

# A Sample Document

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## 1 The Quadratic Formula

**Theorem 1.1.** *The complex solution(s) to the general quadratic equation  $ax^2 + bx + c = 0$ , where  $a, b, c \in \mathbb{R}$ , are given by*

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

*Proof.* We begin by dividing through by  $a$ .

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

Then we complete the square.

$$\begin{aligned} 0 &= x^2 + \frac{b}{a}x + \frac{c}{a} \\ &= \underbrace{x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2}_{\text{a perfect square}} + \frac{c}{a} - \left(\frac{b}{2a}\right)^2 \\ &= \left(x + \frac{b}{2a}\right)^2 + \frac{c}{a} - \left(\frac{b}{2a}\right)^2 \end{aligned}$$

Then we just use algebra to solve for  $x$ .

$$\begin{aligned} \left(x + \frac{b}{2a}\right)^2 &= \left(\frac{b}{2a}\right)^2 - \frac{c}{a} \\ x + \frac{b}{2a} &= \pm \sqrt{\left(\frac{b}{2a}\right)^2 - \frac{c}{a}} \\ x &= -\frac{b}{2a} \pm \sqrt{\left(\frac{b}{2a}\right)^2 - \frac{c}{a}} \end{aligned}$$

Since the above is equivalent to  $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ , we are done. □

In the wild, we will sometimes need to remember useful trig identities, like

$$\sin^2(x) + \cos^2(x) = 1$$

which follows from the Pythagorean Theorem. Occasionally, we'll need to remember certain trigonometric limits as well, like

$$\lim_{x \rightarrow 0} \frac{\sin(x)}{x} = 1.$$

At some point, everyone needs to know how to evaluate  $\int_1^5 3x^2 \cos(x^3) dx$ . For this, we will need the Fundamental Theorem of Calculus, which states that

$$\int_a^b f(x) dx = F(b) - F(a),$$

where  $F$  is any antiderivative of  $f$ . And we should **always** remember the determinant of a  $2 \times 2$  matrix,

$$\det \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - bc.$$

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We can do many cool things in L<sup>A</sup>T<sub>E</sub>X! If you can think it, you can write it. That reminds me, I need to grab these things at the grocery store:

- Milk
- Bread
- **Toilet paper !!!**

While I'm shopping, I should remember the cardinal rules:

- A) Remember to bring your grocery list
- B) Get cold items last
- C) Never put bread on the bottom