Playing With Latex

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1 Deriving the Quadratic Forumla

Start with the general formula for a quadratic equation

$$ax^2 + bx + c = 0$$

Divide by a

$$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$$

Subtract $\frac{c}{a}$ from both sides

$$x^2 + \frac{b}{a}x = -\frac{c}{a}$$

Complete the square

$$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = \frac{b^2}{4a^2} - \frac{c}{a}$$

Factor on the left, find a common denominator on the right

$$(x + \frac{b}{2a})^2 = \frac{b^2}{4a^2} - \frac{4ac}{4a^2}$$

Take the square root of both sides

$$x + \frac{b}{2a} = \pm\sqrt{\frac{b^2-4ac}{4a^2}}$$

Subtract $\frac{b}{2a}$ from both sides

$$x = -\frac{b}{2a} \pm \frac{\sqrt{b^2-4ac}}{\sqrt{4a^2}}$$

And reorganize

$$x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

2 Deriving Trigonometric Identities

Start with the identity

$$\sin^2(\theta) + \cos^2(\theta) = 1 \tag{1}$$

Divide both sides by $\cos^2(\theta)$

$\frac{\sin^2(\theta)}{\cos^2(\theta)} + \frac{\cos^2(\theta)}{\cos^2(\theta)} = \frac{1}{\cos^2(\theta)}$

$$\tan^2(\theta) + 1 = \sec^2(\theta) \tag{2}$$

Alternatively, start with the same identity and divide both sides by $\sin^2(\theta)$

$\frac{\sin^2(\theta)}{\sin^2(\theta)} + \frac{\cos^2(\theta)}{\sin^2(\theta)} = \frac{1}{\sin^2(\theta)}$

$$1 + \cot^2(\theta) = \csc^2(\theta) \tag{3}$$

Pythagorean Theorem $a^2 + b^2 = c^2$