

Notes 13.2 Continued

Graphs of Polar Equations

A limaçon is a figure with polar equation
 $r = a + b \cos \theta$ or $r = a + b \sin \theta$

If $a < b$, then it has an inner loop $r = 1 + 2 \cos \theta$
 If $a > b$, then it has **no** inner loop $r = 3 + 2 \cos \theta$
 If $a = b$, then it is heart shaped (**cardioid**) $r = 1 - \sin \theta$

$r = 2 \cos(2\theta)$ example of a **rose** *If number next to θ is even, then $2n$ petals.
 $r = 6 \sin(5\theta)$ If number next to θ is odd, then n petals.

Convert equations from Polar to Cartesian form.

* recall:
 $x = r \cos \theta$
 $y = r \sin \theta$
 $r^2 = x^2 + y^2$

1. $r = 4$ *check by graphing

$\sqrt{x^2 + y^2} = 4$
 $x^2 + y^2 = 16 \rightarrow \text{circle}$

2. $r = 6 \cos \theta$
 $r^2 = 6r \cos \theta$
 $x^2 + y^2 = 6x$

$x^2 - 6x + y^2 = 0 \rightarrow \text{circle}$

3. $r = -4 \cos \theta$
 $r^2 = -4r \cos \theta$

$x^2 + y^2 = -4x$
 $x^2 + 4x + y^2 = 0 \rightarrow \text{circle}$

4. $r = 2 \sin \theta$
 $r^2 = 2r \sin \theta$

$x^2 + y^2 = 2y$
 $x^2 + y^2 - 2y = 0 \rightarrow \text{circle}$

5. $r \sin \theta = 3$

$y = 3 \rightarrow \text{line}$

6. $r \cos \theta = 7$

$x = 7 \rightarrow \text{line}$

7. $r = \frac{9}{5-4 \cos \theta}$ * $5-4 \cos \theta$

$r(5-4 \cos \theta) = 9$
 $5r - 4r \cos \theta = 9$
 $5\sqrt{x^2 + y^2} - 4x = 9$
 $(5\sqrt{x^2 + y^2})^2 = (4x + 9)^2$
 $25(x^2 + y^2) = (4x + 9)(4x + 9)$
 $25x^2 + 25y^2 = 16x^2 + 72x + 81$

$9x^2 - 72x + 25y^2 - 81 = 0$
 ellipse

8 on back \rightarrow

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$$r = \frac{9}{4+5\cos\theta}$$

$$r(4+5\cos\theta) = 9$$

$$4r + 5r\cos\theta = 9$$

$$4\sqrt{x^2+y^2} + 5x = 9$$

$$(4\sqrt{x^2+y^2})^2 = (9-5x)^2$$

$$16(x^2+y^2) = (-5x+9)(-5x+9)$$

$$16x^2 + 16y^2 = 25x^2 - 90x + 81$$

$$0 = 9x^2 - 90x - 16y^2 + 81$$

hyperbola