Chapter 3: Quadratic Functions. Based on these sources, here is a comprehensive guide to help you prepare for your test on **Quadratic Functions**, including key concepts, essential equations, and a study checklist.

Important Concepts and Key Ideas

- **Properties of Quadratic Functions:** These functions are of degree 2 and their graphs are parabolas. A parabola is symmetric about a vertical line called the **axis of symmetry**, which passes through the **vertex**.
- **Forms of the Quadratic Function:**
  - **Standard Form ($f(x) = ax^2 + bx + c$):** Useful for identifying the y-intercept (c).
  - **Factored Form ($f(x) = a(x - r)(x - s)$):** Useful for identifying the x-intercepts or zeros (r and s).
  - **Vertex Form ($f(x) = a(x - h)^2 + k$):** Useful for identifying the vertex (h, k) and the axis of symmetry ($x = h$).
- **Maximum and Minimum Values:** The y-coordinate of the vertex represents the maximum or minimum value of the function. If $a > 0$, the parabola opens up and has a minimum; if $a < 0$, it opens down and has a maximum.
- **The Inverse of a Quadratic Function:** The inverse of $f(x) = x^2$ is not a function unless the domain of the original function is restricted (e.g., $x \geq 0$). Graphically, the inverse is a reflection across the line $y = x$.
- **Operations with Radicals:** An **entire radical** (e.g., $\sqrt{72}$) can be simplified into a **mixed radical** (e.g., $6\sqrt{2}$) by extracting perfect-square factors. You can only add or subtract **like radicals** (those with the same number under the radical sign).
- **The Discriminant ($b^2 - 4ac$):** This value determines the number of zeros for a quadratic function:
  - $D > 0$: Two distinct real zeros.
  - $D = 0$: One real zero (the vertex sits on the x-axis).
  - $D < 0$: No real zeros.
- **Families of Parabolas:** A “family” is a group of parabolas that share a common characteristic, such as the same vertex, the same zeros, or the same y-intercept.
- **Linear-Quadratic Systems:** A line can intersect a parabola at most at two points. Intersection points are found by setting the linear equation equal to the quadratic equation and solving the resulting quadratic.

Important Equations, Laws, and Rules

Rule/Concept	Equation/Formula
Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
Discriminant	$D = b^2 - 4ac$
Vertex (from zeros)	$x = \frac{r+s}{2}$
Radical Multiplication	$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ (for $a, b \geq 0$)
Radical Multiplication (Mixed)	$(c\sqrt{a})(d\sqrt{b}) = cd\sqrt{ab}$
Inverse Mapping	Point (x, y) becomes (y, x)
Profit Function	$P(x) = R(x) - C(x)$ (Revenue - Cost)

Study Checklist

1. Properties and Graphing (3.1 - 3.2)

- [ ] Can you identify a quadratic function from a table of values using **second differences**?
- [ ] Can you convert between standard, factored, and vertex forms?
- [ ] Do you know how to **complete the square** to find the vertex?
- [ ] Can you solve real-world “max/min” problems (e.g., maximizing profit or area)?

2. Inverses and Radicals (3.3 - 3.4)

- [ ] Can you find the equation of an inverse by switching x and y and solving for y?
- [ ] Do you know how to restrict the domain so the inverse is a function?
- [ ] Can you simplify radicals by finding the largest perfect-square factor?
- [ ] Can you multiply binomial radical expressions (e.g., using FOIL)?

3. Solving Equations and Systems (3.5, 3.6, 3.8)

- [ ] Can you solve quadratic equations using factoring and the **quadratic formula**?
- [ ] Do you know how to identify **inadmissible solutions** in word problems (e.g., negative time or width)?
- [ ] Can you use the **discriminant** to predict the number of zeros or intersection points?
- [ ] Can you solve a **linear-quadratic system** algebraically and state the points of intersection?

4. Modeling and Families (3.7)

- [ ] Can you determine the equation of a parabola given its vertex and one other point?
- [ ] Can you determine the equation of a parabola given its zeros and one other point?
- [ ] Do you understand that changing 'a' in $y = a(x - h)^2 + k$ creates a family of parabolas with the same vertex?