In prior work an orbit method, due to Pukanszky and Lipsman, was used to produce an injective mapping $\Psi : \Delta(K, N) \to n^*/K$ from the space of bounded $K$-spherical functions for a nilpotent Gelfand pair $(K, N)$ into the space of $K$-orbits in the dual for the Lie algebra $n$ of $N$. We have conjectured that $\Psi$ is a topological embedding. This has been proved for all pairs $(K, N)$ with $N$ a Heisenberg group. A nilpotent Gelfand pair $(K, N)$ is said to be irreducible if $K$ acts irreducibly on $n/[n,n]$. In this paper and its sequel we will prove that $\Psi$ is an embedding for all such irreducible pairs. Our proof involves careful study of the non-Heisenberg entries in Vinberg’s classification of irreducible nilpotent Gelfand pairs. Part I concerns generalities and six related families of examples from Vinberg’s list in which the center for $n$ can have arbitrarily large dimension.

**Keywords:** Gelfand pairs, spherical functions, nilpotent Lie groups, orbit method.

**MSC:** 22E30, 43A90.