

# Solving Multi-Step Inequalities

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 42

## Quick Review

Multi-step inequalities follow the same playbook as multi-step equations: **distribute** to clear parentheses, **combine like terms** on each side, then use inverse operations to isolate the variable. The one rule that's different: when you **multiply or divide by a negative**, flip the inequality sign. Two ways to write solutions: **set-builder** notation  $\{x \mid x > 3\}$  ("the set of all  $x$  such that  $x > 3$ "), and **interval** notation  $(3, \infty)$ . For interval notation, use square brackets for  $\leq$  and  $\geq$  (the boundary's included) and parentheses for  $<$ ,  $>$ , and  $\pm\infty$  (not included).

## PRACTICE

Solve each inequality.

- |                               |       |                                     |       |
|-------------------------------|-------|-------------------------------------|-------|
| 1. $2x + 5 > 13$              | _____ | 11. $-5(x - 2) + 3x < 14$           | _____ |
| 2. $4n - 3 \leq 9$            | _____ | 12. $9 + 4a > 3a + 15$              | _____ |
| 3. $-3a + 8 < 2$              | _____ | 13. $3x - 5 \leq 2x + 7$            | _____ |
| 4. $6 - 2y \geq 10$           | _____ | 14. $-2(3y - 1) > 4y + 12$          | _____ |
| 5. $3(x - 1) > 12$            | _____ | 15. $\frac{x}{2} + \frac{x}{3} < 5$ | _____ |
| 6. $-2(m + 4) \leq 6$         | _____ | 16. $5 - (x + 3) \geq 2x - 7$       | _____ |
| 7. $5k + 2 - 3k < 10$         | _____ | 17. $-4(2k + 1) < -3(k + 2)$        | _____ |
| 8. $4(2p - 1) \geq 12$        | _____ | 18. $\frac{3x - 1}{2} \geq 4$       | _____ |
| 9. $7 - 3(n + 2) > -8$        | _____ | 19. $2(x + 5) - 3x \leq 0$          | _____ |
| 10. $\frac{2x + 6}{4} \leq 3$ | _____ | 20. $0.5(4x - 2) > 3$               | _____ |

## VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Write the inequality shown on the number line.

Answer: \_\_\_\_\_

22. Write the inequality shown on the number line.

Answer: \_\_\_\_\_



## ◆ Word Problems

23. A student needs at least 80 points total on 4 quizzes to earn a B. After three quizzes the student has scores of 18, 22, and 19. What score  $s$  is needed on the fourth quiz? \_\_\_\_\_
24. A parking garage charges \$5 plus \$2.50 per hour. You have at most \$20. Write and solve an inequality for the number of hours  $h$  you can park. \_\_\_\_\_
25. A taxi service charges a \$4 base fare plus \$1.75 per mile. Maria has at most \$25 to spend. What's the maximum distance she can travel? \_\_\_\_\_
26. A phone plan costs \$25 per month plus \$0.10 per text. If Jamal's budget is less than \$40 per month, how many texts  $t$  can he send? \_\_\_\_\_
27. A gym charges a \$30 sign-up fee plus \$8 per class. Leah has at most \$110. How many classes  $c$  can she take? \_\_\_\_\_
28. A club earns \$12 per ticket but pays a \$25 room fee. How many tickets  $t$  must it sell to make more than \$200? \_\_\_\_\_
29. A streaming plan costs \$15 plus \$3 per rented movie. Nora wants to spend less than \$45. What values of  $m$  work? \_\_\_\_\_
30. A rental car costs \$45 plus \$0.20 per mile. The budget is \$125. What is the greatest mileage  $m$ ? \_\_\_\_\_
31. A science team buys 4 display boards at \$7 each and supplies costing  $s$ . Their total must be under \$60. \_\_\_\_\_
32. Mateo has \$80 saved and adds \$15 each week. How many weeks  $w$  until he has at least \$200? \_\_\_\_\_
33. A ride-share charges \$6 plus \$2.25 per mile. Ari has no more than \$30. What mileage  $m$  fits the budget? \_\_\_\_\_
34. A store ships an order for \$3 plus \$5 per item. The customer wants the total no more than \$28. \_\_\_\_\_
35. A catering company charges \$75 plus \$12 per guest. The event budget is at most \$300. How many guests  $g$  fit? \_\_\_\_\_
36. A school bus rental costs \$120 plus \$3 per student. The club wants the cost below \$300. What values of  $s$  work? \_\_\_\_\_
37. A sale takes 20% off an item and then adds \$5 shipping. If the total must be at most \$45, how large can price  $p$  be? \_\_\_\_\_
38. A payment plan starts with \$50 down and \$20 each month. How many months  $m$  are needed to pay at least \$250? \_\_\_\_\_
39. An art teacher buys two \$18 canvases and  $p$  brushes at \$4 each. The total must be no more than \$80. \_\_\_\_\_
40. A bank account has \$500. Lee withdraws \$35 each week. How many weeks  $w$  until the balance is still above \$255? \_\_\_\_\_
41. A theater charges \$9 per ticket plus a \$6 service fee. Rina wants to spend at most \$60. How many tickets  $t$ ? \_\_\_\_\_
42. A delivery box weighs 2 pounds empty and 1.5 pounds per book. The box must weigh less than 20 pounds. \_\_\_\_\_



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## Answer Keys

- |                 |  |                           |
|-----------------|--|---------------------------|
| 1. $x > 4$      | 15. $x < 6$                            | 29. $m < 10$              |
| 2. $n \leq 3$   | 16. $x \leq 3$                         | 30. $m \leq 400$          |
| 3. $a > 2$      | 17. $k > \frac{2}{5}$                  | 31. $s < 32$              |
| 4. $y \leq -2$  | 18. $x \geq 3$                         | 32. $w \geq 8$            |
| 5. $x > 5$      | 19. $x \geq 10$                        | 33. $m \leq \frac{32}{3}$ |
| 6. $m \geq -7$  | 20. $x > 2$                            | 34. $i \leq 5$            |
| 7. $k < 4$      | 21. $x > 8$                            | 35. $g \leq 18$           |
| 8. $p \geq 2$   | 22. $x \geq -2$                        | 36. $s < 60$              |
| 9. $n < 3$      | 23. $s \geq 21$                        | 37. $p \leq 50$           |
| 10. $x \leq 3$  | 24. $h \leq 6$                         | 38. $m \geq 10$           |
| 11. $x > -2$    | 25. $m \leq 12$ miles                  | 39. $p \leq 11$           |
| 12. $a > 6$     | 26. $t < 150$                          | 40. $w < 7$               |
| 13. $x \leq 12$ | 27. $c \leq 10$                        | 41. $t \leq 6$            |
| 14. $y < -1$    | 28. $t > \frac{225}{12}$ ; at least 19 | 42. $b < 12$              |

### Step-by-Step Tutor Notes

- Keep the order of operations in view, then simplify without skipping the sign check. Subtract 5:  $2x > 8$ . Divide by 2:  $x > 4$ . After simplifying, the answer is  $x > 4$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Add 3:  $4n \leq 12$ . Divide by 4:  $n \leq 3$ . After simplifying, the answer is  $n \leq 3$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract 8:  $-3a < -6$ . Divide by  $-3$  — flip:  $a > 2$ . After simplifying, the answer is  $a > 2$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract 6:  $-2y \geq 4$ . Divide by  $-2$  — flip:  $y \leq -2$ . After simplifying, the answer is  $y \leq -2$ .
- Work one inverse operation at a time and keep both sides balanced. Distribute:  $3x - 3 > 12$ . Add 3:  $3x > 15$ . Divide:  $x > 5$ . After simplifying, the answer is  $x > 5$ .
- Keep the order of operations in view, then simplify without skipping the sign check. Distribute:  $-2m - 8 \leq 6$ . Add 8:  $-2m \leq 14$ . Divide by  $-2$  — flip:  $m \geq -7$ . After simplifying, the answer is  $m \geq -7$ .
- Keep the order of operations in view, then simplify without skipping the sign check. Combine like terms:  $2k + 2 < 10$ . Subtract 2:  $2k < 8$ . Divide:  $k < 4$ . After simplifying, the answer is  $k < 4$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Distribute:  $8p - 4 \geq 12$ . Add 4:  $8p \geq 16$ . Divide:  $p \geq 2$ . After simplifying, the answer is  $p \geq 2$ .
- Distribute:  $7 - 3n - 6 > -8$ . Combine:  $-3n + 1 > -8$ . Subtract 1:  $-3n > -9$ . Divide by  $-3$  — flip:  $n < 3$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Multiply both sides by 4:  $2x + 6 \leq 12$ . Subtract 6:  $2x \leq 6$ . Divide:  $x \leq 3$ . After simplifying, the answer is  $x \leq 3$ .
- Distribute:  $-5x + 10 + 3x < 14$ . Combine:  $-2x + 10 < 14$ . Subtract 10:  $-2x < 4$ . Divide by  $-2$  — flip:  $x > -2$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract  $3a$ :  $9 + a > 15$ . Subtract 9:  $a > 6$ . After simplifying, the answer is  $a > 6$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract  $2x$ :  $x - 5 \leq 7$ . Add 5:  $x \leq 12$ . After simplifying, the answer is  $x \leq 12$ .
- Distribute:  $-6y + 2 > 4y + 12$ . Subtract  $4y$ :  $-10y + 2 > 12$ . Subtract 2:  $-10y > 10$ . Divide by  $-10$  — flip:  $y < -1$ .
- Multiply both sides by 6 to clear fractions:  $3x + 2x < 30$ . Combine:  $5x < 30$ . Divide:  $x < 6$ .
- Distribute:  $5 - x - 3 \geq 2x - 7$ . Combine left:  $2 - x \geq 2x - 7$ . Add  $x$ :  $2 \geq 3x - 7$ . Add 7:  $9 \geq 3x$ . Divide:  $3 \geq x$ , or  $x \leq 3$ .
- Distribute:  $-8k - 4 < -3k - 6$ . Add  $8k$ :  $-4 < 5k - 6$ . Add 6:  $2 < 5k$ . Divide:  $\frac{2}{5} < k$ , or  $k > \frac{2}{5}$ .
- Work one inverse operation at a time and keep both sides balanced. Multiply by 2:  $3x - 1 \geq 8$ . Add 1:  $3x \geq 9$ . Divide:  $x \geq 3$ . After simplifying, the answer is  $x \geq 3$ .
- Distribute:  $2x + 10 - 3x \leq 0$ . Combine:  $-x + 10 \leq 0$ . Subtract 10:  $-x \leq -10$ . Divide by  $-1$  — flip:  $x \geq 10$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. Distribute:  $2x - 1 > 3$ . Add 1:  $2x > 4$ . Divide:  $x > 2$ . After simplifying, the answer is  $x > 2$ .
- Read the table by matching the correct row and column first, then use the count or total that fits the question. The open circle means 8 is not included, and the arrow points right:  $x > 8$ . This gives  $x > 8$ .
- Start with the definition the problem is testing, then apply it directly. The closed circle at  $-2$  and shading right mean  $x \geq -2$ . So the answer is  $x \geq -2$ .
- Set up the inequality:  $18 + 22 + 19 + s \geq 80$ . Combine:  $59 + s \geq 80$ . Subtract 59:  $s \geq 21$ . The student needs at least 21 points on the fourth quiz.
- "At most \$20" is  $\leq$ :  $5 + 2.5h \leq 20$ . Subtract 5:  $2.5h \leq 15$ . Divide by 2.5:  $h \leq 6$  hours.
- $4 + 1.75m \leq 25$ . Subtract 4:  $1.75m \leq 21$ . Divide by 1.75:  $m \leq 12$ . Maria can go up to 12 miles.
- "Less than \$40" is strictly  $<$ :  $25 + 0.10t < 40$ . Subtract 25:  $0.10t < 15$ . Divide:  $t < 150$ . Jamal can send fewer than 150 texts.
- The cost is  $30 + 8c$ , and it must be at most 110:  $30 + 8c \leq 110$ . Subtract 30:  $8c \leq 80$ . Divide by 8:  $c \leq 10$ .
- Profit is  $12t - 25$ . More than \$200 means  $12t - 25 > 200$ . Add 25:  $12t > 225$ . Divide by 12:  $t > 18.75$ , so at least 19 whole tickets.
- The monthly cost is  $15 + 3m$ . Less than \$45 gives  $15 + 3m < 45$ . Subtract 15:  $3m < 30$ . Divide by 3:  $m < 10$ .
- Use  $45 + 0.20m \leq 125$ . Subtract 45:  $0.20m \leq 80$ . Divide by 0.20:  $m \leq 400$ .



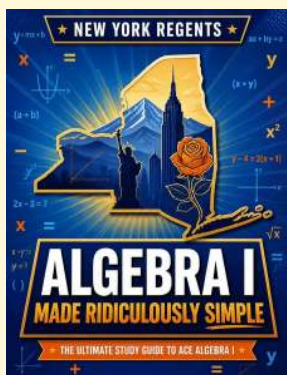
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31. Move carefully through the arithmetic; one clean operation usually unlocks the next one. The display boards cost  $4(7) = 28$ , so  $28 + s < 60$ . Subtract 28:  $s < 32$ . After simplifying, the answer is  $s < 32$ .
32. His savings are  $80 + 15w$ . At least \$200 means  $80 + 15w \geq 200$ . Subtract 80:  $15w \geq 120$ . Divide by 15:  $w \geq 8$ .
33. The cost is  $6 + 2.25m$ . No more than \$30 means  $6 + 2.25m \leq 30$ . Subtract 6:  $2.25m \leq 24$ . Divide by 2.25:  $m \leq \frac{32}{3}$ , about 10.67 miles.
34. Let  $i$  be the number of items. The total is  $3 + 5i \leq 28$ . Subtract 3:  $5i \leq 25$ . Divide by 5:  $i \leq 5$ .
35. Set up  $75 + 12g \leq 300$ . Subtract 75:  $12g \leq 225$ . Divide by 12:  $g \leq 18.75$ , so at most 18 whole guests fit the budget.
36. The cost model is  $120 + 3s < 300$ . Subtract 120:  $3s < 180$ . Divide by 3:  $s < 60$ .
37. After a 20% discount, the item costs  $0.8p$ . Use  $0.8p + 5 \leq 45$ . Subtract 5:  $0.8p \leq 40$ . Divide by 0.8:  $p \leq 50$ .
38. The paid amount is  $50 + 20m$ . At least \$250 means  $50 + 20m \geq 250$ . Subtract 50 and divide by 20:  $m \geq 10$ .
39. The canvases cost  $2(18) = 36$ . So  $36 + 4p \leq 80$ . Subtract 36:  $4p \leq 44$ . Divide by 4:  $p \leq 11$ .
40. The balance is  $500 - 35w$ . Still above \$255 means  $500 - 35w > 255$ . Subtract 500:  $-35w > -245$ . Divide by  $-35$  and flip:  $w < 7$ .
41. Keep the order of operations in view, then simplify without skipping the sign check. The total is  $9t + 6 \leq 60$ . Subtract 6:  $9t \leq 54$ . Divide by 9:  $t \leq 6$ . After simplifying, the answer is  $t \leq 6$ .
42. The weight is  $2 + 1.5b$ . Less than 20 means  $2 + 1.5b < 20$ . Subtract 2:  $1.5b < 18$ . Divide by 1.5:  $b < 12$ .



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