1. For nontrivial ideals I and J of a ring R, prove that if R is an integral domain, then $I \cap J \neq \{0\}$.
2. Prove that no ideal of R is a maximal ideal in $R[x]$.
3. Demonstrate that it is possible for a set I to be an ideal in a ring R, and J to be ideal in I, but for J not to be an ideal of R.
4. Describe the smallest subring of $\mathbb{R}$ which contains $\frac{2}{3}$.
5. Prove that if a ring R has no zero-divisors and contains a nonzero element x such that $x^2 = x$, then x is the multiplicative identity in R.