Graphing Functions and Transformations

Name: _____	Date: _____	Score: _____ / 26

Quick Review

To graph a function: build a table of (x, y) points, plot them, connect with a smooth curve (or line if linear). Pick x-values on both sides of 0. **Key features**: the **y-intercept** is where the graph hits the y-axis (set $x = 0$). The **x-intercepts** (zeros) are where it hits the x-axis (set $y = 0$). The graph is **increasing** when it goes up left-to-right and **decreasing** when it goes down. **Transformations** from a parent function $f(x)$: $f(x) + k$ shifts *up* by k (down if $k < 0$); $a \cdot f(x)$ with $|a| > 1$ is a vertical stretch (narrower); with $|a| < 1$ a compression (wider); $-f(x)$ reflects over the x-axis (flips upside down).

PRACTICE

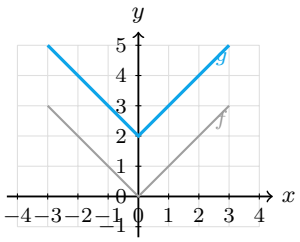
Find intercepts or describe transformations.

1. $f(x) = 3x - 6$; intercepts _____
2. $f(x) = x^2 - 9$; x-intercepts _____
3. $f(x) = -2x + 4$; intercepts _____
4. $g(x) = x^2 + 5$ vs. $f(x) = x^2$ _____
5. $g(x) = -x^2$ vs. $f(x) = x^2$ _____
6. $g(x) = \frac{1}{2}x^2$ vs. $f(x) = x^2$ _____
7. $f(x) = |x| - 2$; intercepts _____
8. $g(x) = 3|x|$ vs. $f(x) = |x|$ _____
9. $g(x) = x^2 + 2$ vs. x^2 _____
10. $f(x) = 4x$; intercepts _____
11. $g(x) = (x - 3)^2$ vs. x^2 _____
12. $g(x) = -2x^2$ vs. x^2 _____
13. $f(x) = 2x + 8$; intercepts _____
14. $f(x) = x^2 - x - 6$; x-int _____
15. $g(x) = |x| + 1$ vs. $|x|$ _____
16. $f(x) = -\frac{1}{2}x + 3$; y-int _____
17. $g(x) = x^3 + 4$ vs. x^3 _____
18. $f(x) = 5$; intercepts _____
19. $f(x) = x^2 + 4$; x-int _____
20. $g(x) = (x + 2)^2 - 3$ vs. x^2 _____

VISUAL PRACTICE

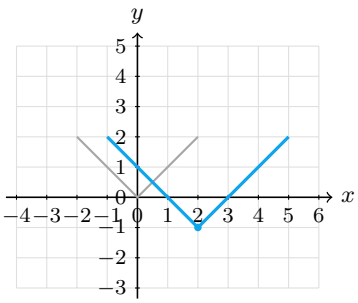
Use the graph, table, chart, or diagram to answer the question.

21. The graph of $f(x) = |x|$ is shifted to make $g(x) = |x| + 2$. What changed?



Answer: _____

22. The graph of $f(x) = |x|$ is shifted. What is the new vertex?



Answer: _____

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Word Problems

23. A company's profit (thousands of dollars) is $P(x) = x^2 - 6x + 8$, where x is hundreds of units sold. At what unit sales does profit equal zero?

Model: _____ **Answer:** _____

24. Describe the transformations needed to graph $g(x) = -x^2 + 5$ starting from $f(x) = x^2$. State the vertex and direction.

Model: _____ **Answer:** _____

25. A ball is launched from ground level, and its height is modeled by $h(t) = -16t^2 + 32t$ feet. Use the equation to determine when the ball returns to the ground.

Model: _____ **Answer:** _____

26. A linear function representing a simple cost model passes through $(0, 4)$ and $(2, 10)$. Find the intercepts and explain which point gives the y-intercept immediately.

Model: _____ **Answer:** _____

Answer Keys

1. y-int $(0, -6)$, x-int $(2, 0)$
2. $x = \pm 3$
3. $y = (0, 4)$, $x = (2, 0)$
4. shift up 5
5. reflect over x-axis
6. vertical compression
7. $y = (0, -2)$, $x = (\pm 2, 0)$
8. vertical stretch
9. shift up 2
10. both at $(0, 0)$
11. shift right 3
12. reflect and stretch
13. $y = (0, 8)$, $x = (-4, 0)$
14. $x = 3$ or $x = -2$
15. shift up 1
16. $(0, 3)$
17. shift up 4
18. $y = (0, 5)$, no x-int
19. none
20. left 2, down 3
21. shift up 2
22. $(2, -1)$
23. $x = 2$, $x = 4$
24. reflect over x-axis, shift up 5; $(0, 5)$, opens down
25. $t = 2$ sec
26. $y = (0, 4)$, $x = (-\frac{4}{3}, 0)$

Step-by-Step Tutor Notes

1. Read the table by matching the correct row and column first, then use the count or total that fits the question. y-int: $f(0) = -6$. x-int: $3x - 6 = 0 \Rightarrow x = 2$. This gives y-int $(0, -6)$, x-int $(2, 0)$.
2. Set $x^2 - 9 = 0$. Factor: $(x - 3)(x + 3) = 0$. So $x = 3$ or $x = -3$.
3. Read the table by matching the correct row and column first, then use the count or total that fits the question. y-int: $f(0) = 4$. x-int: $-2x + 4 = 0 \Rightarrow x = 2$. This gives $y = (0, 4)$, $x = (2, 0)$.
4. Work one inverse operation at a time and keep both sides balanced. Adding 5 outside the squaring moves every point up by 5. After simplifying, the answer is shift up 5.
5. Start with the definition the problem is testing, then apply it directly. The negative flips the parabola upside down — opens downward now. So the answer is reflect over x-axis.
6. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Multiplying by $\frac{1}{2}$ (less than 1) makes the parabola wider/flatter. After simplifying, the answer is vertical compression.
7. y-int: $f(0) = |0| - 2 = -2$. x-int: $|x| - 2 = 0$, so $|x| = 2$, giving $x = \pm 2$.
8. For a table question, slow down and locate the exact row, column, or cell before calculating. Multiplying by 3 (greater than 1) makes the V-shape narrower/steeper. This gives vertical stretch.
9. This is a good place to slow down, check the notation, and simplify cleanly. Same shape, every point moves up 2. So the answer is shift up 2.
10. For a table question, slow down and locate the exact row, column, or cell before calculating. $f(0) = 0$ and $4x = 0 \Rightarrow x = 0$. The line passes through the origin. This gives both at $(0, 0)$.
11. Subtracting 3 from x *inside* the function moves the graph right by 3 (horizontal shifts are counter-intuitive).
12. Take it one clear step at a time and keep the original question in mind. Two transformations: the negative flips it, and the 2 stretches it vertically. So the answer is reflect and stretch.
13. Read the table by matching the correct row and column first, then use the count or total that fits the question. y-int $= 8$. x-int: $2x + 8 = 0 \Rightarrow x = -4$. This gives $y = (0, 8)$, $x = (-4, 0)$.
14. Use the structure of the expression to find the important point, then check that it fits the context. Factor: $(x - 3)(x + 2) = 0$. Two x-intercepts. That leads to $x = 3$ or $x = -2$.
15. Keep the order of operations in view, then simplify without skipping the sign check. Adding 1 outside the absolute value lifts the V by 1. After simplifying, the answer is shift up 1.
16. Line up the two changes first; that keeps the rate from getting mixed up. $f(0) = 3$. (The y-intercept in slope-intercept form is just the constant term.). So the requested value is $(0, 3)$.
17. Take it one clear step at a time and keep the original question in mind. $+4$ outside the function shifts the whole cubic up by 4. So the answer is shift up 4.
18. y-int is 5. But 5 is never 0, so there are no x-intercepts (horizontal line above the x-axis).
19. $x^2 + 4 = 0$ would need $x^2 = -4$, which is impossible for real x. No x-intercepts. (Parabola sits entirely above the x-axis.).
20. $(x + 2)$ inside shifts *left* 2 (opposite of what you'd expect), and -3 outside shifts down 3.
21. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Adding 2 outside the function moves every point up 2 units. After simplifying, the answer is shift up 2.
22. Look for the key feature the question asks about, such as a zero, intercept, or vertex. The new graph has its corner at $(2, -1)$, so that is the new vertex. That leads to $(2, -1)$.
23. Set $P(x) = 0$: $x^2 - 6x + 8 = 0$. Factor: $(x - 2)(x - 4) = 0$. So $x = 2$ or $x = 4$. The company breaks even at 200 units and 400 units. Between them, profit is negative (a loss).
24. The negative reflects the parabola over the x-axis (now opens down). The $+5$ shifts everything up 5. Result: a downward parabola with vertex $(0, 5)$.
25. Ground means $h = 0$: $-16t^2 + 32t = 0$. Factor: $-16t(t - 2) = 0$, so $t = 0$ or $t = 2$. The ball starts at the ground ($t = 0$) and comes back at $t = 2$ seconds.
26. Slope $= \frac{10-4}{2-0} = 3$, so $y = 3x + 4$. y-intercept already given: $(0, 4)$. x-intercept: $3x + 4 = 0 \Rightarrow x = -\frac{4}{3}$.

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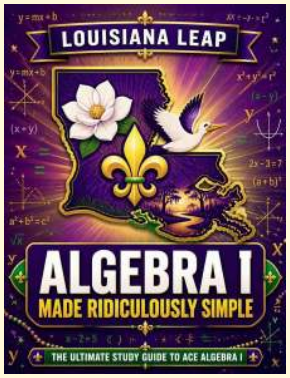

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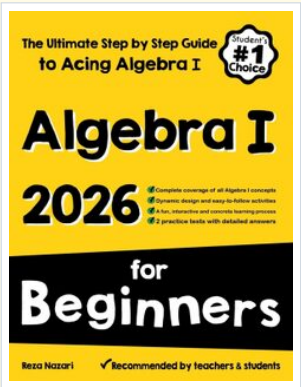

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