Mathematics

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Preface

Mathematics possesses not only truth, but supreme beauty,a beauty cold and austere, like that of a sculpture, and capable of stern perfection, such as only great art can show.
–Bertrand Russell

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1 Algebra

1.1 Why Study Algebra ?

Algebra is the unifying thread of all mathematics, the language of the universe, the language of science. It's an abstract system, meaning that you can describe really complex events in a more simple way thanks to the abstraction.

1.2 Sets and Functions

Definition. *set* is a collection of objects. We call the objects, *elements*. A set is denoted by listing the elements between

$S \cup \emptyset = S$, $S \cap \emptyset = \emptyset$, $S \setminus \emptyset = S$, $S \setminus S = \emptyset$.

In general, we must take care in applying functions to equations. If we apply a many-to-one function, we may introduce spurious solutions. Applying $f(x) = x^2$ to the equation $x = \frac{\pi}{2}$ results in $x^2 = \frac{\pi^2}{4}$, which has the two solutions, $x = \{\pm\frac{\pi}{2}\}$. Applying $f(x) = \sin x$ results in $x^2 = \frac{\pi^2}{4}$, which has an infinite number of solutions, $x = \{\frac{\pi}{2} + 2n\pi \,|\, n \in \mathbb{Z}\}$.