Definition 1. For a real number $x$, $|x|$ is defined as follows.

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{otherwise} \end{cases}$$

Problem 1. For real numbers $x, y$, $|xy| = |x||y|$.

Problem 2. Prove that $\sqrt{2}$ is irrational.
Problem 3. There are infinitely many primes.

Problem 4. There are irrational numbers \( x \) and \( y \) such that \( x^y \) is rational.