Characteristics of Quadratic Functions

Name: _____ Date: _____ Score: _____ / 26

Quick Review

Three forms of a quadratic, each highlighting different features: **Standard form** $y = ax^2 + bx + c$ shows the y-intercept (c). **Vertex form** $y = a(x-h)^2 + k$ shows the vertex (h, k) directly. **Factored form** $y = a(x - r_1)(x - r_2)$ shows the zeros (roots) r_1 and r_2. **Domain** of any quadratic is all real numbers. **Range**: if opening up, $y \geq k$ (the vertex y); if opening down, $y \leq k$. The parabola is **increasing** on one side of the axis of symmetry and **decreasing** on the other — the vertex is where it switches.

PRACTICE

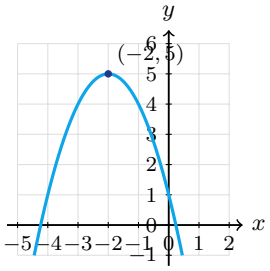
Identify features of each quadratic.

1. $y = (x-3)^2 + 2$; vertex _____
2. $y = (x+1)^2 - 5$; vertex _____
3. $y = 2(x-1)^2 + 4$; range _____
4. $y = -(x+2)^2 + 7$; range _____
5. $y = x^2 - 9$; zeros _____
6. $y = (x-2)(x+5)$; zeros _____
7. $y = x^2 + 4x$; vertex _____
8. $y = -x^2 + 6x - 5$; find the maximum _____
9. $y = x^2$; domain _____
10. $y = x^2$; range _____
11. $y = -x^2$; range _____
12. $y = x^2 - 6x + 9$; vertex _____
13. $y = x^2 + 1$; zeros _____
14. $y = x^2 - 1$; zeros _____
15. $y = (x-2)^2$; increasing on _____
16. $y = -(x-1)^2$; max value _____
17. $y = 3(x-4)^2 + 1$; vertex, min/max _____
18. $y = x^2 - 2x + 1$; vertex _____
19. $y = 2(x+3)(x-1)$; zeros _____
20. $y = x^2 - 25$; vertex, zeros _____

VISUAL PRACTICE

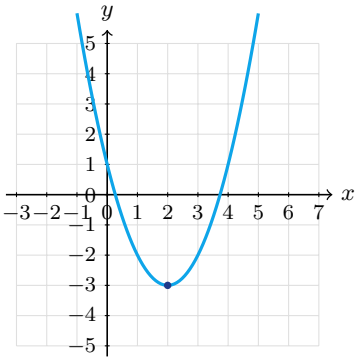
Use the graph, table, chart, or diagram to answer the question.

21. The parabola has vertex $(-2, 5)$ and opens down. What is its maximum value?



Answer: _____

22. The parabola opens up and has vertex $(2, -3)$. What is the minimum value?



Answer: _____

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Word Problems

23. A soccer ball is kicked upward, and its height is modeled by $h(t) = -16t^2 + 48t$. Find the maximum height.

Model: _____ **Answer:** _____

24. A parabolic arch is modeled by $y = -x^2 + 16$, where ground level is $y = 0$. Find the arch's ground-level width and maximum height.

Model: _____ **Answer:** _____

25. A fundraiser models revenue with $R(p) = -2p^2 + 40p$, where p is the ticket price in dollars. What ticket price maximizes revenue?

Model: _____ **Answer:** _____

26. A diver jumps with height $h(t) = -16t^2 + 8t + 24$. When does the diver hit water?

Model: _____ **Answer:** _____

Answer Keys

1. $(3, 2)$
2. $(-1, -5)$
3. $y \geq 4$
4. $y \leq 7$
5. ± 3
6. $2, -5$
7. $(-2, -4)$
8. $y = 4$ at $x = 3$
9. $\mathbb{R}$
10. $y \geq 0$
11. $y \leq 0$
12. $(3, 0)$
13. none
14. ± 1
15. $x > 2$
16. 0
17. $(4, 1)$, min
18. $(1, 0)$
19. $-3, 1$
20. $(0, -25)$, ± 5
21. 5
22. -3
23. 36 ft
24. width 8, height 16
25. $p = \$10$, $R = \$200$
26. $t = \frac{3}{2}$ sec

Step-by-Step Tutor Notes

1. First identify the feature of the graph or equation that matches the wording of the question. Vertex form. That leads to $(3, 2)$.
2. Focus on the main idea of the problem, then simplify carefully. $h = -1, k = -5$. So the answer is $(-1, -5)$.
3. Focus on the main idea of the problem, then simplify carefully. Opens up, min 4. So the answer is $y \geq 4$.
4. Take it one clear step at a time and keep the original question in mind. Opens down, max 7. So the answer is $y \leq 7$.
5. Start with the definition the problem is testing, then apply it directly. $x^2 = 9$. So the answer is ± 3.
6. Use the structure of the expression to find the important point, then check that it fits the context. Factored form: zeros are 2 and -5. That leads to $2, -5$.
7. Use the clue in the question first, then let the arithmetic finish the job. $x = -2$, $y = 4 - 8 = -4$. So the answer is $(-2, -4)$.
8. Use the clue in the question first, then let the arithmetic finish the job. $x = -\frac{6}{-2} = 3$, $y = -9 + 18 - 5 = 4$. So the answer is $y = 4$ at $x = 3$.
9. This is a good place to slow down, check the notation, and simplify cleanly. All real x allowed. So the answer is $\mathbb{R}$.
10. Take it one clear step at a time and keep the original question in mind. x^2 is always nonneg. So the answer is $y \geq 0$.
11. Start with the definition the problem is testing, then apply it directly. Negated. So the answer is $y \leq 0$.
12. Look for the key feature the question asks about, such as a zero, intercept, or vertex. $= (x - 3)^2$, vertex $(3, 0)$. That leads to $(3, 0)$.
13. This is a good place to slow down, check the notation, and simplify cleanly. $x^2 = -1$ has no real solution. So the answer is none.
14. Start with the definition the problem is testing, then apply it directly. $x^2 = 1$. So the answer is ± 1.
15. Use the structure of the expression to find the important point, then check that it fits the context. To the right of vertex, parabola goes up. That leads to $x > 2$.
16. First identify the feature of the graph or equation that matches the wording of the question. Vertex $(1, 0)$, opens down. That leads to 0.
17. This is a good place to slow down, check the notation, and simplify cleanly. $a = 3 > 0$ opens up, so $(4, 1)$ is the minimum. So the answer is $(4, 1)$, min.
18. This is a good place to slow down, check the notation, and simplify cleanly. $= (x - 1)^2$. So the answer is $(1, 0)$.
19. Use the structure of the expression to find the important point, then check that it fits the context. From factored form. That leads to $-3, 1$.
20. Use the structure of the expression to find the important point, then check that it fits the context. Vertex at y-int; zeros at ± 5. That leads to $(0, -25)$, ± 5.
21. Use the structure of the expression to find the important point, then check that it fits the context. A downward-opening parabola reaches its maximum at the vertex. The maximum value is 5. That leads to 5.
22. Because the parabola opens up, the vertex gives the minimum value. Its y-value is -3.
23. Use the given numbers to build the model, then finish the calculation. $t = -\frac{48}{-32} = 1.5$. $h(1.5) = -36 + 72 = 36$ ft.
24. For a table question, slow down and locate the exact row, column, or cell before calculating. Zeros: $x^2 = 16 \Rightarrow x = \pm 4$. Width $= 8$. Vertex: $(0, 16)$. Max height $= 16$. This gives width 8, height 16.
25. First identify the feature of the graph or equation that matches the wording of the question. Vertex: $p = -\frac{40}{-4} = 10$. $R(10) = -200 + 400 = 200$. That leads to $p = \$10$, $R = \$200$.
26. $h = 0$: $-16t^2 + 8t + 24 = 0 \Rightarrow 2t^2 - t - 3 = 0 \Rightarrow (2t - 3)(t + 1) = 0$. Positive: $t = \frac{3}{2}$.

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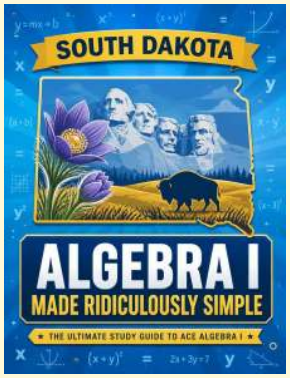

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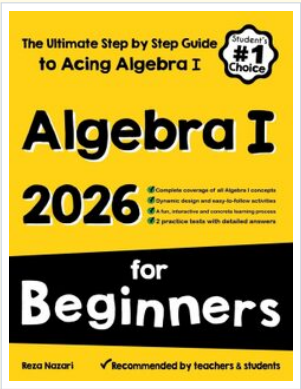

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