Section 6.1 – Polar Coordinates – Day 2

Now that you know how to plot points in polar coordinates, you will draw graphs of functions in polar coordinates. You will create T-tables with θ and the corresponding function value r, and then graph these $(r,\ \theta)$ ordered pairs.

There are many different types of polar graphs, but we will be looking mainly at polar graphs called limaçons. Limaçon comes from the French word for snail.

The general equation is of the form: $r = c + a\cos\theta$, $r = c - a\cos\theta$, $r = c + a\sin\theta$, or $r = c - a\sin\theta$.
If $a > c$, the graph will have what is called an inner loop.
If $a = c$, the graph will touch the pole.

Example 4: Plot the graph of $r = 3 + 7\cos\theta$.

$a = 7, \quad c = 3$

$a > c \quad \Rightarrow$ There will be an inner loop

Create a table of points to graph

θ	$r = 3+7\cos\theta$	θ	$r = 3+7\cos\theta$	θ	$r = 3+7\cos\theta$
0°	$r = 3+7\cos 0^\circ$ $= 3+7(1)$ $= 3+7$ $= 10$ $(r,\theta) = (10, 0^\circ)$	135°	$r = 3+7\cos 135^\circ$ $= 3+7\left(\frac{-\sqrt{2}}{2}\right)$ $= 3-4.95$ $= -1.95$ $(r,\theta) = (-1.95, 135^\circ)$	270°	$r = 3+7\cos 270^\circ$ $= 3+7(0)$ $= 3+0$ $= 3$ $(r,\theta) = (3, 270^\circ)$
30°	$r = 3+7\cos 30^\circ$ $= 3+7\left(\frac{\sqrt{3}}{2}\right)$ $= 3+6.06$ $= 9.06$ $(r,\theta) = (9.06, 30^\circ)$	150°	$r = 3+7\cos 150^\circ$ $= 3+7\left(\frac{-\sqrt{3}}{2}\right)$ $= 3-6.06$ $= -3.06$ $(r,\theta) = (-3.06, 150^\circ)$	300°	$r = 3+7\cos 300^\circ$ $= 3+7\left(\frac{1}{2}\right)$ $= 3+3.5$ $= 6.5$ $(r,\theta) = (6.5, 300^\circ)$
45°	$r = 3+7\cos 45^\circ$ $= 3+7\left(\frac{\sqrt{2}}{2}\right)$ $= 3+4.95$ $= 7.95$ $(r,\theta) = (7.95, 45^\circ)$	180°	$r = 3+7\cos 180^\circ$ $= 3+7(-1)$ $= 3-7$ $= -4$ $(r,\theta) = (-4, 180^\circ)$	315°	$r = 3+7\cos 315^\circ$ $= 3+7\left(\frac{\sqrt{2}}{2}\right)$ $= 3+4.95$ $= 7.95$ $(r,\theta) = (7.95, 315^\circ)$
60°	$r = 3+7\cos 60^\circ$ $= 3+7\left(\frac{1}{2}\right)$ $= 3+3.5$ $= 6.5$ $(r,\theta) = (6.5, 60^\circ)$	210°	$r = 3+7\cos 210^\circ$ $= 3+7\left(\frac{-\sqrt{3}}{2}\right)$ $= 3-6.06$ $= -3.06$ $(r,\theta) = (-3.06, 210^\circ)$	330°	$r = 3+7\cos 330^\circ$ $= 3+7\left(\frac{\sqrt{3}}{2}\right)$ $= 3+6.06$ $= 9.06$ $(r,\theta) = (9.06, 330^\circ)$
90°	$r = 3+7\cos 90^\circ$ $= 3+7(0)$ $= 3+0$ $= 3$ $(r,\theta) = (3, 90^\circ)$	225°	$r = 3+7\cos 225^\circ$ $= 3+7\left(\frac{-\sqrt{2}}{2}\right)$ $= 3-4.95$ $= -1.95$ $(r,\theta) = (-1.95, 225^\circ)$	360°	$r = 3+7\cos 360^\circ$ $= 3+7(1)$ $= 3+7$ $= 10$ $(r,\theta) = (10, 360^\circ)$
120°	$r = 3+7\cos 120^\circ$ $= 3+7\left(\frac{-1}{2}\right)$ $= 3-3.5$ $= -0.5$ $(r,\theta) = (-0.5, 120^\circ)$	240°	$r = 3+7\cos 240^\circ$ $= 3+7\left(\frac{-1}{2}\right)$ $= 3-3.5$ $= -0.5$ $(r,\theta) = (-0.5, 240^\circ)$		

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So, the ordered pairs (r, θ) for the graph are:

$(10, 0^\circ)$
$(9.06, 30^\circ)$
$(7.95, 45^\circ)$
$(6.5, 60^\circ)$
$(3, 90^\circ)$
$(-0.5, 120^\circ)$
$(-1.95, 135^\circ)$
$(-3.06, 150^\circ)$
$(-4, 180^\circ)$
$(-3.06, 210^\circ)$
$(-1.95, 225^\circ)$
$(-0.5, 240^\circ)$
$(3, 270^\circ)$
$(6.5, 300^\circ)$
$(7.95, 315^\circ)$
$(9.06, 330^\circ)$
$(10, 360^\circ)$