

Characteristics of Quadratic Functions

Name: _____

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Q 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

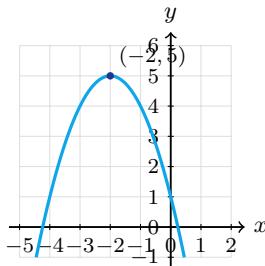
Identify features of each quadratic.

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

◆ VISUAL PRACTICE

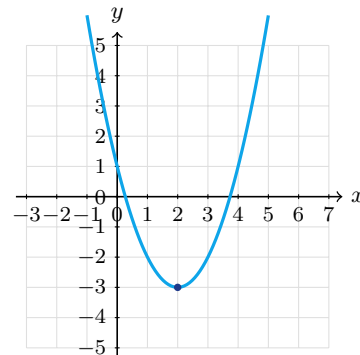
Use the graph, table, chart, or diagram to answer the question.

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

- | | |
|--|--|
| <ol style="list-style-type: none"> 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. $y < 0$ 12. $(3, 0)$ 13. none | <ol style="list-style-type: 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 $y < 0$.
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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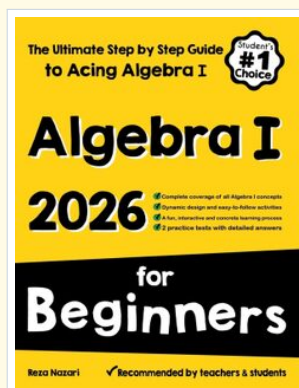
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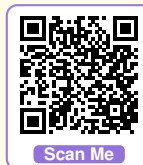
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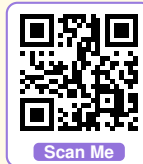
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