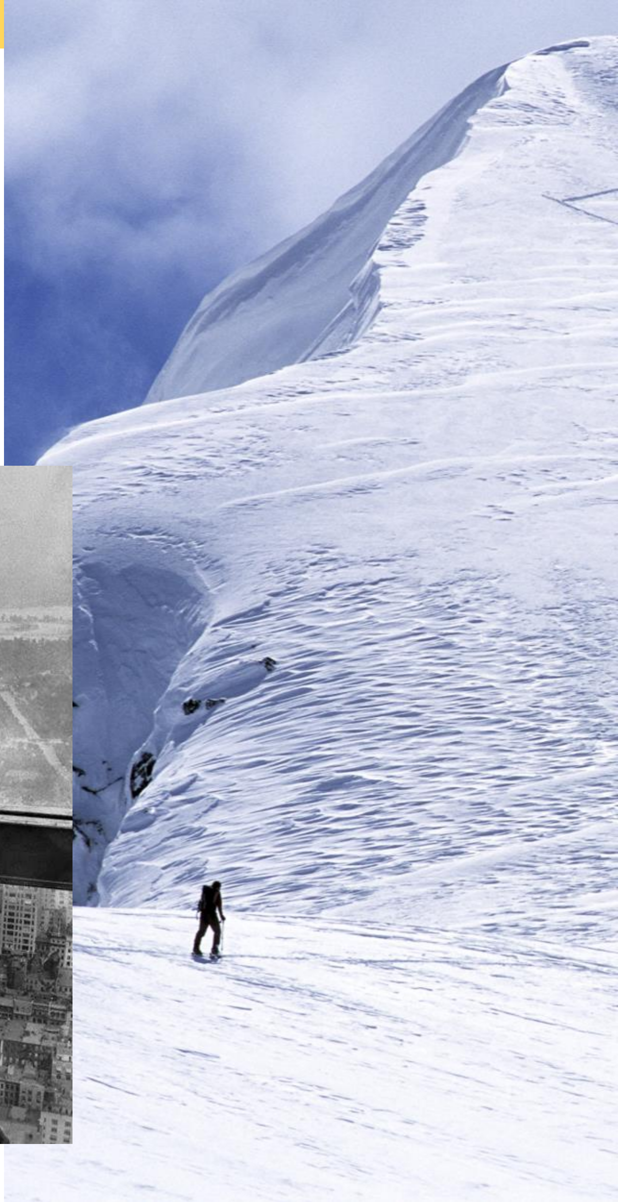

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Forms of Linear Equations

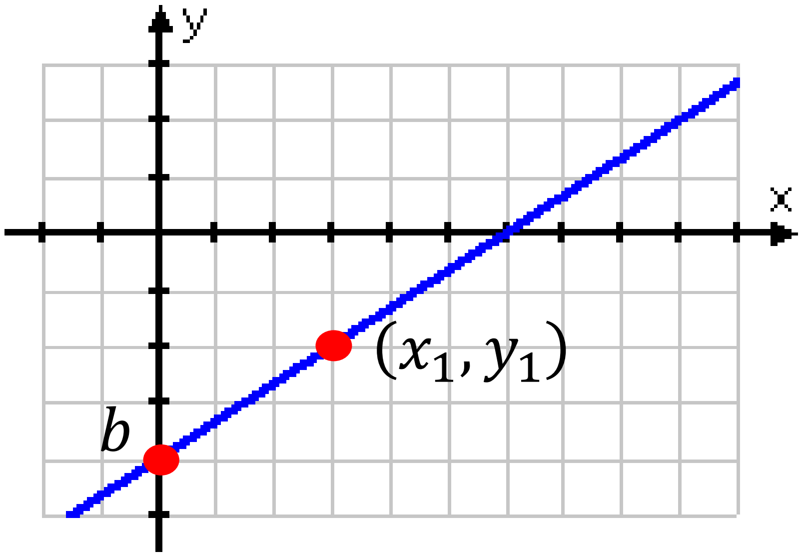
Forms of Linear Equations	Equations
Slope-Intercept Form	$y = mx + b$
Point-Slope Form	$y - y_1 = m(x - x_1)$
Standard Form	$cx + dy = e$

m = slope

b = y−intercept

(x_1, y_1) = a point on the line

c, d and e are constants



Workbook P. 8

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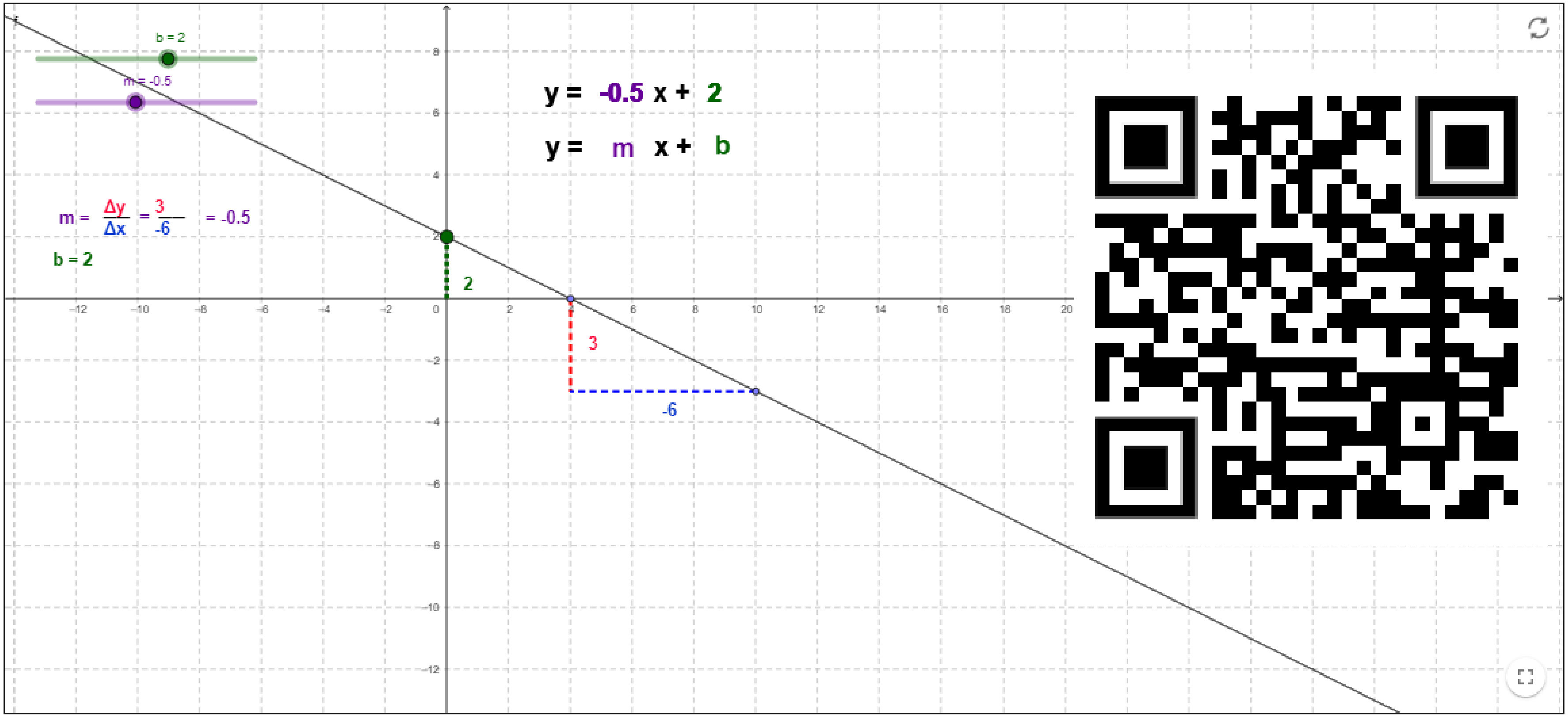
Graphing Linear Equations



https://www.geogebra.org/m/n5gskda8

Anchor Chart for Finding Slope

T-Chart

Use the slope formula.

$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Example:

x	*y*
1	-9
3	-6
5	-3

$$m = \frac{-3-(-9)}{5-1}$$

$$m = \frac{6}{4} = \frac{3}{2}$$

Slope-Intercept

Locate *m* in the equation.

$$y = mx + b$$

Example:

$$\boldsymbol{y = 3x - 4}$$

$$y = mx + b$$

$$m = 3$$

Standard

$$cx + dy = e$$

Transform equation to slope-intercept form and locate *m* in the equation.

Example:

$$\boldsymbol{3x + 9y = 4}$$

$$-3x \qquad -3x$$

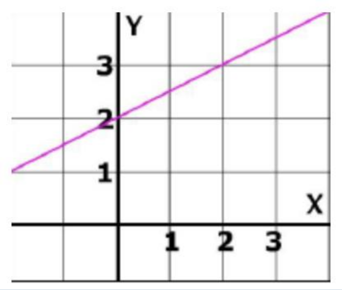
$$9y = -3x + 4$$

$$\frac{9y}{9} = \frac{-3x}{9} + \frac{4}{9}$$

$$y = \frac{-3}{9}x + \frac{4}{9}$$

$$m = \frac{-3}{9}$$

Graph



Locate two points on the graph, then use the slope formula.

Example:

$$(0.2)\text{ and}(2{,}3)$$

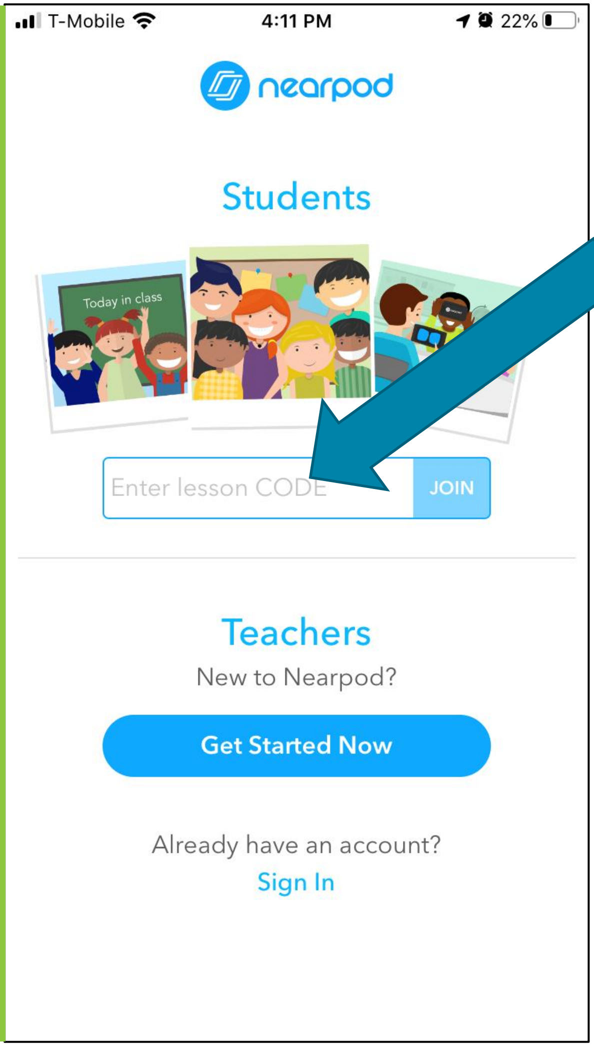
$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

$$m = \frac{3-2}{2-0}$$

$$m = \frac{1}{2}$$

Graphing Exercise

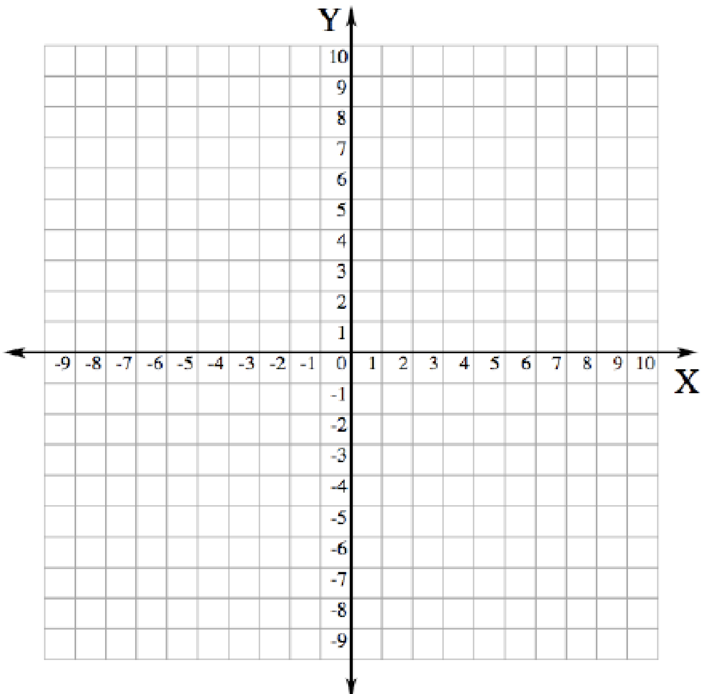
Nearpod App



Join at join.nearpod.com or in the app

Supplemental Graphing Activities

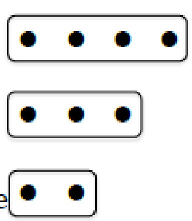
Slope-Intercept Form Battleship



Battleship

Destroyer

Submarine



Each person chooses a color and draws three ships like those on the left. Ships may be placed horizontally or vertically but not diagonally.

To get a hit, write an equation in slope-intercept form that crosses through a point that an enemy ship occupies. You may not use vertical or horizontal lines.

Graph the equation. Record your move on the chart.

You may hit more than one ship with a single line if you are clever! Mark an X on any points you've crossed. You cannot hit your own ship.

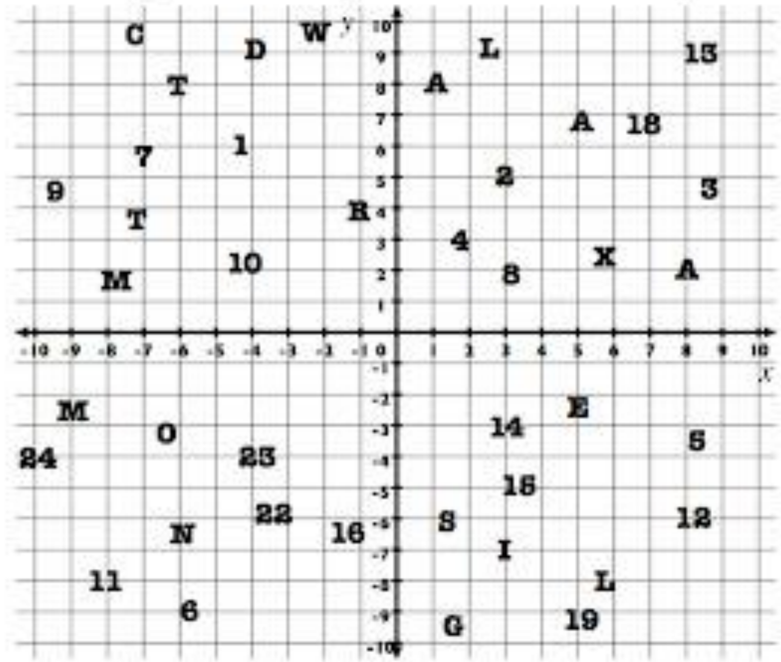
The winner sinks all of his opponent's boats first.

Created by iisanumber.blogspot.com

Kathryn (2013). Slope-Intercept Form Battleship. i is a number. http://iisanumber.blogspot.com/2013/02/slope-intercept-form-battleship.html

Algebra I Period: Name:
Unit 7, Lesson 8: Individual Work

What's green and fluffy and comes from outer space?



Carefully graph each line to match numbers with letters. Write them in the spaces below.

$2x - 4y = 8$	$2x + 8y = -64$	$-2x + 4y = 8$	$3x + 5y = -15$	$12x - 3y = 3$	$y = -8$	$x + 3y = 18$
$-4x + 6y = -54$	$4x - y = -8$	$3x - 10y = 20$	$4x + 9y = 9$	$5x - 3y = 12$	$8x + 4y = 40$	$x + 3y = 27$

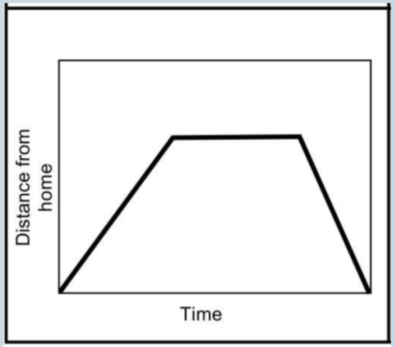
Answer:

23	15	8	22	2	5	12	19	4	7	11	16	24	18

D. Wekselgreene (2010). Some fun(ish) worksheets. http://exponentialcurve.blogspot.com/2010/04/some-funish-worksheets.html

Anchor Chart for Using Slope to Interpret Distance vs. Time Graphs

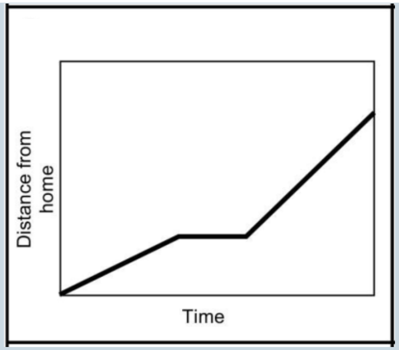
Scenario 1



Example:
Maria walked to the store at the end of her street, bought a gallon on milk and then ran all the way back.

Time	Distance
0	0
1	20
2	40
3	40
4	40
5	0

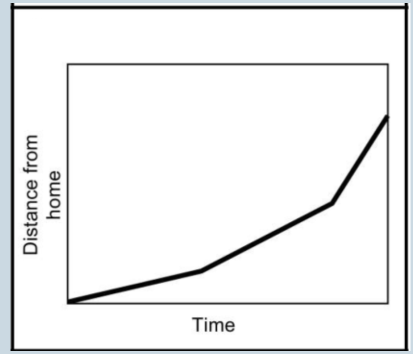
Scenario 2



Example:
Lucy walked slowly along the road, stopped to look at her cell phone, realized that she was late, and then started running.

Time	Distance
0	0
1	20
2	40
3	40
4	80
5	120

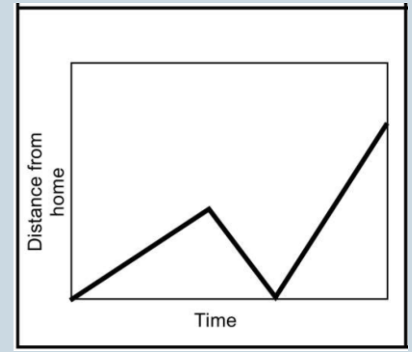
Scenario 3



Example:
Opposite Tom's home is a hill. He climbed slowly up the hill, walked across the top, and then ran quickly down the other side.

Time	Distance
0	0
1	10
2	20
3	40
4	60
5	120

Scenario 4



Example:
Mario went out to walk with some friends. Upon realizing he left his wallet, ran back home to get it. He then had to run to catch up with the others.

Time	Distance
0	0
1	30
2	60
3	0
4	60
5	120

Linear Modeling Word Problem

Mathematical Reasoning

Question 6 of 10

Answer Explanation Calculator Flag for Review

A scientist is studying red maple tree growth in a state park. She measured the trunk diameters of a sample of trees in the same month every other year. The tables show the data for two of the trees.

Tree 1

Year	Trunk Diameter (inches)
1	18.6
3	19.2
5	19.8
7	20.4
9	21.0
11	21.6
13	22.2

$$m = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

$$m = \frac{(19.2 - 18.6)}{(3 - 1)}$$

$$m = \frac{(0.6)}{(2)}$$

$$m = 0.3$$

$$y = mx + b$$

$$18.6 = 0.3(1) + b$$

$$18.6 - 0.3 = b$$

$$18.3 = b$$

This is the final year in which she will collect data. When her data collection is complete, she will predict future red maple tree growth.

Formula Sheet Calculator Reference

The scientist creates an equation that models her data for each tree so that she can predict the diameter in the future. Complete a linear equations that fits the data for tree 1, where x is the year and y is the trunk diameter, in inches.

Click on the variables and number you want to select and drag them into the boxes.

$$y = mx + b$$

Equation for Tree 1

$y = \square \; \square + \square$

⁻0.6	⁻0.3	0.3	0.6
18.0	18.3	18.6	x

Previous Next

Linear Modeling Word Problem

Mathematical Reasoning

Question 6 of 10

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Flag for Review

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Tree 1

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1	18.6
3	19.2
5	19.8
7	20.4
9	21.0
11	21.6
13	22.2

+2

+0.6

$$m = \frac{0.6}{2}$$

$$m = 0.3$$

The y-intercept is simply the trunk diameter at year 0.

$$b = 18.6 - 0.3$$

$$b = 18.3$$

This is the final year in which she will collect data. When her data collection is complete, she will predict future red maple tree growth.

Formula Sheet

Calculator Reference

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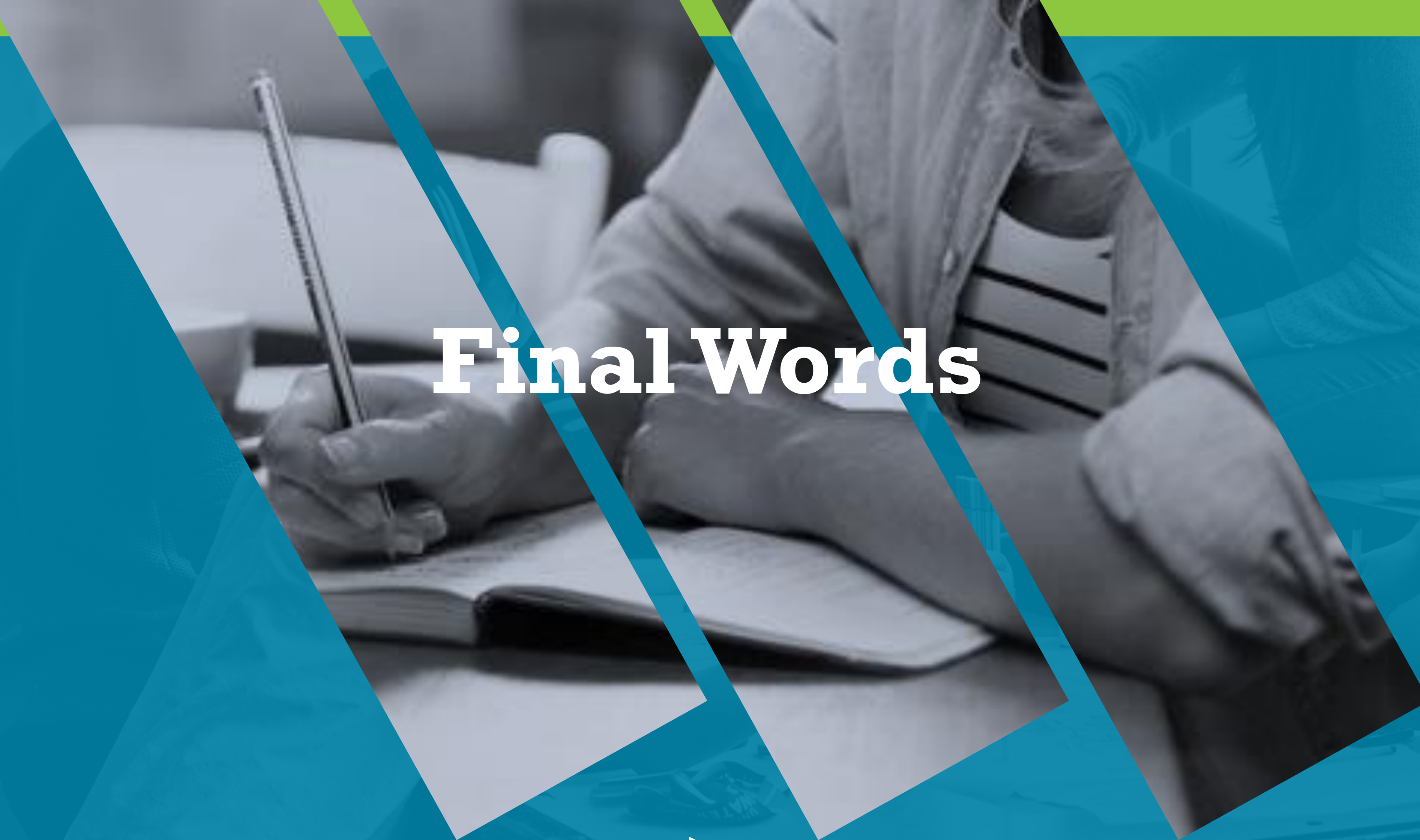
Equation for Tree 1

$y = \square\ \square + \square$

−0.6	−0.3	0.3	0.6
18.0	18.3	18.6	x

Previous Next



Final Words

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Some people want it to happen, some wish it would happen, others make it happen.

Michael Jordan

Questions

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Thank you!

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