

# Compound Inequalities

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

## Quick Review

A **compound inequality** joins two inequalities with “and” or “or.” “**And**” (**intersection**): both conditions must be true at once. Written as  $a < x < b$  or “ $x > a$  and  $x < b$ .” The solution is the *overlap* of the two individual graphs. Interval notation:  $(a, b)$  (use brackets for  $\leq/\geq$ ). “**Or**” (**union**): at least one condition is true. Written as “ $x < a$  or  $x > b$ .” The solution is the *combined* shading. Interval notation:  $(-\infty, a) \cup (b, \infty)$ . To solve: handle each piece by the usual rules, then combine. For three-part “and” inequalities like  $-2 \leq 3x + 1 < 10$ , do the same operation to *all three parts* to keep them in sync.

## PRACTICE

Solve each compound inequality.

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

## VISUAL PRACTICE

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

21. Write the compound inequality shown.



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

22. Write the compound inequality shown.



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



## ◆ Word Problems

23. A doctor recommends that a patient's heart rate during exercise stay between 120 and 160 beats per minute, inclusive. Write a compound inequality for the acceptable heart rate  $h$ . \_\_\_\_\_
24. A weather alert is issued when the temperature  $t$  is below  $20^{\circ}\text{F}$  or above  $95^{\circ}\text{F}$ . Write a compound inequality and express it in interval notation. \_\_\_\_\_
25. A roller coaster requires riders to be at least 48 inches but no taller than 76 inches. Write a compound inequality for acceptable heights  $h$ . \_\_\_\_\_
26. A bottling plant rejects bottles that are filled with less than 498 mL or more than 502 mL. Write an inequality for rejected fill amounts  $v$ . \_\_\_\_\_
27. A swimming pool should have a pH from 7.2 to 7.8, inclusive. Write the safe range for pH  $p$ . \_\_\_\_\_
28. A car's tire pressure should stay between 32 and 36 psi, inclusive. Write a compound inequality for pressure  $p$ . \_\_\_\_\_
29. A food safety warning applies below  $40^{\circ}\text{F}$  or above  $140^{\circ}\text{F}$ . Write the warning range for temperature  $t$ . \_\_\_\_\_
30. A teen event is for students at least 13 years old and younger than 18. Write the allowed ages  $a$ . \_\_\_\_\_
31. A package passes inspection if its weight is from 14.5 lb to 15.5 lb, inclusive. Write the passing range  $w$ . \_\_\_\_\_
32. A sound meter flags readings below 30 dB or above 85 dB. Write the flagged range for sound level  $s$ . \_\_\_\_\_
33. An honor-roll score must be at least 90 and at most 100. Write the possible scores  $s$ . \_\_\_\_\_
34. A printer accepts paper widths greater than 7.9 inches and less than 8.6 inches. Write the accepted widths  $w$ . \_\_\_\_\_
35. A highway work zone allows speeds from 45 mph to 65 mph, inclusive. Write the allowed speeds  $s$ . \_\_\_\_\_
36. A factory rejects rods shorter than 9.8 cm or longer than 10.2 cm. Write the rejected lengths  $l$ . \_\_\_\_\_
37. A scholarship requires a GPA of at least 3.5 and at most 4.0. Write the eligible GPAs  $g$ . \_\_\_\_\_
38. A plant grows best when the room is warmer than  $65^{\circ}\text{F}$  but cooler than  $80^{\circ}\text{F}$ . Write the temperature range  $t$ . \_\_\_\_\_
39. A medicine refrigerator should stay from  $36^{\circ}\text{F}$  to  $46^{\circ}\text{F}$ , inclusive. Write the safe temperatures  $t$ . \_\_\_\_\_
40. A river alert is issued below 2 feet or above 8 feet. Write the alert levels  $r$ . \_\_\_\_\_
41. A game level is unlocked for ratings at least 1500 but below 2000. Write the eligible ratings  $r$ . \_\_\_\_\_
42. A concert ticket discount applies to ages under 12 or over 65. Write the ages  $a$  that receive the discount. \_\_\_\_\_



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## Answer Keys

- |                            |  |                             |
|----------------------------|--|-----------------------------|
| 1. $-2 < x < 4$            | 15. $x < -2$ or $x > 4$                                      | 29. $t < 40$ or $t > 140$   |
| 2. $-2 \leq n \leq 5$      | 16. $-2 < x < 5$   | 30. $13 \leq a < 18$        |
| 3. $-1 < x \leq 3$         | 17. $x \leq -4$ or $x \geq 6$                                | 31. $14.5 \leq w \leq 15.5$ |
| 4. $3 < a < 7$             | 18. $-3 \leq x < 3$  | 32. $s < 30$ or $s > 85$    |
| 5. $x < -2$ or $x > 5$     | 19. $x > 6$ or $x < -3$                                      | 33. $90 \leq s \leq 100$    |
| 6. $m > 4$ or $m < -3$     | 20. $-3 \leq x < 3$  | 34. $7.9 < w < 8.6$         |
| 7. $-12 \leq x < 8$        | 21. $-2 < x \leq 1$  | 35. $45 \leq s \leq 65$     |
| 8. $-1 < k \leq 4$         | 22. $-1 < x \leq 4$  | 36. $l < 9.8$ or $l > 10.2$ |
| 9. $y < -2$ or $y > 5$     | 23. $120 \leq h \leq 160$ , $[120, 160]$                     | 37. $3.5 \leq g \leq 4.0$   |
| 10. $-2 \leq x \leq 2$     | 24. $t < 20$ or $t > 95$ , $(-\infty, 20) \cup (95, \infty)$ | 38. $65 < t < 80$           |
| 11. $3 < n < 9$            | 25. $48 \leq h \leq 76$                                      | 39. $36 \leq t \leq 46$     |
| 12. $-\frac{5}{3} < x < 3$ | 26. $v < 498$ or $v > 502$                                   | 40. $r < 2$ or $r > 8$      |
| 13. $7 < x < 11$           | 27. $7.2 \leq p \leq 7.8$                                    | 41. $1500 \leq r < 2000$    |
| 14. $-2 \leq x \leq 2$     | 28. $32 \leq p \leq 36$                                      | 42. $a < 12$ or $a > 65$    |

### Step-by-Step Tutor Notes

1. Keep the order of operations in view, then simplify without skipping the sign check. Subtract 3 from all three parts:  $-2 < x < 4$ . After simplifying, the answer is  $-2 < x < 4$ .
2. Work one inverse operation at a time and keep both sides balanced. Divide all three parts by 2:  $-2 \leq n \leq 5$ . After simplifying, the answer is  $-2 \leq n \leq 5$ .
3. Work one inverse operation at a time and keep both sides balanced. Subtract 2 from all three:  $-3 < 3x \leq 9$ . Divide by 3:  $-1 < x \leq 3$ . After simplifying, the answer is  $-1 < x \leq 3$ .
4. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Add 1 to all three:  $6 < 2a < 14$ . Divide by 2:  $3 < a < 7$ . After simplifying, the answer is  $3 < a < 7$ .
5. Solve each side:  $x < -2$  from the first,  $x > 5$  from the second. "Or" combines them with no overlap requirement.
6. Divide first:  $m > 4$ . Subtract 5 in second:  $m < -3$ . Two separate ranges joined by "or."
7. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Multiply all three parts by 2:  $-12 \leq x < 8$ . After simplifying, the answer is  $-12 \leq x < 8$ .
8. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract 1:  $-4 < 4k \leq 16$ . Divide by 4:  $-1 < k \leq 4$ . After simplifying, the answer is  $-1 < k \leq 4$ .
9. For a table question, slow down and locate the exact row, column, or cell before calculating. First:  $2y < -4 \Rightarrow y < -2$ . Second:  $2y > 10 \Rightarrow y > 5$ . "Or" — two pieces. This gives  $y < -2$  or  $y > 5$ .
10. Subtract 5 from all three:  $-4 \leq -2x \leq 4$ . Divide by  $-2$  — flip both inequality signs:  $2 \geq x \geq -2$ , or  $-2 \leq x \leq 2$ .
11. First:  $n > 3$ . Second:  $n < 9$ . Combine with "and":  $3 < n < 9$ , or in interval notation  $(3, 9)$ .
12. Distribute or work with three parts:  $-8 < 3x - 3 < 6$ . Add 3 to all:  $-5 < 3x < 9$ . Divide by 3:  $-\frac{5}{3} < x < 3$ .
13. Keep the order of operations in view, then simplify without skipping the sign check. Add 5 to all three:  $7 < x < 11$ . After simplifying, the answer is  $7 < x < 11$ .
14. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtract 1:  $-4 \leq 2x \leq 4$ . Divide by 2:  $-2 \leq x \leq 2$ . After simplifying, the answer is  $-2 \leq x \leq 2$ .
15. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Divide each by 5:  $x < -2$  or  $x > 4$ . Two separated ranges. After simplifying, the answer is  $x < -2$  or  $x > 4$ .
16. Keep the order of operations in view, then simplify without skipping the sign check. Add 3 to all:  $-4 < 2x < 10$ . Divide by 2:  $-2 < x < 5$ . After simplifying, the answer is  $-2 < x < 5$ .
17. Start with the definition the problem is testing, then apply it directly. First:  $x \leq -4$ . Second:  $x \geq 6$ . "Or" joins them. So the answer is  $x \leq -4$  or  $x \geq 6$ .
18. Keep the order of operations in view, then simplify without skipping the sign check. Subtract 2:  $-12 \leq 4x < 12$ . Divide by 4:  $-3 \leq x < 3$ . After simplifying, the answer is  $-3 \leq x < 3$ .
19. Keep the order of operations in view, then simplify without skipping the sign check. Multiply each by 3:  $x > 6$  or  $x < -3$ . After simplifying, the answer is  $x > 6$  or  $x < -3$ .
20. Subtract 10:  $-6 < -2x \leq 6$ . Divide by  $-2$  — flip both:  $3 > x \geq -3$ , or  $-3 \leq x < 3$ .
21. This is a good place to slow down, check the notation, and simplify cleanly. The graph starts just above  $-2$  and includes 1, so  $-2 < x \leq 1$ . So the answer is  $-2 < x \leq 1$ .
22. Focus on the main idea of the problem, then simplify carefully. The interval starts just above  $-1$  and includes 4. So the answer is  $-1 < x \leq 4$ .
23. "Between 120 and 160, inclusive" means both endpoints are allowed. So  $120 \leq h \leq 160$ . In interval notation, that's  $[120, 160]$  — closed brackets because the endpoints are included.
24. "Below 20" and "above 95" are strict, so the alert covers  $t < 20$  or  $t > 95$  — an "or" compound. In interval notation:  $(-\infty, 20) \cup (95, \infty)$ . The cup symbol means "union" — both pieces together.
25. Both endpoints are included ("at least" =  $\geq$ , "no taller than" =  $\leq$ ). So  $48 \leq h \leq 76$ , or  $[48, 76]$  in interval notation.
26. "Less than" and "more than" are strict, so rejection happens when  $v < 498$  or  $v > 502$ . The acceptable range (not rejected) would be  $498 \leq v \leq 502$ , but this question asks about the rejection condition.
27. "From 7.2 to 7.8, inclusive" means both endpoints are included, so  $7.2 \leq p \leq 7.8$ .
28. Name the quantities first so the model is easy to read. The word "between" gives the two boundaries, and "inclusive" means use  $\leq$ :  $32 \leq p \leq 36$ .
29. Set up the model from the story, then calculate carefully. Below and above are strict conditions. The warning range is  $t < 40$  or  $t > 140$ .



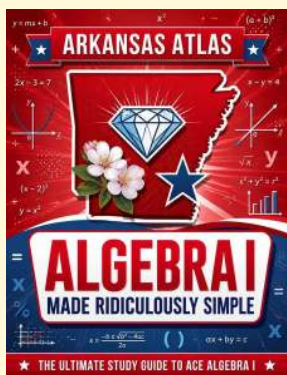
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30. At least 13 includes 13, so use  $\leq$ . Younger than 18 does not include 18, so  $13 \leq a < 18$ .
31. The package passes when it is inside the inclusive range, so  $14.5 \leq w \leq 15.5$ .
32. Name the quantities first so the model is easy to read. The flagged values are outside the acceptable band:  $s < 30$  or  $s > 85$ .
33. At least 90 means  $s \geq 90$ , and at most 100 means  $s \leq 100$ . Together:  $90 \leq s \leq 100$ .
34. Greater than 7.9 and less than 8.6 are both strict, so the accepted widths are  $7.9 < w < 8.6$ .
35. Name the quantities first so the model is easy to read. The speeds may include both endpoints, so the allowed range is  $45 \leq s \leq 65$ .
36. Use the given numbers to build the model, then finish the calculation. Rejected rods are outside the acceptable interval, so  $l < 9.8$  or  $l > 10.2$ .
37. At least 3.5 means  $g \geq 3.5$ , and at most 4.0 means  $g \leq 4.0$ . Together:  $3.5 \leq g \leq 4.0$ .
38. Set up the model from the story, then calculate carefully. Warmer than and cooler than are strict phrases, so the range is  $65 < t < 80$ .
39. Set up the model from the story, then calculate carefully. The safe range includes 36 and 46, so  $36 \leq t \leq 46$ .
40. Name the quantities first so the model is easy to read. The alert happens outside the normal range:  $r < 2$  or  $r > 8$ .
41. Name the quantities first so the model is easy to read. At least 1500 includes 1500, while below 2000 excludes 2000. So  $1500 \leq r < 2000$ .
42. The discount applies to two separate age groups, so use "or":  $a < 12$  or  $a > 65$ .



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