Consider $G_Z = \text{Spec}(\mathbb{Z}[x])_0$ of nonzero prime ideals of $\mathbb{Z}[x]$ as a partially ordered set by inclusion. We further view $G_Z$ as an infinite bipartite graph with the prime ideals as the vertices and the inclusion relations as the edges. In this paper, we investigate fundamental graph theoretic properties of $G_Z$. In particular, we describe the diameter, circumference, girth, radius, eccentricity, global and local connectivity, and cliques of $G_Z$. The complement of $G_Z$ is investigated as well. (Received September 20, 2016)