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. $1 < x + 3 < 7$ _____

2. $-4 \leq 2n \leq 10$ _____

3. $-1 < 3x + 2 \leq 11$ _____

4. $5 < 2a - 1 < 13$ _____

5. $x + 2 < 0$ or $x - 1 > 4$ _____

6. $3m > 12$ or $m + 5 < 2$ _____

7. $-6 \leq \frac{x}{2} < 4$ _____

8. $-3 < 4k + 1 \leq 17$ _____

9. $2y - 3 < -7$ or $2y - 3 > 7$ _____

10. $1 \leq 5 - 2x \leq 9$ _____

11. $n + 4 > 7$ and $n - 1 < 8$ _____

12. $-8 < 3(x - 1) < 6$ _____

13. $2 < x - 5 < 6$ _____

14. $-3 \leq 2x + 1 \leq 5$ _____

15. $5x < -10$ or $5x > 20$ _____

16. $-7 < 2x - 3 < 7$ _____

17. $x + 1 \leq -3$ or $x - 2 \geq 4$ _____

18. $-10 \leq 4x + 2 < 14$ _____

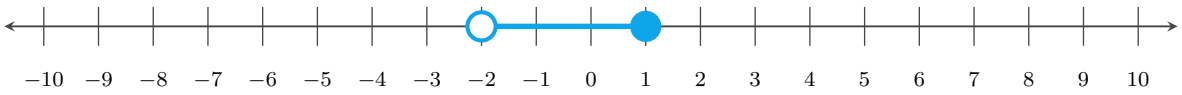
19. $\frac{x}{3} > 2$ or $\frac{x}{3} < -1$ _____

20. $4 < -2x + 10 \leq 16$ _____

VISUAL PRACTICE

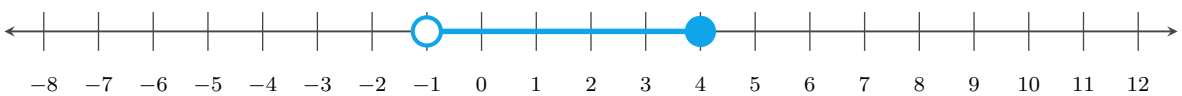
Use the graph, table, chart, or diagram to answer the question.

21. Write the compound inequality shown.



Answer: _____

22. Write the compound inequality shown.



Answer: _____

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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 $20°$F or above $95°$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 $40°$F or above $140°$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 $65°$F but cooler than $80°$F. Write the temperature range t. _____

39. A medicine refrigerator should stay from $36°$F to $46°$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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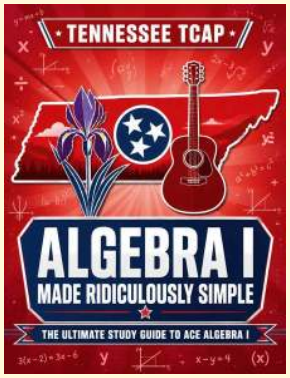

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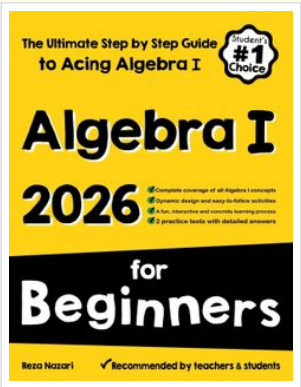

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