Graphing Linear Inequalities in Two Variables

Name: _____	Date: _____	Score: _____ / 24

Quick Review

A **linear inequality in two variables**, like $y > 2x + 1$, has a whole *region* of solutions, not just a line. To graph it, first graph the **boundary line** $y = 2x + 1$. Use a **solid line** for $\leq$ or $\geq$ (the line is included) and a **dashed line** for $<$ or $>$ (not included). Then **shade** the side that works: for $y >$ shade above, for $y <$ shade below. To test whether a point is a solution, just substitute it in — if it makes a true statement, it's in the shaded region.

◇ **Example:** Is the point $(2, 5)$ a solution of $y > 2x - 1$?

⇒ To check a point, we just substitute its coordinates and see if the inequality stays true. Here $x = 2$ and $y = 5$, so we plug in: $5 > 2(2) - 1$. Work out the right side: $2(2) - 1 = 3$, so the question becomes "is $5 > 3$?" Yes, it is! So $(2, 5)$ is a solution and would land in the shaded region of the graph. If we had gotten a false statement, the point would be outside it.

Answer: yes, $5 > 3$

PRACTICE

Test each point in the inequality, or describe the boundary line.

1. $(0, 0)$: $y > x + 1$ _____
2. $(0, 5)$: $y > x + 1$ _____
3. $(3, 2)$: $y < x$ _____
4. $(1, 4)$: $y < x$ _____
5. $(2, 7)$: $y \geq 2x + 1$ _____
6. $(1, 1)$: $y \geq 2x + 1$ _____
7. $(4, 0)$: $y \leq x - 2$ _____
8. $(1, 3)$: $y \leq x - 2$ _____
9. $(0, 0)$: $y \leq 3x + 4$ _____
10. $(5, 2)$: $y > x - 1$ _____
11. $y > x + 2$: line solid or dashed? _____
12. $y \leq 3x - 1$: line solid or dashed? _____
13. $y \geq -x$: line solid or dashed? _____
14. $y < 2x + 5$: line solid or dashed? _____
15. $y > x$: shade above or below? _____
16. $y < x - 3$: shade above or below? _____
17. $(2, 2)$: $y \geq x$ _____
18. $(6, 1)$: $y < \frac{1}{2}x$ _____
19. $(0, 4)$: $y \leq 2x + 1$ _____
20. $(3, 10)$: $y > 3x$ _____

Word Problems

21. A student earns $\$10$ per lawn (x) and $\$15$ per car wash (y), and wants to earn more than $\$60$. Does mowing 3 lawns and washing 2 cars satisfy $10x + 15y > 60$? _____

22. A backpack can hold no more than 20 lb. Books weigh 2 lb each (x) and notebooks 1 lb each (y). Does 5 books and 8 notebooks satisfy $2x + y \leq 20$? _____

23. A line has equation $y = 4x - 3$. For the inequality $y \geq 4x - 3$, should the boundary line be solid or dashed, and which side is shaded? _____

24. A budget says spending x on snacks and y on drinks must stay under $\$25$, so $x + y < 25$. Is spending $\$12$ on snacks and $\$10$ on drinks allowed? _____

Answer Keys

1. no
2. yes
3. yes
4. no
5. yes
6. no
7. yes
8. no
9. yes
10. no
11. dashed
12. solid
13. solid
14. dashed
15. above
16. below
17. yes
18. yes
19. no
20. yes
21. no
22. yes
23. solid line, shade above
24. yes

Step-by-Step Explanations

1. Substitute: $0 > 0 + 1$ means $0 > 1$, which is false.
2. Substitute: $5 > 0 + 1$ means $5 > 1$, which is true.
3. Substitute: $2 < 3$, which is true.
4. Substitute: $4 < 1$ is false.
5. Substitute: $7 \geq 2(2) + 1 = 5$, which is true.
6. Substitute: $1 \geq 2(1) + 1 = 3$ is false.
7. Substitute: $0 \leq 4 - 2 = 2$, which is true.
8. Substitute: $3 \leq 1 - 2 = -1$ is false.
9. Substitute: $0 \leq 3(0) + 4 = 4$, which is true.
10. Substitute: $2 > 5 - 1 = 4$ is false.
11. The symbol $>$ does not include the line, so the boundary is dashed.
12. The symbol $\leq$ includes the line, so the boundary is solid.
13. The symbol $\geq$ includes the line, so the boundary is solid.
14. The symbol $<$ excludes the line, so the boundary is dashed.
15. For $y >$, the solutions sit above the boundary line.
16. For $y <$, the solutions sit below the boundary line.
17. Substitute: $2 \geq 2$ is true (equal counts for $\geq$).
18. Substitute: $1 < \frac{1}{2}(6) = 3$, which is true.
19. Substitute: $4 \leq 2(0) + 1 = 1$ is false.
20. Substitute: $10 > 3(3) = 9$, which is true.
21. Substitute $x = 3$, $y = 2$: $10(3) + 15(2) = 60$. Since $60 > 60$ is false, it does not satisfy the inequality.
22. Substitute $x = 5$, $y = 8$: $2(5) + 8 = 18$. Since $18 \leq 20$ is true, the load fits.
23. The $\geq$ sign includes the line, so it is solid, and $y \geq$ means the solutions are on or above the line.
24. Substitute $x = 12$, $y = 10$: $12 + 10 = 22$. Since $22 < 25$ is true, the spending is within budget.

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