Week 3: Quadratic Functions – Cheat Sheet (Revised)

# 1. General Form

f(x) = ax² + bx + c  
Graph is a parabola (a ≠ 0):

* - Opens upward if a > 0 (Minimum at vertex)
* - Opens downward if a < 0 (Maximum at vertex)

# 2. Key Features

* Vertex: x = -b / 2a, y = f(-b / 2a)
* Axis of Symmetry: x = -b / 2a
* Y-intercept: f(0) = c
* X-intercepts: Solve f(x) = 0

# 3. Slope of a Quadratic Function

* Slope = rate of change of f(x):

• Slope at any point x: 2ax + b

• Slope is 0 at the vertex (x = -b / 2a)

• Slope increases/decreases linearly with x

# 4. Solving Methods

• Factoring: Simple roots or perfect squares

• Completing the Square: Convert to (x ± a)² = b

• Quadratic Formula: x = (-b ± √(b² - 4ac)) / 2a

# 5. Discriminant (D = b² - 4ac)

* - D > 0: Two real roots (rational or irrational)
* - D = 0: One repeated real root
* - D < 0: No real roots (complex)

# 6. Real-World Applications (Tutorials)

* Bus fare revenue: Revenue max at vertex
* Fuel efficiency: Max km/l ⇒ Min cost/km
* YouTube likes: Max likes at vertex
* Tent cost: Cost ∝ surface area (πr√(r² + h²))
* Triangle under curve: Area from vertex and roots
* Closest point to curve: Min value of function
* Repeated root graph: Touch x-axis at one point
* Road symmetry: Parabola symmetry simplifies design

# 7. Tips

• Use vertex for optimization (max/min)

• Graph helps visualize root count and function behavior

• Axis of symmetry divides parabola into mirror halves