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Transforming Mathematics Education

SECONDARY
MATH ONE

An Integrated Approach

Standard Teacher Notes

MODULE 4

Equations & Inequalities

MODULE 4 - TABLE OF CONTENTS

EQUATIONS & INEQUALITIES

4.1 Cafeteria Actions and Reactions

A Develop Understanding Task

Elvira, the cafeteria manager, has just received a shipment of new trays with the school logo prominently displayed in the middle of the tray. After unloading 4 cartons of trays in the pizza line, she realizes that students are arriving for lunch and she will have to wait until lunch is over before unloading the remaining cartons. The new trays are very popular and in just a couple of minutes 24 students have passed through the pizza line and are showing off the school logo on the trays. At this time, Elvira decides to divide the remaining trays in the pizza line into 3 equal groups so she can also place some in the salad line and the sandwich line, hoping to attract students to the other lines. After doing so, she realizes that each of the three serving lines has only 12 of the new trays.

"That's not many trays for each line. I wonder how many trays there were in each of the cartons I unloaded?"

1. Help the cafeteria manager answer her question using the data in the story about each of the actions she took. Explain how you arrive at your solution.

Elvira is interested in collecting data about how many students use each of the tables during each lunch period. She has recorded some data on Post-It Notes to analyze later. Here are the notes she has recorded:

- Some students are sitting at the front table. (I got distracted by an incident in the back of the lunchroom, and forgot to record how many students.)

- Each of the students at the front table has been joined by a friend, doubling the number of students at the table.

- Four more students have just taken seats with the students at the front table.

- The students at the front table separated into three equal-sized groups and then two groups left, leaving only one-third of the students at the table.

- As the lunch period ends, there are still 12 students seated at the front table.

Elvira is wondering how many students were sitting at the front table when she wrote her first note. Unfortunately, she is not sure what order the middle three Post-It Notes were recorded in since they got stuck together in random order. She is wondering if it matters.

2. Does it matter which order the notes were recorded in? Determine how many students were originally sitting at the front table based on the sequence of notes that appears above. Then rearrange the middle three notes in a different order and determine what the new order implies about the number of students seated at the front table at the beginning.

3. Here are three different equations that could be written based on a particular sequence of notes. Examine each equation, and then list the order of the five notes that is represented by each equation. Find the solution for each equation.

- $\dfrac{2(x+4)}{3} = 12$

- $2\left(\dfrac{x}{3} + 4\right) = 12$

- $\dfrac{2x+4}{3} = 12$

4. 1 Cafeteria Actions and Reactions – Teacher Notes
A Develop Understanding Task

Purpose: In this task students will develop insights into how to extend the process of solving equations—which they have previously examined for one- or two-step equations—so that the process works with multistep equations. They will observe that the process of solving an equation consists of writing a sequence of equivalent equations until the value(s) that will make each of the equations in the sequence true becomes evident. Each equation in the sequence of equivalent equations is obtained by operating on the expressions on each side of the previous equation in the same way, such as multiplying both sides of the equation by the same amount, or adding the same amount to both sides of the equation. This property of equality is often referred to as "keeping the equation in balance." Our goal in each step of the equation solving process is to make the next equivalent equation contain fewer operations than the previous one by "un-doing" one operation at a time. When there are multiple operations involved in an equation, the order in which to "un-do" the operations can be somewhat problematic. This task examines ways to determine the sequence of "un-do-it" steps by using the structure of the equation.

Core Standards Focus:
A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Related Standards: A.REI.3

Standards for Mathematical Practice of Focus in the Task:
> **SMP 2 – Reason abstractly and quantitatively**
> **SMP 3 – Construct viable arguments and critique the reasoning of others**
> **SMP 7 – Look for and make use of structure**

Additional Resources for Teachers:

A handout containing the descriptions found on the five Post-It Notes referred to in the task is provided as part of these teacher notes. The handout can be duplicated and cut into five cards to represent the Post-It Notes. Students can rearrange the cards to model the sequence of events represented by each given equation and use this arrangement of cards to determine the order of inverse operations to be used is solving the equation.

The Standards for Mathematical Practice Prompt Cards available from Mathematics Vision Project can be used with this task. Have students focus on the prompts and sentence stems from cards 2, 3 or 7 as they work, and use these prompts to support their language and explanations.

An answer key for the questions in the task can also be found as a separate page at the end of these teacher notes. It is recommended that you work through the task yourself before consulting the answer key to develop a better sense of how your students might engage in the task.

The Teaching Cycle:

Launch (Whole Class):

Read the initial story context about Elvira, the cafeteria manager, and the sequence of events that led to "twelve new trays in each of three serving lines" and challenge students to "un-do" the actions that got her to this situation to see if they can answer Elvira's question of "how many trays were in each carton?" Give students a few minutes to work individually or with a partner to analyze this situation, then have a student share his or her thinking.

Record the steps of the explanation of how to find the number of trays in a carton for use in a few minutes:

- Since there are now twelve trays in each of three serving lines, there must have been 36 trays before Elvira divided them up.

- Since 24 students removed trays after lunch period started, there must have been 36+24=60 trays that were unloaded.

- Since the 60 trays came from 4 cartons, there must have been 15 trays in each carton.

Now propose that the story of Elvira's "actions" could have been represented by the following sequence of equivalent equations, and have students connect each equation in the sequence to the appropriate action:

Let $x = 15$ This represents the number of trays in each carton.

$4x = 60$ This would represent the number of trays unloaded from four cartons.

$4x - 24 = 36$ This would represent the remaining trays after 24 students passed through the line.

$\frac{4x-24}{3} = 12$ This would represent the number of trays in each of the three lines.

This last equation represents a multi-step equation. Have students pretend that we do not know the solution for *x.* Have them discuss with a partner how they could look at this equation and "see" the steps listed on the board for "un-doing" the story, as represented by the numbers and operations in this equation. Have students share what they have noticed, then have them work on the second situation with Elvira and the Post-It Notes.

Explore (Small Group):

Encourage students to do the same thing with the 5 Post-It Notes that they did with the serving trays scenario. That is, they should write out the steps of reasoning that would help them work backwards to the solution. Have them then change the order of the middle three Post-It Notes and solve the situation again. Ask, did the order matter?

Listen for how students are making decisions about which order the notes were arranged in for each of the three different equations listed in problem 3.

Discuss (Whole Class):

The discussion should focus on question 3 and how students can recognize the order of events that got to "still 12 students seated at the front table." Once they can see how the sequence of events unfolded, they should be able to determine how to reverse the sequence of events. It may be necessary to write out the list of events and "un-do-it" explanations for each problem, similar to what was done in the launch.

Aligned Ready, Set, Go: Equations and Inequalities 4.1

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.1

4.1

READY

Topic: Solutions to an equation.

Graph the following equations on the coordinate grid. Determine if the given point is a solution to the equation?

1. $y = 5x - 2$
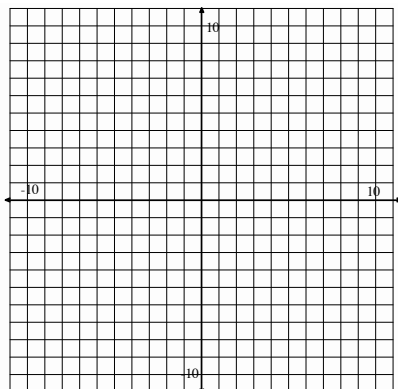
Point: $(1 , 3)$ Yes? / No?

2. $y = -\frac{1}{2}x + 8$
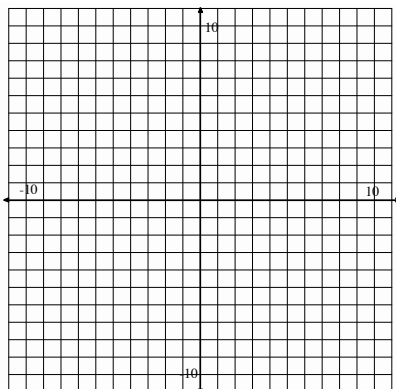
Point: $(0 , 7)$ Yes? / No?

3. $y = -x + 4$
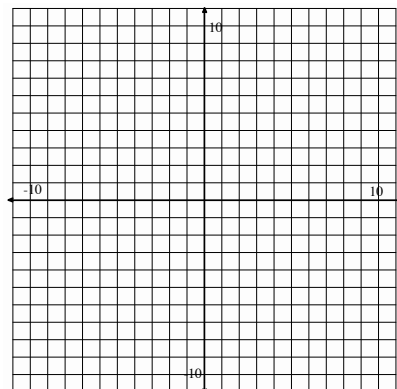
Point: $(2 , 2)$ Yes? / No?

4. $y = x + 2$

Point: $(1 , 3)$ Yes? / No?

5. $y = \frac{5}{2}x - 7$
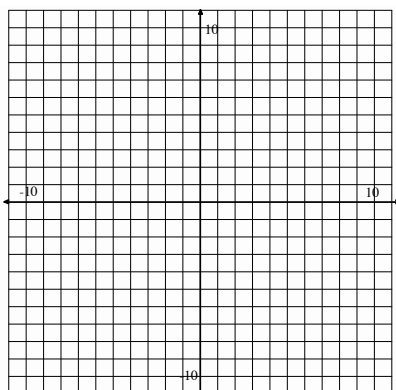
Point: $(2 , -2)$ Yes? / No?

6. $y = -\frac{4}{3}x$

Point: $(2 , -5)$ Yes? / No?

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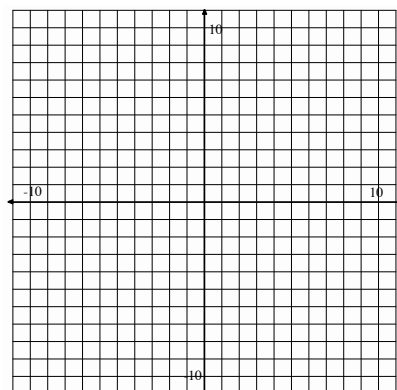
SET

Topic: Solve linear equations using parentheses.

Determine if the two expressions listed are equivalent.   Explain your reasoning.

7. $14 - (3a + 2)$ $14 - 3a - 2$		**8.** $4b - 10$ $2(2b - 5)$	
9. $\frac{(x-7)}{4}$ $\frac{x}{4} - \frac{7}{4}$		**10.** $\frac{3(w-9)}{5}$ $\frac{3w}{5} - 27$	

11. Without solving, determine if the two equations below have the same solution.
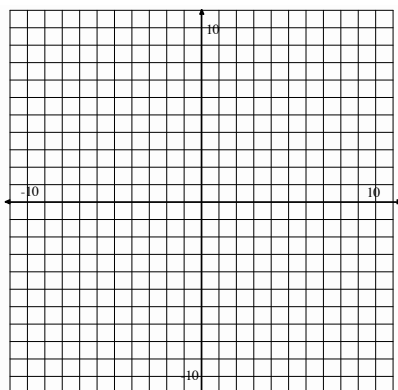   Explain why or why not?

$$3(x - 5) = 35 \text{ and } 3x - 5 = 35.$$

12. Circle the expressions that are equivalent.

$\frac{4t - 10}{2}$	$\frac{4t}{2} - 10$	$2t - 10$	$4t - 5$

Solve for x.

13. $\frac{4(x-2)}{5} = 20$ **14.** $4\left(\frac{x}{5} - 2\right) = 20$ **15.** $\frac{4x-2}{5} = 20$

GO

Topic: Determine if a number is a solution to an equation.

Indicate whether the given value is a solution to the corresponding equation.
Show your work.

16. $a = -3;$ $4a + 3 = -9$

Yes?/No?

17. $x = \frac{4}{3};$ $\frac{3}{4}x + \frac{1}{2} = \frac{3}{2}$

Yes?/No?

18. $y = 2;$ $2.5y - 10 = -0.5$

Yes?/No?

19. $z = -5;$ $2(5 - 2z) = 20 - 2(z - 1)$

Yes?/No?

20. $w = \frac{1}{4};$ $4w = w + \frac{3}{4}$

Yes?/No?

21. $b = 5;$ $6x - 2 = 4(x + 2)$

Yes?/No?

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4. 2 Elvira's Equations

A Solidify Understanding Task

Elvira, the cafeteria manager, likes to keep track of the things she can count or measure in the cafeteria. She hopes this will help her improve the efficiency of the cafeteria. To remind herself to keep track of important quantities, she has made a table of variables and descriptions of the things she wants to record. Here is a table of things she has decided to keep track of.

Symbol	Meaning (description of what the symbol means in context)	Units (what is counted or measured)
S	Number of students that buy lunch in the salad line	
W	Number of students that buy lunch in the sandwich line	
P	Number of students that buy lunch in the pizza line	
F	Number of food servers in the cafeteria	
M_T	Number of minutes it takes to serve lunch to all students	
C	Number of classes in the school	
P_L	Price per lunch	
A		
R		
T		
D_F		
M		

Elvira has written the following equation to describe a cafeteria relationship that seems meaningful to her. She has introduced a new variable *A* to describe this relationship.

$$A = \frac{S+W+P}{C}$$

1. What does *A* represent in terms of the school and the cafeteria? Record this information in the table above.

2. Using what you know about manipulating equations, solve this equation for *S.* Your solution will be of the form *S = an expression written in terms of the variables A, C, W* and *P.*

3. Does your expression for *S* make sense in terms of the meanings of the other variables? Explain why or why not.

Here is another one of Elvira's equations.

$$R = P_L(S + W + P)$$

4. What does *R* represent in terms of the school and the cafeteria? Record this information in the table above.

5. Using what you know about manipulating equations, solve this equation for P_L.

6. Does your expression for P_L make sense in terms of the meanings of the other variables? Explain why or why not.

7. Elvira notices that she uses the expression *S + W + P* a lot in writing other expressions. She decides to represent this expression using the variable *T*, so that *T = S + W + P.* What does *T* represent in terms of the school and the cafeteria? Record this information in the table above.

Elvira is having a meeting with the staff members who work in the lunchroom. She has created a couple of new equations for the food servers.

$$D_F = \frac{T \cdot P_L}{F} \qquad\qquad M = \frac{M_T}{T}$$

8. a. What does D_F represent in terms of the school and the cafeteria? Record this information in the table above.

 b. Solve this equation for P_L. Describe why your solution makes sense in terms of the other variables.

9. a. What does M represent in terms of the school and the cafeteria? Record this information in the table above.

 b. Solve this equation for T. Describe why your solution makes sense in terms of the other variables.

10. One of the staff members suggests that they need to write expressions for each of the following. Using the variables in the table, what would these expressions look like?

 a.   The average number of students served each minute

 b.   The average number of minutes students wait in the pizza line

4. 2 Elvira's Equations – Teacher Notes
A *Solidify Understanding Task*

Purpose: The purpose of this task is to apply the equation solving process developed in the previous task to solving literal equations and formulas. Working with literal equations solidifies the notion that operations have to be "un-done" in an appropriate order by doing the inverse operation to both sides of the equation. This task also solidifies the meaning of expressions by attending to the units associated with each of the variables.

Quantities are measured in units. When quantities are added, subtracted, multiplied or divided the units on the result of the operation may be different from the units used to measure the individual quantities. The new units formed are a consequence of the meaning of the operations. For example, if the amount of gasoline I put in my car is measured in gallons, and the distance I travel when using up that amount of gasoline is measured in miles, then a new unit of measure, miles per gallon, emerges to measure the efficiency of my car's usage of gasoline. This is a result of dividing the number of gallons of gasoline used by the number of miles driven. In this task students solidify the use of units as a tool for understanding problems and as a guide for determining what operations make sense when combining quantities using the four basic arithmetic operations.

Core Standards Focus:

N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Related Standards: N.Q.2, A.REI.1, A.SSE.1

Standards for Mathematical Practice of Focus in the Task:

      SMP 2 – Reason abstractly a quantitatively

      SMP 3 – Construct viable arguments and critique the reasoning of others

      SMP 4 – Model with mathematics

      SMP 7 – Look for and make use of structure

Additional Resources for Teachers:

The Standards for Mathematical Practice Prompt Cards available from Mathematics Vision Project can be used with this task. Have students focus on the prompts and sentence stems from different cards than the ones used in the previous task.

An answer key for the questions in the task can be found as a separate page at the end of these teacher notes. It is recommended that you work through the task yourself before consulting the answer key to develop a better sense of how your students might engage in the task.

The Teaching Cycle:

Launch (Whole Class):

Give students a few minutes of individual think time to determine the units and fill out the third column of the table for each of the variables currently listed. Then have them share their proposed units for the variables as a class. Students should note that even though the descriptions on the variables may be different, the units in which the variables are measured may still be the same. For example, S, the number of students who buy lunch in the salad line, W, the number of students who buy lunch in the sandwich line, and P, the number of students who buy lunch in the pizza line, each describe different groups of students eating different lunches, but the unit "students" (or "people" or "individuals") can be used for each of these variables. Also note that some descriptions can meaningfully be assigned a variety of different units. For example, "price per lunch" could meaningfully be measured using the units "dollars per lunch" or "pennies per lunch". Since each student buys a lunch, "price per lunch" would also measure "dollars per student." This is a typical issue when modeling real-world situations—identifying the meaning of the variables in a useful, yet

consistent way. Help students understand that the convention frequently used to denote units such as "dollars per student" is to write $dollars/_{student}$.

As part of the launch, give pairs of students a few minutes to determine the meaning of the variable A in question 1 by using the descriptions and units associated with the variables in the expression that define A. With their partners, they should also work through questions 2 and 3 together, and then discuss this sequence of questions as a whole class. It is important that students understand this series of expectations for each new expression they encounter: interpret the meaning of the expression in terms of the units and descriptions of the variables involved, solve for one of the variables in the literal equation, and check the solution process by verifying that the variable solved for has the same meaning as its given description. Once variable A's description and units have been recorded in the table, set students to work with their partners on the remainder of the task.

Explore (Small Group):

Listen for how students are interpreting the meaning of new variables using the given descriptions of the variables involved in each expression. Support their work on solving each literal equation by reminding them of their work from the previous task. You might ask, How do we determine which order to un-do each operation in the expression?

It may be difficult for some students to recognize that they can multiply both sides of an equation by a variable, or subtract a variable from both sides of an equation. Some students may not even recognize the operations involved in the expressions when quantities are represented by variables instead of numbers. In such cases, it may be helpful to ask, "What if, instead of this variable, there was a number written in this position of the equation? What operation would be performed by that number?"

Note that question 10 is provided for fast-finishers, and that students who have completed the task through question 7, and are working on questions 8 and 9, should have access to the whole class discussion.

Discuss (Whole Class):

The major focus of the discussion should be on the equation solving process as applied to literal equations. Have students present their solutions to questions 5, 8b and 9b.

Once the solution strategies have been presented and discussed, turn the focus of the discussion to using units to interpret the meaning of expressions, and using units to justify the steps in the equation solving process.

If there is time, have students propose their expressions for question 10.

Aligned Ready, Set, Go: Equations and Inequalities 4.2

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.2

4.2

READY, SET, GO!	Name	Period	Date

READY

Topic: Isolate a variable with inverse operations.

Isolate the indicated variable and then fill in the blank for the statement that follows.

1. Solve for *x*; *ax = 7*   I can find *1x or x* by _____ on both sides of the equation.

2. Solve for *p*; *8 + p = w*   I can find *1p or p* by _____ on both sides of the equation.

3. Solve for *m*; *e = mc²*   I can find *1m or m* by _____ on both sides of the equation.

4. Solve for *t*;   *d = rt*   I can find *1t or t* by _____ on both sides of the equation.

5. Solve for *r*; *d = rt*   I can find *r* by _____ on both sides of the equation.

6. Solve for *h*; *7 - h = 0*   I can find *h* by _____ on both sides of the equation.

7. Solve for *b*; *b - 11 = 3*   I can find *b* by _____ on both sides of the equation.

8. Solve for *y*; $\frac{1}{2}y = k$ I can find *y* by _____ on both sides of the equation.

9. Solve for *h*; $A = \frac{bh}{2}$ I can find *h* by _____ on both sides of the equation.

10. Solve for *x*; *y = mx + b*   I can find *x* by _____ on both sides of the equation.

SET

Topic: Defining and interpreting variables and units of measure.

Jaxon likes to be organized, so he made the following chart. He has decided to keep track of the miles he runs and the time he spends running. He attends P.E. class on Monday, Wednesday, and Friday, but he goes to school everyday. *Fill in the Units column on the chart*.

Symbol	Meaning (Description of what the symbol means in context)	Units (What is counted or measured)
M	Number of miles ran in PE class on Mondays	
W	Number of miles ran PE class on Wednesdays	
F	Number of miles ran PE class on Fridays	
S	Number of miles from Jaxon's house to the school.	
H	Time (in hours) to travel to school	
t_M	Time (in minutes) spent running in PE on Monday	
t_W	Time (in minutes) spent running in PE on Wednesday	
t_F	Time (in minutes) spent running in PE on Friday	

Make meaning of the expressions below, write what they each mean!

If an expression does not make sense, say why.

11. $M + W + F$ 12. $4(M + W + F)$ 13. $2S$ 14. $t_M + t_W + t_F$
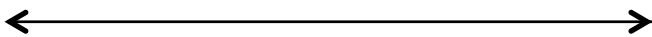
15. $\frac{t_M + t_W + t_F}{3}$ 16. $5(2H)$ 17. $M + H$

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SOLVING EQUATIONS AND INEQUALITIES – 4.2

4.2

GO
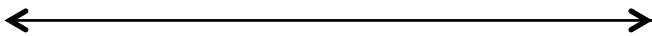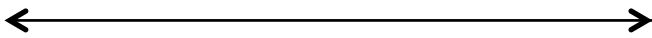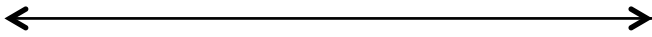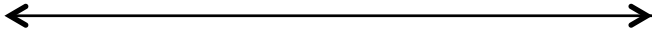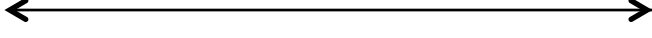
Topic: Set notation to interval notation. Inequalities on a number line.

Below you will find the domains of several different functions. The domains are described in either set notation or interval notation. Fill in the missing notation.

Set Notation	Interval Notation
18. $\{x \mid x \in \mathbb{R}, -2 < x < 6\}$	
19.	[-4, 7]
20. $\{x \mid x \in \mathbb{R}, x \geq -9\}$	
21.	(0, 13]
22. $\{x \mid x \in \mathbb{R}, -15 \leq x \leq -8\}$	
23.	[-32, -15)
24.	$(-\infty, \infty)$

25. Which notation, interval or set, would most appropriate when working with a domain of whole numbers?

For each of the inequalities provided graph the values being described on the numbers line.

26. $x < 6$	
27. $x > 5$	
28. $x \geq -9$	
29. $-7 \leq x < 0$	
30. $3 \leq x \leq 25$	
31. $-15 < x \leq 8$	

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4.3 Solving Equations Literally

A Practice Understanding Task

Solve each of the following equations for *x*:

1. $\dfrac{3x+2}{5} = 7$

2. $\dfrac{3x+2y}{5} = 7$

3. $\dfrac{4x}{3} - 5 = 11$

4. $\dfrac{4x}{3} - 5y = 11$

5. $\dfrac{2}{5}(x+3) = 6$

6. $\dfrac{2}{5}(x+y) = 6$

7. $2(3x+4) = 4x+12$

8. $2(3x+4y) = 4x+12y$

Write a verbal description for each step of the equation solving process used to solve the following equations for *x*. Your description should include statements about how you know what to do next. For example, you might write, "*First I _____, because _____…*"

9. $\dfrac{ax+b}{c} - d = e$

10. $r \cdot \sqrt{\dfrac{mx}{n}} + s = t$

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4. 3 Solving Equations Literally – Teacher Notes
A Practice Understanding Task

Purpose: This task provides practice for solving linear equations in one variable, solving linear equations in two variables for one of its variables, and solving literal equations. The process for solving multivariable equations for one of its variables becomes more apparent when juxtaposed with similarly-formatted equations in one variable. The only difference in the solution process is the ability to carry out numerical computations to simplify the expressions in the one-variable equations.

Core Standards Focus:

A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Related Standards:

Standards for Mathematical Practice of Focus in the Task:

SMP 7 – Look and make use of structure

SMP 8- Look for and express regularity in repeated reasoning

Additional Resources for Teachers:

An answer key for the questions in the task can be found as a separate page at the end of these teacher notes. It is recommended that you work through the task yourself before consulting the answer key to develop a better sense of how your students might engage in the task.

The Teaching Cycle:

Launch (Whole Class):

Encourage students to note the similarities in their work on the pairs of problems in questions 1-8. Also point out that they are to write detailed explanations of their solution strategy on problems 9 and 10. One way to facilitate this would be to have students fold a piece of paper in half lengthwise. On the left side of the paper they write out their algebra steps, and on the right side they write out their justifications.

Explore (Small Group):

Monitor students while working on these problems and offer appropriate feedback, as necessary. Some of the problems have alternative strategies, such as #5 where you can distribute the 2/5 first, or multiply both sides of the equations by 5/2 first.

Help students recognize the difference between changing the form of an expression on one side of an equation, vs. writing an equivalent equation by applying the same operation to both sides.

If students are having difficulties with #9 or #10, have them write a related equation in which they replace all letters with numbers except for the *x*. See if they can solve the related equation for *x* and if that work can help them solve the original literal equation. Problem 10 involves a square root in order to emphasize that one of the key issues in solving an equation is to "un-do" an operation by applying the inverse operation to both sides. Help students think about how that would play out in problem 10. That is, how might they "un-do" a square root?

Discuss (Whole Class):

Have students present their solution process for any problems that may have been difficult for a number of students. You might also want to have students critique each other's explanations on problems 9 and 10 by having students exchange papers. They should fold their partner's paper in half, so that only the right side with the written explanation is showing. On a separate sheet of paper they should write-out the algebra steps they would take to solve each problem, based only on the wording of their partners' explanation. They should discuss any explanations that are unclear with their partner.

Aligned Ready, Set, Go: Equations and Inequalities 4.3

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.3

4.3

| READY, SET, GO! | Name | Period | Date |

READY

Topic: Solving Inequalities.

Use the inequality $-9 < 2$ to complete each row in the table.

Apply each operation to the original inequality $-9 < 2$	Result	Is the resulting inequality true or false?
Example: Add 3 to both sides	-9+3 < 2+3 → -6 < 5	True
1. Subtract 7 from both sides.		
2. Add 15 to both sides.		
3. Add -10 to both sides.		
4. Multiply both sides by 10.		
5. Divide both sides by 5.		
6. Multiply both sides by -6.		
7. Divide both sides by -3.		

8. What operations when performed on an inequality, reverse the inequality? (Be very specific!)

SET

Topic: Solve literal equations that require more than one step.

Solve for the indicated variable. Show your work!!!

9. Solve for h. $\quad Q = 25\pi h$

10. Solve for h. $\quad Q = \pi r^2 h$

11. Solve for m. $\quad y = 7m + 6$

12. Solve for m. $\quad y = mx + b$

13. Solve for z. $\quad A = (z + 7)3$

14. Solve for z. $\quad A = (z + 7)w$

15. Solve for x. $\quad \frac{x+2}{7} = 4$

16. Solve for x. $\quad \frac{x+2y}{7} = 4$

17. Solve for x. $\quad \frac{2x}{5} - 9 = 6$

18. Solve for x. $\quad \frac{2x}{5} - 9y = 6$

19. Solve for x. $\quad \frac{3}{4}(x - 2) = 12$

20. Solve for x. $\quad \frac{3}{4}(x - 2y) = 12$

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GO

Topic: Identifying x-intercepts and y-intercepts

Locate the x-intercept and y-intercept in the table. Write each as an ordered pair.

21.

x	y
-4	12
-3	10
-2	8
-1	6
0	4
1	2
2	0

x – intercept:

y – intercept:

22.

x	y
0	-6
3	-5
6	-4
9	-3
12	-2
15	-1
18	0

x – intercept:

y – intercept:

23.

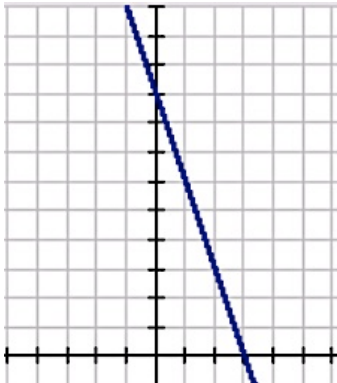| x	y
-3	10
-2	8
-1	6
0	4
1	2
2	0
3	-2

x – intercept:

y – intercept:

Locate the x-intercept and the y-intercept in the graph. Write each as an ordered pair.

24.

x – intercept:

y – intercept:

25.

x – intercept:

y – intercept:

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.3
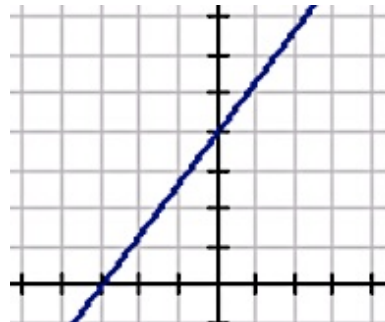
4.3

Solve each equation for x. Provide the justifications for each step. See the first example as a reminder for the types of justifications that might be used.

Example:

$3x - 6 = 15$	Justification
$+6 \quad +6$	Addition Property of equality
$\dfrac{3x}{3} = \dfrac{21}{3}$	Division Property of equality
$x = 7$	

26.

$4x - 10 = 2$	Justification

27.

$-16 = 3x + 11$	Justification

28.

$6 - 2x = 10$	Justification

29.

$6x + 3 = x + 18$	Justification

30.

$3x - 10 = 2x + 12$	Justification

31.

$12x + 3y = 15$	Justification

32.

$X(B + 7) = 9$	Justification

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4.4 Greater Than?

A Develop Understanding Task

For each situation you are given a mathematical statement and two expressions beneath it.

1. Decide which of the two expressions is greater, if the expressions are equal, or if the relationship cannot be determined from the statement.
2. Write an equation or inequality that shows your answer.
3. Explain why your answer is correct.

Watch out—this gets tricky!

Example:

Statement: $x = 8$

Which is greater? $x + 5$ or $3x + 2$

Answer: $3x + 2 > x + 5$ because if $x = 8, 3x + 2 = 26, x + 5 = 13$ and $26 > 13$.

Try it yourself:

1. Statement: $y < x$
   Which is greater? $x - y$ or $y - x$

2. Statement: $2x - 3 > 7$
   Which is greater? 5 or x

3. Statement: $10 - 2x < 6$
   Which is greater? x or 2

4. Statement: $4x \leq 0$
   Which is greater? 1 or x

5. Statement: n is an integer
   Which is greater? n or $-n$

6. Statement $x > y$
   Which is greater? $x + a$ or $y + a$

7. Statement: $x > y$
   Which is greater? $x - a$ or $y - a$

8. Statement: $5 > 4$
   Which is greater? $5x$ or $4x$

9. Statement: $5 > 4$
   Which is greater? $\dfrac{5}{x}$ or $\dfrac{4}{x}$

10. Statement: $0 < x < 10$ and $0 < y < 12$
    Which is greater? x or y

11. Statement: $3^{n+2} \geq 27$
    Which is greater? n or 1

4.4 Greater Than? – Teacher Notes

A Develop Understanding Task

Purpose: The purpose of this task is to challenge students to reason about inequality relationships and to develop an understanding of the properties of inequalities. Each problem requires reasoning about numbers, including negative numbers and fractions, and thinking mathematically about the various possibilities in the given problem situation.

Core Standards Focus:

A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.

a. Construct a viable argument to justify a solution method.

b. Solve equations and inequalities in one variable.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Mathematics I Note: *Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for.*

Standards for Mathematical Practice of Focus in the Task:

SMP 1 – Make sense of problems and persevere in solving them

SMP 2 – Reason abstractly and quantitatively

SMP 8 – Look for and express regularity in repeated reasoning

The Teaching Cycle:

Launch (Whole Class):

Explain to students that this task is a big logic puzzle. All of the problems require thinking about all the different possibilities to decide which expression is greater. There are some that cannot be determined from the information given. When that happens, students should write down what information they would need in order to have a definite answer for the question. (You may choose

not to tell students this in advance so that they have an opportunity to wrestle with the ideas and to justify their position.) Start by asking students to read the example given. To confirm the instructions, ask how they see the three required parts of the explanation in the answer. Next, refer students to problem #1. Give them a few minutes to answer and write their own explanation. Ask the class for their answers and explanations and model how to write an answer with a complete explanation. You may also want to model thinking about possible values for x and y, like: "If x is a negative number, then y must also be a negative number because it is less than x."

Explore (Small Group or Pairs): Monitor students as they work. Encourage them to think about the various possibilities for x and y in each case. Be sure that their written explanations adequately communicate their logic. Watch for problems that generate disagreement or difficulty for the class discussion. Also look for students' explanations that demonstrate sound mathematical logic or good communication to be highlighted in the discussion. If you notice a common misconception occurring during the exploration, plan to raise it as an issue in the discussion.

Discuss (Whole Class): Start the discussion with problems 6-9. Ask previously-selected students to give their explanations for each of these problems. Be sure that the explanations include example of both positive and negative numbers. Highlight for the class that these three problems are asking them to justify the properties of inequalities. Generally, students will have tested specific numbers and made generalizations about all numbers based upon the selected examples. Ask the class if they can create an argument as to why each property can be generalized to all real numbers. Write each of the properties of inequalities (addition, subtraction, multiplication, and division), and ask students to state them in their own words. After going through each of these, turn the discussion to any misconceptions or provocative problems that were selected during the exploration phase.

Aligned Ready, Set, Go Homework: Getting Ready 4.4

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.4

4.4

READY, SET, GO!   **Name**   **Period**   **Date**

READY

Topic: Write an equation from a context. Interpret notation for inequalities.

Write an equation that describes the story. Then answer the question asked by the story.

1. Virginia's Painting Service charges $10 per job and $0.20 per square foot. If Virginia earned $50 for painting one job, how many square feet did she paint at the job?

2. Renting the ice-skating rink for a party costs $200 plus $4 per person. If the final charge for Dane's birthday party was $324, how many people attended his birthday party?

Indicate if the following statements are <u>true</u> or <u>false</u>. Explain your thinking.

3. The notation $12 < x$ means the same thing as $x < 12$. It works just like $12 = x$ and $x = 12$.

4. The inequality $-2(x + 10) \geq 75$ says the same thing as $-2x - 20 \geq 75$. I can multiply by -2 on the left side without reversing the inequality symbol.

5. When solving the inequality $10x + 22 < 2$, the second step should say $10x > -20$ because I added -22 to both sides and I got a negative number on the right.

6. When solving the inequality $-5x \geq 45$, the answer is $x \leq -9$ because I divided both sides of the inequality by a negative number.

7. The words that describe the inequality $x \geq 100$ are "*x is greater than or equal to 100.*"

SET

Topic: Solve inequalities. Verify that given numbers are elements of the solution set.

Solve for x. (Show your work.) Indicate if the given value of x is an element of the solution set.

8. $2x - 9 < 3$

9. $4x + 25 > 13$

Is this value part $x = 6$; *yes*?   *no*?
of the solution set?

Is this value part $x = -5$; *yes*?   *no*?
of the solution set?
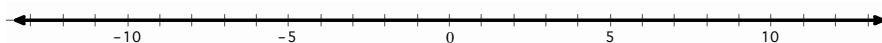
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10. $6x - 4 \leq -28$

Is this value part of the solution set? $x = -10; \; yes?$ $no?$

11. $3x - 5 \geq -5$

Is this value part of the solution set? $x = 1; \; yes?$ $no?$

Solve each inequality and graph the solution on the number line.
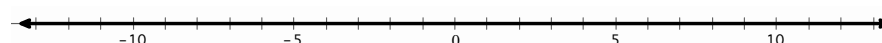
12. $x + 9 \leq 7$
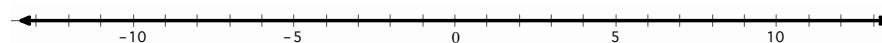
13. $-3x - 4 > 2$
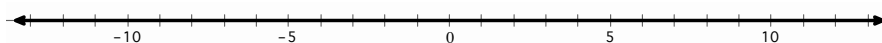
14. $3x < -6$

15. $\frac{x}{5} > -\frac{3}{10}$

16. $-10x > 150$
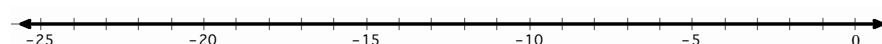
17. $\frac{x}{-7} \geq -5$
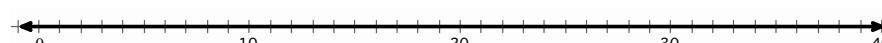
Solve each multi-step inequality.

18. $x - 5 > 2x + 3$

19. $\frac{3(x-4)}{12} \leq \frac{2x}{3}$

20. $2(x - 3) \leq 3x - 2$

GO

Topic: Use substitution to solve linear systems

Solve each system of equations by using substitution.

Example: $\begin{cases} y = 12 \\ 2x - y = 14 \end{cases}$

The first equation states that $y = 12$. That information can be used in the second equation to find the value of x by replacing y with 12. The second equation now says $2x - (12) = 14$. Solve this new equation by adding 12 to both sides and then dividing by 2. The result is x = 13.

21. $\begin{cases} y = 5 \\ -x + y = 1 \end{cases}$

22. $\begin{cases} x = 8 \\ 5x + 2y = 0 \end{cases}$

23. $\begin{cases} 2y = 10 \\ 4x - 2y = 50 \end{cases}$

24. $\begin{cases} 3x = 12 \\ 4x - y = 5 \end{cases}$

25. $\begin{cases} y = 2x - 5 \\ y = x + 8 \end{cases}$

26. $\begin{cases} 3x = 9 \\ 5x + y = -5 \end{cases}$

4.5 May I Have More, Please?

A Solidify Understanding Task

Elvira, the cafeteria manager, has to be careful with her spending and manages the cafeteria so that they can serve the best food at the lowest cost. To do this, Elvira keeps good records and analyzes all of her budgets.

1. Elvira's cafeteria has those cute little cartons of milk that are typical of school lunch. The milk supplier charges $0.35 per carton of milk, in addition to a delivery charge of $75. What is the maximum number of milk cartons that Elvira can buy if she has budgeted $500 for milk?

    a. Write and solve an inequality that models this situation.

    b. Describe in words the quantities that would work in this situation.

    c. Write your answer in both interval and set notation.

2. Students love to put ranch dressing on everything, so Elvira needs to keep plenty in stock. The students eat about 2.25 gallons of ranch each day! Elvira started the school year with 130 gallon of ranch dressing. She needs to have at least 20 gallons left when she reorders to have enough in stock until the new order comes. For how many days will her ranch dressing supply last before she needs to reorder?

    a. Write and solve an inequality that models this situation.

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    b.   Describe in words the quantities that would work in this situation.

    c.   Write your answer in both interval and set notation.

3.   The prices on many of the cafeteria foods change during the year. Elvira finds that she has ordered veggie burgers four times and paid $78, $72, $87, and $90 on the orders. To stay within her budget, Elvira needs to be sure that the average order of veggie burgers is not more than $82. How much can she spend on the fifth order to keep the average order within her budget?

    a.   Write and solve an inequality that models this situation.

    b.   Describe in words the quantities that would work in this situation.

    c.   Write your answer in both interval and set notation.

4.   Elvira can purchase ready-made pizzas for $14.50 each. If she makes them in the cafeteria, she can spend $44.20 on ingredients and $6.25 per pizza on labor. For how many pizzas is it cheaper for the cafeteria to make the pizzas themselves rather than buy them ready-made?

    a.   Write and solve an inequality that models this situation.

    b.   Describe in words the quantities that would work in this situation.

    c.   Write your answer in both interval and set notation.

5. Elvira is comparing prices between two different suppliers of fresh lettuce. Val's Veggies charges $250 for delivery plus $1.50 per bag of lettuce. Sally's Salads charges $100 for delivery plus $4.00 per bag of lettuce. How many bags of lettuce must be purchased for Val's Veggies to be the cheaper option?

    a. Write and solve an inequality that models this situation.

    b. Describe in words the quantities that would work in this situation.

    c. Write your answer in both interval and set notation.

6. Each student that buys school lunch pays $2.75. The cafeteria typically brings in between $1168.75 and $1438.25. How many students does the cafeteria usually serve?

    a. Model this situation using an inequality.

    b. Describe in words the quantities that would work in this situation.

    c. Write your answer in both interval and set notation.

4. 5 May I Have More, Please? – Teacher Notes
A *Solidify Understanding Task*

Purpose: The purpose of this task is to for students to solidify their understanding of how to use and solve inequalities. The task gives students a number of situations and asks them to write inequalities to model the situations. Students will use the properties of inequalities, along with applying their experience in solving equations to solve the inequalities and answer the questions. Students will also work with both interval and set notation to write their solutions. They have previously used these two notations to write the domain and range for functions. The notation should be familiar, but this is a slightly different purpose for using it than students have seen. In each case, students are asked to state their solution in words before writing it using both set builder and interval notation so that they will relate the notation to the range of solutions.

Core Standards Focus:

A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.
a. Construct a viable argument to justify a solution method.
b. Solve equations and inequalities in one variable.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Mathematics I Note: *Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for.*

Standards for Mathematical Practice of Focus in the Task:
SMP 2 – Reason abstractly and quantitatively
SMP 4 – Model with mathematics

Teaching Cycle

Launch (Whole Class):

Read the initial story context about Elvira, the cafeteria manager, and the problem situation given in #1. Ask students to write a model for the amount paid for milk, which will be: $0.35x + 75$. Ask students how they can use the inequality symbols to show that the amount paid for milk cannot be more than \$500. Discuss why the inequality would be written as: $0.35x + 75 \leq 500$. Walk students through the solution of the inequality, asking them to justify each step using one of the properties of inequalities.

$$0.35x + 75 \leq 500$$
$$0.35x \leq 425$$
$$x \leq 1214.29$$

This context requires interpreting the algebraic solution. First, since Elvira can't purchase a fraction of a milk carton, the maximum number she could purchase would be 1214. Next, discuss with the students that the range of numbers of implied by the solution $x \leq 1214.29$ includes negative numbers, which don't make sense in this context. Ask students to describe the actual solution in words, which should be something like: from 0 to 1214 cartons of milk. Then, model using and reading both notations:

Interval notation: $[0,1214]$

Set builder notation: $\{x| \, 0 \leq x \leq 1214\}$

Explore (Small Group):

Encourage students to continue with the rest of the situations. Listen as they are working to see that they understand the contexts and are interpreting their solutions to match the situation given. Watch students as they make sense of problem #6, which could be written as a compound inequality or as two inequalities. Most students will not have experience in solving compound inequalities, but look for productive approaches that can be leveraged during the class discussion.

Discuss (Whole Class):

Begin the discussion with problem #2. Select a student that has written the equation:

$130 - 2.25x \geq 20$. Ask students to explain how they decided to use $\geq$ or $\leq$. Ask the students to show how they solved the inequality and justify their steps. Be sure to highlight the fact that if they divide by -2.25, they need to reverse the inequality.

If time permits, you may ask students to present problems #3 and #4, but be sure to leave time to discuss problems #5 and #6. Problem #5 leads to variables on both sides of the inequality, which adds a bit of algebraic complexity to work through. Problem 6 presents a compound inequality or two inequalities. If both approaches are available in the class, have them both presented and ask the class to compare the approaches so that students see that a compound inequality of this form combines two conditions that must both be met.

Aligned Ready, Set, Go: Equations and Inequalities 4.5

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES – 4.5

4.5

READY, SET, GO!	Name	Period	Date

READY

Topic: Interpret phrases that imply an inequality.

Rewrite the given "word sentence" as a "math sentence." Each math sentence will use one of the following symbols: $>$, $<$, $\leq$, $\geq$. Use "x" in place of the number.

	Word Sentence	Math Sentence
Example:	I am thinking of a number that is greater than 13.	$x > 13$
1.	I am thinking of a number that is at least 13.	
2.	I am thinking of a number that is no fewer than 13.	
3.	I am thinking of a number that does not exceed 13.	
4.	I am thinking of a number that is at most 13.	
5.	I am thinking of a number that is no more than 13.	
6.	I am thinking of a number that is fewer than 13.	
7.	I am thinking of a number that is not above 13.	
8.	I am thinking of a number that is less than 13.	
9.	I am thinking of a number that is not under 13.	
10.	I am thinking of a number that is not greater than 13.	

SET

Topic: Write and solve inequalities from a context.

11.   To take sweepstakes for the largest pumpkin crop at the Riverside County Fair, the average weight of Ethan's two pumpkins must be greater than 875 lbs. One of his pumpkins weighs 903 lbs. What is the least amount of pounds the second pumpkin could weigh in order for Ethan to win the prize?

    a)   Write an inequality that models this situation. Be sure to define your variables.

    b)   Describe in words the quantities that would work in this situation.

    c)   Write your answer in both interval and set notation.

12.   The average of Aaron's three test scores must be at least 93 to earn an A in the class. Aaron scored 89 on the first test and 94 on the second test. What scores can Aaron get on his third test to guarantee an A in the class? (The highest possible score is 100.)

    a)   Write and solve an inequality that models this situation. Be sure to define your variables.

    b)   Describe in words the quantities that would work in this situation.

    c)   Write your answer in both interval and set notation.

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13. A cell phone company offers a plan that costs $35.99 and includes unlimited texting. Another company offers a plan that costs $19.99 and charges $0.25 per text. For what number of texts does the second company's plan cost more than the first company's plan?

    a) Write and solve an inequality that models this situation. Be sure to define your variables.

    b) Describe in words the quantities that would work in this situation.

    c) Write your answer in both interval and set notation.

GO

Topic: Use substitution to solve linear systems

Solve each system of equations by using substitution.

Example: $\begin{cases} y = x + 3 \\ 2x - y = 14 \end{cases}$

The first equation states that $y = x + 3$. That information can be used in the second equation to find the value of x by replacing y with $x + 3$. The second equation now says $2x - (x + 3) = 14$. Solve this new equation by first distributing the negative over $(x + 3)$. The new equation will be $2x - x - 3 = 14$. Combine like terms. You will get the equivalent equation $x - 3 = 14$. Add 3 to both sides. You should get $x = 17$. But you still don't know the value of y. Now that you know the value of x, you can use either equation to figure out the value of y. Since the first equation is simpler, you may want to substitute the known value of x (recall that $x = 17$) into it. It should be easy to see what y equals. $y = (17) + 3 = 20$.

21. $\begin{cases} y = x + 5 \\ 2x + y = -1 \end{cases}$ 22. $\begin{cases} x = y - 1 \\ 5x + 2y = 9 \end{cases}$

23. $\begin{cases} y = 10 - x \\ 4x - 2y = 40 \end{cases}$ 24. $\begin{cases} x = 1 + y \\ 4x - y = 7 \end{cases}$

4.6 Taking Sides

A Practice Understanding Task

Joaquin and Serena work together productively in their math class. They both contribute their thinking and when they disagree, they both give their reasons and decide together who is right. In their math class right now, they are working on inequalities. Recently they had a discussion that went something like this:

Joaquin: The problem says that "6 less than a number is greater than 4." I think that we should just follow the words and write: $6 - n > 4$.

Serena: I don't think that works because if n is 20 and you do 6 less than that you get 20 – 6 = 14. I think we should write $n - 6 > 4$

Joaquin: Oh, you're right. Then it makes sense that the solution will be $n > 10$, which means we can choose any number greater than 10.

The situations below are a few more of the disagreements and questions that Joaquin and Serena have. Your job is to decide how to answer their questions, decide who is right, and give a mathematical explanation of your reasoning.

1. Joaquin and Serena are assigned to graph the inequality $x \geq -7$.
   Joaquin thinks the graph should have an open dot -7.
   Serena thinks the graph should have a closed dot at -7.
   Explain who is correct and why.

2. Joaquin and Serena are looking at the problem $3x + 1 > 0$.
   Serena says that the inequality is always true because multiplying a number by three and then adding one to it makes the number greater than zero.
   Is she right? Explain why or why not.

3. The word problem that Joaquin and Serena are working on says, "4 greater than x".
    Joaquin says that they should write: $4 > x$.
    Serena says they should write: $4 + x$
    Explain who is correct and why.

4. Joaquin is thinking hard about equations and inequalities and comes up with this idea:
    If $45 + 47 = t$, then $t = 45 + 47$.
    So, if $45 + 47 < t$, then $t < 45 + 47$.
    Is he right? Explain why or why not.

5. Joaquin's question in #4 made Serena think about other similarities and differences in equations and inequalities. Serena wonders about the equation $-\dfrac{x}{3} = 4$ and the inequality $-\dfrac{x}{3} > 4$. Explain to Serena ways that solving these two problems are alike and ways that they are different. How are the solutions to the problems alike and different?

6. Joaquin solved $-15q \leq 135$ by adding 15 to each side of the inequality. Serena said that he was wrong. Who do you think is right and why?

    Joaquin's solution was $q \leq 150$. He checked his work by substituting 150 for q in the original inequality. Does this prove that Joaquin is right? Explain why or why not.

    Joaquin is still skeptical and believes that he is right. Find a number that satisfies his solution but does not satisfy the original inequality.

7.   Serena is checking her work with Joaquin and finds that they disagree on a problem. Here's
        what Serena wrote: $3x + 3 \leq -2x + 5$
                                                   $3x \leq -2x + 2$
                                                   $x \leq 2$

        Is she right? Explain why or why not?

8.   Joaquin and Serena are having trouble solving $-4(3m - 1) \geq 2(m + 3)$
        Explain how they should solve the inequality, showing all the necessary steps and
        identifying the properties you would use.

9.   Joaquin and Serena know that some equations are true for any value of the variable and
        some equations are never true, no matter what value is chosen for the variable. They are
        wondering about inequalities. What could you tell them about the following inequalities?
        Do they have solutions? What are they? How would you graph their solutions on a number
        line?

        a. $4s + 6 \geq 6 + 4s$

        b. $3r + 5 > 3r - 2$

        c. $4(n + 1) < 4n - 3$

10.   The partners are given the literal inequality $ax + b > c$ to solve for x. Joaquin says that he
        will solve it just like an equation. Serena says that he needs to be careful because if a is a
        negative number, the solution will be different. What do you say? What are the solutions
        for the inequality?

4.6 Taking Sides – Teacher Notes

A Practice Understanding Task

Purpose: The purpose of this task is to practice the reasoning and solving of inequalities. Many common misconceptions and mistakes made when solving inequalities are addressed in the task. Students are asked to think about the differences and similarities in solving inequalities versus solving equations, including that most inequalities produce a range of solutions, that the inequality sign must be turned when multiplying or dividing by a negative number, and that the reflexive property holds only for equations.

Core Standards:
A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.
a. Construct a viable argument to justify a solution method.
b. Solve equations and inequalities in one variable.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Mathematics I Note: *Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for.*

Standards for Mathematical Practice of Focus in the Task:

SMP 3 - Construct viable arguments and critique the reasoning of others.

SMP6 - Attend to precision.

The Teaching Cycle:

Essential Question for Students: *What are some of the common misconceptions of inequalities?*

Launch (Whole Class):
Hand out the worksheet and go over the scenario given about Joaquin and Serena. Ask a student to demonstrate Serena's argument that changed Joaquin's mind. Start with #1, giving students about 3 minutes to answer the question individually, writing their best explanation in complete

sentences. Ask a student to read their explanation and then model a thorough answer on the board. The explanation should be something like:

> *The inequality $x \geq -7$ should be graphed with a closed dot on -7 and all points to the right of -7 filled in. This is because the symbol ≥ means greater than or equal to, so -7 is a solution to the inequality. The closed dot on -7 shows that the number is included in the solution set. An open dot would indicate that -7 is not a solution.*

Next, ask the class to think about #2. Give students a few minutes to talk to their neighbor about their reasoning and then ask them to write individually for a few minutes. While they are working, circulate through the room to find an exemplar to use with the class. It is important that students are first considering the logic of why Serena believes the inequality to always be true. Then, students should recognize that she is only considering nonnegative numbers. Be sure that both parts of the argument are discussed to model the thinking process that will be required throughout the task and also what a complete answer will look like.

Explore (Small Group):

Let students work on the remainder of the task as you monitor their thinking. Throughout the task, students will be challenged to consider whether the strategies that they have learned for equations will apply to inequalities. If you find that some groups are spending excessive time on a problem, redirect their focus to problems 4, 5, 7, and 8, which will be the focus of the whole group discussion. Identify a group to present one of each of these problems.

Discuss (Whole Group):

Start the discussion with the presentation of problem #4. Be sure that the group identifies that if the two sides of an equation are switched, the equation remains true. Their explanation should also include the idea that if the sides of an inequality are switched, then the inequality sign must be turned. Ask the group to demonstrate this thinking by substituting numbers into the inequality for x. Remind students that this often comes up because the solutions to inequalities are conventionally written with the variable on the left side of the inequality. So, an expression like $4 < x$ is routinely converted to $x > 4$.

Next, move the discussion to #5. Again, students are asked to consider the difference between solving an equation and solving an inequality. The explanation from the group should include the

idea that the steps in solving the equation and the inequality are the same. The only difference is that the inequality sign must be turned when multiplying by -3. Press students to explain why that rule holds, rather than simply stating the rule.

The explanation of #7 should include showing all the proper steps in the solution of the inequality. As students demonstrate the problem, they will see that Serena did not properly add 2x to both sides of the inequality. Ask students why this inequality seemed to be solved exactly like an equation, but other inequalities do not.

Close the discussion with question #8. Emphasize the reasons for each step and compare the properties of inequalities with the properties of equations.

Aligned Ready, Set, Go: Equations and Inequalities 4.6

SECONDARY MATH I // MODULE 4

SOLVING EQUATIONS AND INEQUALITIES - 4.6

4.6

READY

Topic: Solving equations and inequalities from a context.

Write the given situation as an equation or inequality and then solve it.

1. The local amusement park sells summer memberships for $50 each. Normal admission to the park costs $25; admission for members costs $15.

    a. If Darren wants to spend no more than $100 on trips to the amusement park this summer, how many visits can he make if he buys a membership with part of that money?

    b. How many visits can he make if he pay normal admission instead?

    c. If he increases his budget to $160, how many visits can he make as a member?

    d. How many can he make as a non-member with the increased budget of $160?

2. Jade just took a math test with 20 questions, each question is worth an equal number of points. The test is worth 100 points total.

    a. Write an equation that can be used to calculate Jade's score based on the number of questions she got right on the test.

    b. If a score of 70 points earns a grade of *C-*, how many questions would Jade need to get right to get at least a *C-* on the test?

    c. If a score of 83 points earns a grade of *B*, how many questions would Jade need to get right to get at least a *B* on the test?

    d. Suppose Jade got a score of 60% and then was allowed to retake the test. On the retake, she got all the questions right that she got right the first time, and also got half the questions right that she got wrong the first time. What percent of the questions did Jade get right, in total, on the retake?

4.6

SET

Topic: Solve and justify one variable inequalities

Solve each inequality, justifying each step you use.

3.

$-5x < 35$	Justification

4.

$x + 68 \geq 75$	Justification

5.

$2x - 4 \leq 10$	Justification

6.

$5 - 4x \leq 17$	Justification

7.

$\dfrac{x}{-3} > -\dfrac{10}{9}$	Justification

8.

$2(x - 3) \leq 3x - 2$	Justification

Solve each inequality and graph the solution on the number line.

9. $x - 8 > -20$
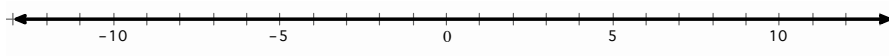
10. $x + 11 > 13$
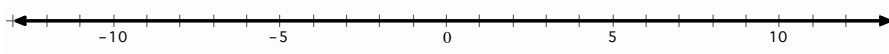
Solve each multi-step inequality.

11. $4x + 3 < -1$

12. $4 - 6x \leq 2(2x + 3)$

13. $5(4x + 3) \geq 9(x - 2) - x$

14. $\frac{2}{3}x - \frac{1}{2}(4x - 1) \geq x + 2(x - 3)$

Topic: Solve literal equations

15. Solve the following equation for C: $F = \frac{9}{5}C + 32$

16. Given $V = \frac{1}{3}\pi r^2 h,$ rewrite the formula to isolate the variable r.

17. The area formula of a regular polygon is $A = \frac{1}{2}Pa.$ The variable a represents the apothem and P represents the perimeter of the polygon. Solve the equation for the apothem, $a.$

18. The equation $y = mx + b$ is the equation of a line. Isolate the variable b.

19. The equation for the circumference c of a circle with radius r is $c = 2\pi r$.
    Solve the equation for the radius, r.

20. The equation for the area of a circle A based on diameter d is $A = \pi \dfrac{d^2}{4}$.
    Solve the equation to isolate the diameter, d.

GO

Topic: Solve systems of equations by graphing

Graph both lines on the same coordinate grid. Identify the point of intersection. Then test the x and y values of the point of intersection in the two equations.

21. $\begin{cases} y = 2x + 5 \\ -x + y = 1 \end{cases}$

22. $\begin{cases} 10 + y = 3x \\ 2x + y = 0 \end{cases}$

23. $\begin{cases} x + y = 9 \\ x - y = -7 \end{cases}$