Designing Patterns with Polar Equations using Maple

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The Cartesian coordinates and polar coordinates can be used to identify a point in two dimensions. The polar coordinate system has a fixed point **O** called the origin or pole and a directed half –line called the polar axis with end point **O.** A point **P** on the plane can be described by the polar coordinates **(r,** θ**),** where r is the radial distance from the origin and θ is the angle made by **OP** with the polar axis.

Several important types of graphs have equations that are simpler in polar form than in rectangular form. For example, the polar equation of a circle having radius **a** and centered at the origin is simply **r = a.** In other words**,** polar coordinate system is useful in describing two dimensional regions that may be difficult to describe using Cartesian coordinates. For example, graphing the circle $x^2 + y^2 = a^2$ in Cartesian coordinates requires two functions, one for the upper half and one for the lower half. In polar coordinate system, the same circle has the very simple representation **r = a.**

Maple can be used to create patterns in two dimensions using polar coordinate system. When we try to analyze two dimensional patterns mathematically it will be helpful if we can draw a set of patterns in different colors using the help of technology. To investigate and compare some patterns we will go through some examples of cardioids and rose curves that are drawn using Maple.

The name cardioid comes from the shape of a heart. The general equation of a cardioid is of the form $r = a + b\cos(k\theta)$ or $r = a + b\sin(k\theta)$. The shape of cardioids vary depending on the values of a,b and k. To analyze different shapes of the cardioids we will first go through some simple examples of polar equations of the form $r = a + b\cos(\theta)$ with different values of a, b, and k=1.