MATHCLEARGUIDE

Solving Multi-Step Inequalities

Algebra 1 · Inequalities, Unit 2 · Lesson 1 · Grades 9-10

11 pages · Worksheets + Answer Key

Standard: A-REI.B.3, A-REI.A.1

3x + 5 < 20 gives x < 5



Open circle at 5. The shade is the answer.

Teacher Guide

Solving Multi-Step Inequalities · Algebra 1 · A-REI.B.3, A-REI.A.1

WHAT IS INSIDE

Page 3 holds the Flip or No Flip task cards: 8 cards to cut apart, each stopped at the step before the division, with the divisor waiting. Pages 4 to 6 are the practice pages: multi-step inequalities with no flip, then the flip page, then a mixed page with short stories. Filled in key copies of all four student pages sit at the end.

SKILL AND STANDARD

Standard A-REI.B.3: "Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters." This lesson teaches the inequality half. Standard A-REI.A.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." The text names equations. The habit is carried to inequalities here: every worked example names the property beside the step, names the flip where it fires, and checks with two test values.

HOW TO USE IT

1. Teach with the slide deck first, or start with the Flip or No Flip cards on page 3 in pairs. About 50 minutes for the whole lesson.

2. Cut the cards before the lesson. Each pair needs one set. Pupils mark flip or no flip before they touch the numbers, and two cards are traps.

3. Pages 4 to 6 also work alone: morning work, math block, intervention, homework, sub plans or review.

4. Mark from the filled in key copies at the end of this file. Every key shows the steps, the property, the drawn graph and both test values.

THE HONEST LINE

This unit is the Reasoning with Equations and Inequalities strand of Algebra 1 (A-REI), with Creating Equations (A-CED) beside it on the writing pages. This lesson claims the inequality half of A-REI.B.3 and the justifying habit of A-REI.A.1, carried from equations to inequalities. One honest line: this unit teaches one variable inequalities in depth. Quadratic inequalities, rational inequalities, absolute value equations and systems of inequalities wait for their own Algebra 1 units, and no page here repeats the solving equations unit or the Grade 6 inequalities lesson.

WHERE THIS GOES NEXT

The four lessons that follow take this one skill the rest of the way. Compound Inequalities teaches the two joins, and and or, where two conditions share one variable and the answer is an overlap on the line or a pair of rays walking apart. Variables on Both Sides brings the gathering move from equations into inequalities, and reads the two endings that are not rays at all, no solution and every number. Absolute Value Inequalities starts from distance, the one idea the bars have always meant, and splits each problem into the compound work of the lesson before it. Word Problems teaches the writing itself, from budgets, wages and test scores, and closes with one first look at systems of inequalities. Each paid lesson teaches its own slice in full, with the same named steps, the same drawn graphs and the same two test checks.

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Flip or No Flip Task Cards

Name: _____ Date: _____ Class: _____

Cut the cards apart. Work in pairs. Each card stops at the step before the division, with the divisor waiting. Mark flip or no flip before you touch the numbers, write the reason, then solve, graph and check with one test value.

CARD 1

3x < 15

Next move: divide both sides by 3.

Flip / No flip (circle one)

Reason: _____



Check: _____

CARD 2

-3x < 12

Next move: divide both sides by -3.

Flip / No flip (circle one)

Reason: _____



Check: _____

CARD 3

2x ≥ 14

Next move: divide both sides by 2.

Flip / No flip (circle one)

Reason: _____



Check: _____

CARD 4

-4x ≤ 12

Next move: divide both sides by -4.

Flip / No flip (circle one)

Reason: _____



Check: _____

CARD 5

6x < 18

Next move: divide both sides by 6.

Flip / No flip (circle one)

Reason: _____



Check: _____

Trap: the line subtracts a negative. That is not the divisor. Look at the divisor and its sign only.

CARD 6

-1 / 2x < 3

Next move: divide both sides by -1/2.

Flip / No flip (circle one)

Reason: _____



Check: _____

Trap: the divisor is a negative fraction. A small divisor can still be negative, and the flip still fires.

CARD 7

5x > 25

Next move: divide both sides by 5.

Flip / No flip (circle one)

Reason: _____



Check: _____

CARD 8

-2x ≥ 12

Next move: divide both sides by -2.

Flip / No flip (circle one)

Reason: _____



Check: _____

No Flip Anywhere

Same moves as equations. Positive divisors only, so the sign never flips.

Name: _____ Date: _____ Class: _____

REMEMBER

Worked in full: 4x + 3 < 19. Every move named, both test values checked, the graph drawn.

4x + 3 < 19 then 4x < 16 (subtraction property of inequality) then x < 4 (division property of inequality)



Check the boundary: put x = 4 in the original: 4(4) + 3 < 19, and 19 < 19 is false. The boundary is not a solution, so its circle stays open.

Check the shade: put x = 3 in the original: 4(3) + 3 < 19, and 15 < 19 is true. The shade runs the right way.

1. **2x + 3 < 11**



Answer: _____

2. **3x + 5 ≤ 20**



Answer: _____

3. **4x - 6 < 18**



Answer: _____

4. **5x + 2 > 27**



Answer: _____

5. **x / 2 + 3 < 8**



Answer: _____

6. **x / 4 + 1 ≤ 4**



Answer: _____

7. **2(x + 3) < 16**



Answer: _____

8. **3x + 2x + 4 < 24**



Answer: _____

9. **6x - 5 ≥ 19**



Answer: _____

10. **x / 3 - 1 > 4**



Answer: _____

11. **4x + 9 < 33**



Answer: _____

12. **2x + 3x - 5 ≤ 20**



Answer: _____

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The Flip Page

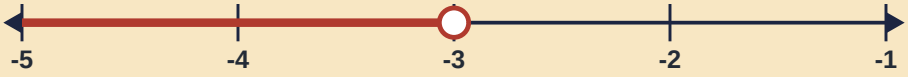
Circle the divisor and its sign before you divide. A negative divisor flips the sign.

Name: _____ Date: _____ Class: _____

REMEMBER

Worked in full: -2x + 5 > 11. The flip fires on the last line, where the division by a negative happens.

-2x + 5 > 11 then -2x > 6 (subtraction property of inequality) then x <-3 (division property, sign flips)



Check the boundary: put x = -3 in the original: -2(-3) + 5 > 11, and 11 > 11 is false. The boundary is not a solution, so its circle stays open.

Check the shade: put x = -4 in the original: -2(-4) + 5 > 11, and 13 > 11 is true. The shade runs the right way.

1. **-2x + 4 < 12**



Answer: _____

2. **-3x - 5 > 10**



Answer: _____

3. **-4x + 7 ≤ 31**



Answer: _____

4. **-5x - 2 ≥ 18**



Answer: _____

5. **x / (-2) + 3 < 7**



Answer: _____

6. **2(-1x + 4) < 10**



Answer: _____

7. **-6x + 9 > 27**



Answer: _____

8. **3(-2x + 1) ≥ 15**



Answer: _____

9. **-1x + 5 < 9**



Answer: _____

10. **-4x - 8 > 16**



Answer: _____

11. **x / (-4) - 2 ≤ 3**



Answer: _____

12. **-7x + 2 < 37**



Answer: _____

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Mixed Moves and Short Stories

Name: _____ Date: _____ Class: _____

REMEMBER

Worked in full: 2(x + 4) + 3x < 28. Open the brackets, gather, then solve.

2(x + 4) + 3x < 28 then 2x + 8 + 3x < 28 (expand the brackets) then 5x + 8 < 28 (combine like terms) then 5x < 20 (subtraction property of inequality) then x < 4 (division property of inequality)



Check the boundary: put x = 4 in the original: 2((4) + 4) + 3(4) < 28, and 28 < 28 is false. The boundary is not a solution, so its circle stays open.

Check the shade: put x = 3 in the original: 2((3) + 4) + 3(3) < 28, and 23 < 28 is true. The shade runs the right way.

1. **2(3x + 4) - 5 < 25**



Answer: _____

2. **4x + 3x - 6 ≥ 22**



Answer: _____

3. **(1 / 2)x + 3 < 9**



Answer: _____

4. **3(x - 2) + 2x > 19**



Answer: _____

5. **-2(x + 3) + 10 < 4**



Answer: _____

CHALLENGE

Solve 4x + 7 > 18. The boundary is a fraction between two whole numbers. Show every step, the graph and both checks.

6. Mina has a 15 gigabyte data cap. She has used 7 gigabytes. Each video uses about 2 gigabytes. How many more videos can she watch at most? Let x = the number of videos.

Inequality: _____

Answer: _____



7. Leo has $40 saved and earns $9 an hour at a cafe. He wants at least $130 for a bike. How many whole hours must he work? Let x = the number of hours.

Inequality: _____

Answer: _____



8. Sara has 156 points. Each extra quiz adds 8 points. She needs at least 240 points in all. How many whole quizzes does she need? Let x = the number of quizzes.

Inequality: _____

Answer: _____



9. A gym charges $25 to join plus $6 a class. Tom can spend at most $85 in all. How many classes can he take? Let x = the number of classes.

Inequality: _____

Answer: _____



10. Ana has $60 saved toward a $180 phone. She saves $15 more each week. How many whole weeks until she has at least enough? Let x = the number of weeks.

Inequality: _____

Answer: _____



Flip or No Flip Task Cards

Name: _____ Date: _____ Class: _____

Cut the cards apart. Work in pairs. Each card stops at the step before the division, with the divisor waiting. Mark flip or no flip before you touch the numbers, write the reason, then solve, graph and check with one test value.

CARD 1

3x < 15

Next move: divide both sides by 3.

No flip **Reason: the divisor is positive.**

Answer: x < 5



Boundary 5: 20 < 20 is false. Shade 4: 17 < 20 is true.

CARD 2

-3x < 12

Next move: divide both sides by -3.

Flip **Reason: the divisor is negative.**

Answer: x > -4



Boundary -4: 14 < 14 is false. Shade -3: 11 < 14 is true.

CARD 3

2x ≥ 14

Next move: divide both sides by 2.

No flip **Reason: the divisor is positive.**

Answer: x ≥ 7



Boundary 7: 10 ≥ 10 is true. Shade 8: 12 ≥ 10 is true.

CARD 4

-4x ≤ 12

Next move: divide both sides by -4.

Flip **Reason: the divisor is negative.**

Answer: x ≥ -3



Boundary -3: 18 ≤ 18 is true. Shade -2: 14 ≤ 18 is true.

CARD 5

6x < 18

Next move: divide both sides by 6.

No flip **Reason: the divisor is positive.**

Answer: x < 3



Boundary 3: 21 < 21 is false. Shade 2: 15 < 21 is true.

CARD 6

-1 / 2x < 3

Next move: divide both sides by -1/2.

Flip **Reason: the divisor is negative.**

Answer: x > -6



Boundary -6: 4 < 4 is false. Shade -5: 7/2 < 4 is true.

CARD 7

5x > 25

Next move: divide both sides by 5.

No flip **Reason: the divisor is positive.**

Answer: x > 5



Boundary 5: 32 > 32 is false. Shade 6: 37 > 32 is true.

CARD 8

-2x ≥ 12

Next move: divide both sides by -2.

Flip **Reason: the divisor is negative.**

Answer: x ≤ -6



Boundary -6: 9 ≥ 9 is true. Shade -7: 11 ≥ 9 is true.

No Flip Anywhere

Name: _____ Date: _____ Class: _____

REMEMBER

Worked in full: 4x + 3 < 19 then 4x < 16 (subtraction property) then x < 4 (division property). Boundary 4: 19 < 19 is false. Shade 3: 15 < 19 is true.



1. 2x + 3 < 11 then 2x < 8 (subtraction property) then x < 4 (division property)



Boundary 4: 11 < 11 is false. Shade 3: 9 < 11 is true. Answer: x < 4.

2. 3x + 5 ≤ 20 then 3x ≤ 15 (subtraction property) then x ≤ 5 (division property)



Boundary 5: 20 ≤ 20 is true. Shade 4: 17 ≤ 20 is true. Answer: x ≤ 5.

3. 4x - 6 < 18 then 4x < 24 (addition property) then x < 6 (division property)



Boundary 6: 18 < 18 is false. Shade 5: 14 < 18 is true. Answer: x < 6.

4. 5x + 2 > 27 then 5x > 25 (subtraction property) then x > 5 (division property)



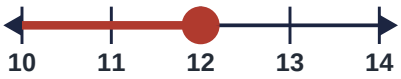
Boundary 5: 27 > 27 is false. Shade 6: 32 > 27 is true. Answer: x > 5.

5. x / 2 + 3 < 8 then (x / 2 + 3) x 2 < 16 (multiplication property) then x + 6 < 16 (expand the brackets) then x < 10 (subtraction property)



Boundary 10: 8 < 8 is false. Shade 9: 15/2 < 8 is true. Answer: x < 10.

6. x / 4 + 1 ≤ 4 then (x / 4 + 1) x 4 ≤ 16 (multiplication property) then x + 4 ≤ 16 (expand the brackets) then x ≤ 12 (subtraction property)



Boundary 12: 4 ≤ 4 is true. Shade 11: 15/4 ≤ 4 is true. Answer: x ≤ 12.

7. 2(x + 3) < 16 then 2x + 6 < 16 (expand the brackets) then 2x < 10 (subtraction property) then x < 5 (division property)



Boundary 5: 16 < 16 is false. Shade 4: 14 < 16 is true. Answer: x < 5.

8. 3x + 2x + 4 < 24 then 5x + 4 < 24 (combine like terms) then 5x < 20 (subtraction property) then x < 4 (division property)



Boundary 4: 24 < 24 is false. Shade 3: 19 < 24 is true. Answer: x < 4.

9. 6x - 5 ≥ 19 then 6x ≥ 24 (addition property) then x ≥ 4 (division property)



Boundary 4: 19 ≥ 19 is true. Shade 5: 25 ≥ 19 is true. Answer: x ≥ 4.

10. x / 3 - 1 > 4 then (x / 3 - 1) x 3 > 12 (multiplication property) then x - 3 > 12 (expand the brackets) then x > 15 (addition property)



Boundary 15: 4 > 4 is false. Shade 16: 13/3 > 4 is true. Answer: x > 15.

11. 4x + 9 < 33 then 4x < 24 (subtraction property) then x < 6 (division property)



Boundary 6: 33 < 33 is false. Shade 5: 29 < 33 is true. Answer: x < 6.

12. 2x + 3x - 5 ≤ 20 then 5x - 5 ≤ 20 (combine like terms) then 5x ≤ 25 (addition property) then x ≤ 5 (division property)



Boundary 5: 20 ≤ 20 is true. Shade 4: 15 ≤ 20 is true. Answer: x ≤ 5.

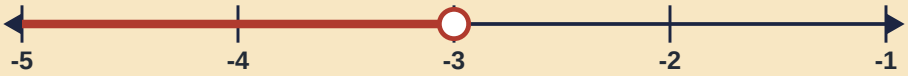
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The Flip Page

Name: _____ Date: _____ Class: _____

REMEMBER

Worked in full: -2x + 5 > 11 then -2x > 6 (subtraction property) then x <-3 (division property, sign flips). Boundary -3: 11 > 11 is false. Shade -4: 13 > 11 is true.



1. **-2x + 4 < 12 then -2x < 8 (subtraction property) then x >-4 (division property, sign flips)**



Boundary -4: 12 < 12 is false. Shade -3: 10 < 12 is true. Answer: x > -4.

2. **-3x - 5 > 10 then -3x > 15 (addition property) then x <-5 (division property, sign flips)**



Boundary -5: 10 > 10 is false. Shade -6: 13 > 10 is true. Answer: x < -5.

3. **-4x + 7 ≤ 31 then -4x ≤ 24 (subtraction property) then x ≥-6 (division property, sign flips)**



Boundary -6: 31 ≤ 31 is true. Shade -5: 27 ≤ 31 is true. Answer: x ≥ -6.

4. **-5x - 2 ≥ 18 then -5x ≥ 20 (addition property) then x ≤-4 (division property, sign flips)**



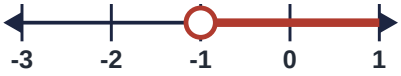
Boundary -4: 18 ≥ 18 is true. Shade -5: 23 ≥ 18 is true. Answer: x ≤ -4.

5. **x / (-2) + 3 < 7 then -1 / 2x < 4 (subtraction property) then x >-8 (division property, sign flips)**



Boundary -8: 7 < 7 is false. Shade -7: 13/2 < 7 is true. Answer: x > -8.

6. **2(-1x + 4) < 10 then -2x + 8 < 10 (expand the brackets) then -2x < 2 (subtraction property) then x >-1 (division property, sign flips)**



Boundary -1: 10 < 10 is false. Shade 0: 8 < 10 is true. Answer: x > -1.

7. **-6x + 9 > 27 then -6x > 18 (subtraction property) then x <-3 (division property, sign flips)**



Boundary -3: 27 > 27 is false. Shade -4: 33 > 27 is true. Answer: x < -3.

8. **3(-2x + 1) ≥ 15 then -6x + 3 ≥ 15 (expand the brackets) then -6x ≥ 12 (subtraction property) then x ≤-2 (division property, sign flips)**



Boundary -2: 15 ≥ 15 is true. Shade -3: 21 ≥ 15 is true. Answer: x ≤ -2.

9. **-1x + 5 < 9 then - x < 4 (subtraction property) then x >-4 (division property, sign flips)**



Boundary -4: 9 < 9 is false. Shade -3: 8 < 9 is true. Answer: x > -4.

10. **-4x - 8 > 16 then -4x > 24 (addition property) then x <-6 (division property, sign flips)**



Boundary -6: 16 > 16 is false. Shade -7: 20 > 16 is true. Answer: x < -6.

11. **x / (-4) - 2 ≤ 3 then -1 / 4x ≤ 5 (addition property) then x ≥-20 (division property, sign flips)**



Boundary -20: 3 ≤ 3 is true. Shade -19: 11/4 ≤ 3 is true. Answer: x ≥ -20.

12. **-7x + 2 < 37 then -7x < 35 (subtraction property) then x >-5 (division property, sign flips)**



Boundary -5: 37 < 37 is false. Shade -4: 30 < 37 is true. Answer: x > -5.

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Mixed Moves and Short Stories

Answer key. Every step, graph and test.

1. **2(3x + 4) - 5 < 25 then 6x + 8 - 5 < 25 (expand the brackets) then 6x + 3 < 25 (combine like terms) then 6x < 22 (subtraction property) then x < 11 / 3 (division property). Boundary 11/3: 25 < 25 is false. Shade 8/3: 19 < 25 is true. Answer: x < 11/3.**



2. **4x + 3x - 6 ≥ 22 then 7x - 6 ≥ 22 (combine like terms) then 7x ≥ 28 (addition property) then x ≥ 4 (division property). Boundary 4: 22 ≥ 22 is true. Shade 5: 29 ≥ 22 is true. Answer: x ≥ 4.**



3. **(1 / 2)x + 3 < 9 then 1 / 2x < 6 (subtraction property) then x < 12 (division property). Boundary 12: 9 < 9 is false. Shade 11: 17/2 < 9 is true. Answer: x < 12.**



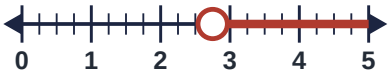
4. **3(x - 2) + 2x > 19 then 3x - 6 + 2x > 19 (expand the brackets) then 5x - 6 > 19 (combine like terms) then 5x > 25 (addition property) then x > 5 (division property). Boundary 5: 19 > 19 is false. Shade 6: 24 > 19 is true. Answer: x > 5.**



5. **-2(x + 3) + 10 < 4 then -2x - 6 + 10 < 4 (expand the brackets) then -2x + 4 < 4 (combine like terms) then -2x < 0 (subtraction property) then x > 0 (division property, sign flips). Boundary 0: 4 < 4 is false. Shade 1: 2 < 4 is true. Answer: x > 0.**



CHALLENGE. 4x + 7 > 18 then 4x > 11 (subtraction property) then x > 11 / 4 (division property). Boundary 11/4: 18 > 18 is false. Shade 15/4: 22 > 18 is true. Answer: x > 11/4.



6. Mina has a 15 gigabyte data cap. She has used 7 gigabytes. Each video uses about 2 gigabytes. How many more videos can she watch at most? Let x = the number of videos.

7 + 2x ≤ 15 then 2x ≤ 8 (subtraction property) then x ≤ 4 (division property). Boundary 4: 15 ≤ 15 is true. Whole answer 4: 15 ≤ 15 is true. Answer: She can stream 4 more videos.



7. Leo has $40 saved and earns $9 an hour at a cafe. He wants at least $130 for a bike. How many whole hours must he work? Let x = the number of hours.

40 + 9x ≥ 130 then 9x ≥ 90 (subtraction property) then x ≥ 10 (division property). Boundary 10: 130 ≥ 130 is true. Whole answer 10: 130 ≥ 130 is true. Answer: He must work at least 10 hours.



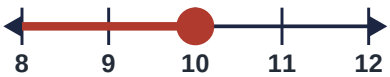
8. Sara has 156 points. Each extra quiz adds 8 points. She needs at least 240 points in all. How many whole quizzes does she need? Let x = the number of quizzes.

156 + 8x ≥ 240 then 8x ≥ 84 (subtraction property) then x ≥ 21 / 2 (division property). Boundary 21/2: 240 ≥ 240 is true. Whole answer 11: 244 ≥ 240 is true. Answer: She needs at least 11 quizzes.



9. A gym charges $25 to join plus $6 a class. Tom can spend at most $85 in all. How many classes can he take? Let x = the number of classes.

25 + 6x ≤ 85 then 6x ≤ 60 (subtraction property) then x ≤ 10 (division property). Boundary 10: 85 ≤ 85 is true. Whole answer 10: 85 ≤ 85 is true. Answer: He can take 10 classes.



10. Ana has $60 saved toward a $180 phone. She saves $15 more each week. How many whole weeks until she has at least enough? Let x = the number of weeks.

60 + 15x ≥ 180 then 15x ≥ 120 (subtraction property) then x ≥ 8 (division property). Boundary 8: 180 ≥ 180 is true. Whole answer 8: 180 ≥ 180 is true. Answer: She needs at least 8 weeks.



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- Then: Variables on Both Sides Inequalities
- Then: Absolute Value Inequalities
- Unit capstone: Inequality Word Problems
- Step before: Two-Step Equations (Unit 1, free)
- The Unit 1 story: the Solving Equations blog post
- Younger step: Inequalities and Two Variables (Grade 6)

The step after this unit, named in words only: Algebra 1 Unit 3, Linear Functions and Graphing. It is not linked here, because it is not built yet.

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