

## Polar Graphs - Summary

	<u>General Equation</u>	<u>Description of Graph</u>	<u>Mathematical Name</u>
I.	$r = a \pm b \cos \theta$ $r = a \pm b \sin \theta$ A. $ a  =  b $ B. $ a  <  b $ C. $ a  >  b $	Heart Loop de Loop i) Flatten Circle if $a = 2b$ ii) Dent or Dimple if $a < 2b$	<b>Limaçon</b> (snail in French):  <b>Cardioid</b> (limacon) <b>Limaçon with inner loop</b> <b>Convex Limaçon</b> <b>Dimpled Limaçon</b>
II.	$r = a \cos n\theta$ $r = a \sin n\theta$  $(n > 1)$	Rose (flower/cloverleaf) (if $n$ is odd then $n$ 'petals' ; if $n$ is even then $2n$ 'petals') ('petals' $\frac{360^\circ}{n}$ apart)  (for $\sin n\theta$ : 1st 'petal' at $\frac{90^\circ}{n}$ ; for $\cos n\theta$ : 1st 'petal' at $0^\circ$ )	<b>Rose</b> (rose curve)
III.	$r = a$ or $r = a \cos \theta$ $r = a \sin \theta$	Circles: center at pole, radius of 'a' center at $(\frac{a}{2}, 0)$ radius of $\frac{a}{2}$ center at $(0, \frac{a}{2})$ radius of $\frac{a}{2}$	<b>Circle</b>
IV.	$\theta = a$ or $r = \frac{a}{\cos \theta}$ $r = \frac{a}{\sin \theta}$	Lines: diagonal at angle of 'a' vertical intercepting at $(a, 0)$ horizontal intercepting at $(0, a)$	<b>Line</b>
V.	$r = a \theta$ (Note: $\theta$ must be a radian decimal number)	Spiral (counterclockwise if $\theta > 0$ ) (clockwise if $\theta < 0$ )	<b>Spiral of Archimedes</b>
VI.	$r^2 = a^2 \cos 2\theta$  $r^2 = a^2 \sin 2\theta$	Figure 8 (bow tie/propeller) ('petals' at $0^\circ$ and $180^\circ$ ) ('petals' at $45^\circ$ and $225^\circ$ )	<b>Lemniscate</b> (ribbon in Greek)

Note the symmetry of the graph with the horizontal ( $0^\circ$ ) polar axis or the vertical ( $90^\circ$ ) axis and the type of trigonometric function the equation has in it. For all categories above, except part VI., if the equation has in it the:

a)  $\cos \theta$  then the graph is symmetrical with the polar axis (horizontal,  $0^\circ$  axis)

b)  $\sin \theta$  then the graph is symmetrical with the vertical  $90^\circ$  axis