

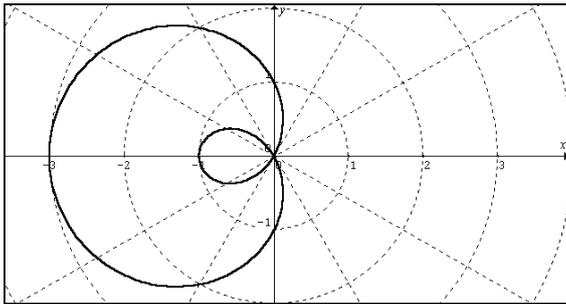
Limaçon (3 tipos)

Equação polar: $r = a \pm b \cos(\theta)$, ou $r = a \pm b \sin(\theta)$; $a \in \mathbb{R}^*$ e $b \in \mathbb{R}_+^*$.

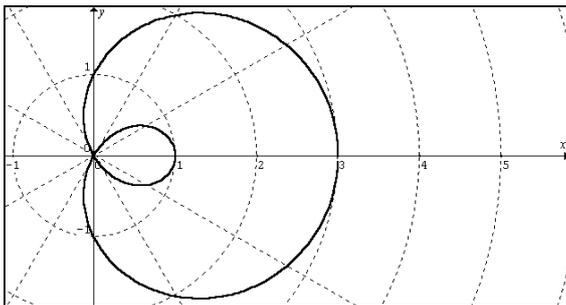
A primeira equação é de uma curva simétrica em relação ao eixo polar ($\cos(\theta)$) e a segunda ($\sin(\theta)$), uma curva simétrica em relação ao eixo a 90° .

1º caso – Limaçon com um laço ($|a| < b$)

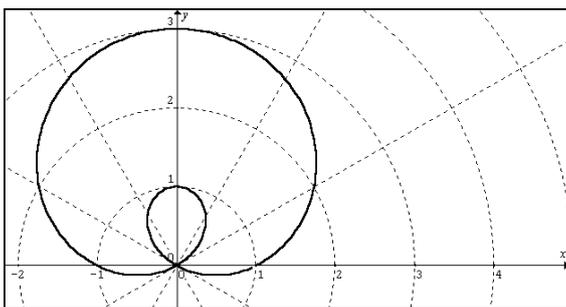
1.1) $r = 1 - 2\cos(\theta)$



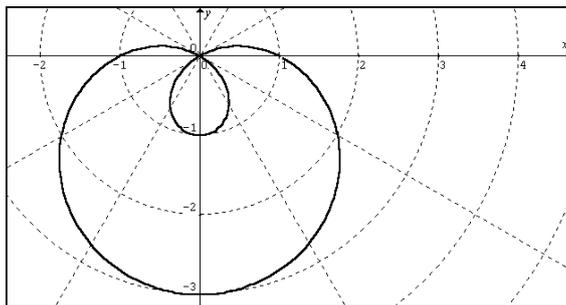
1.2) $r = 1 + 2\cos(\theta)$



1.3) $r = 1 + 2\sin(\theta)$

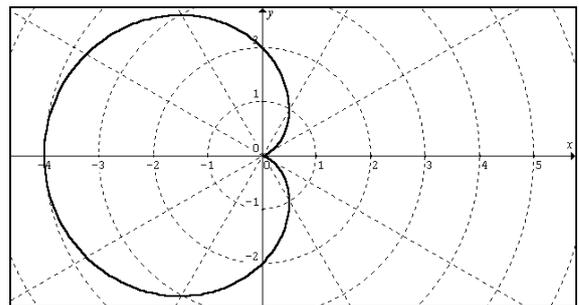


1.4) $r = 1 - 2\sin(\theta)$

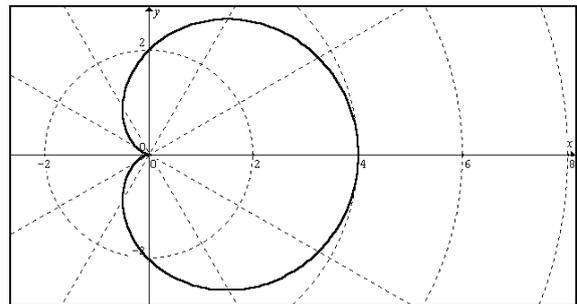


2º caso – Cardióide ($|a| = b$)

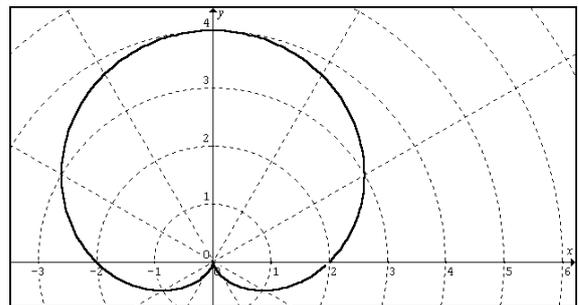
2.1) $r = 2 - 2\cos(\theta)$



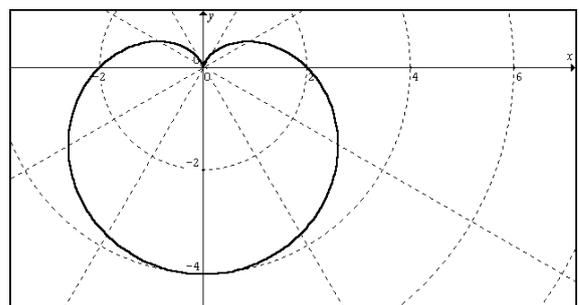
2.2) $r = 2 + 2\cos(\theta)$



2.3) $r = 2 + 2\sin(\theta)$

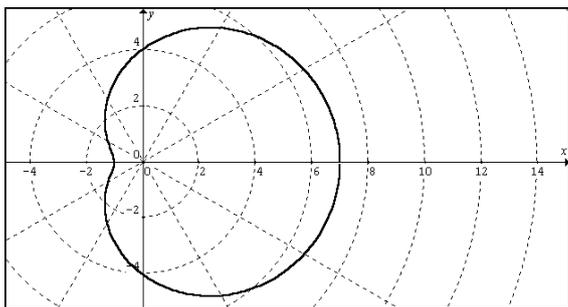


2.4) $r = 2 - 2\sin(\theta)$

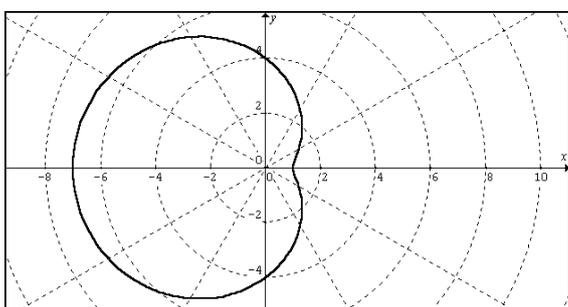


3º caso – Limaçon sem laço ($|a| > b$)

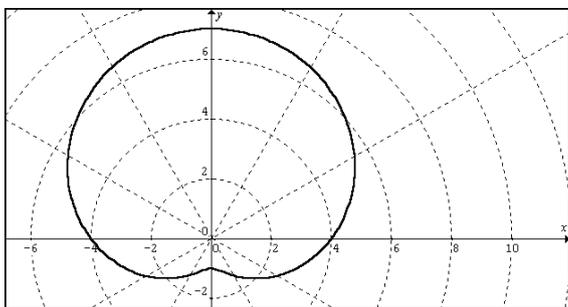
3.1) $r = 4 + 3\cos(\theta)$



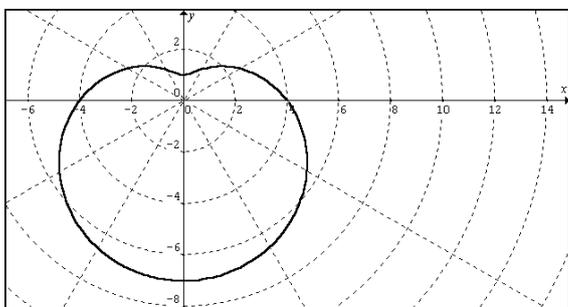
3.2) $r = 4 - 3\cos(\theta)$



3.3) $r = 4 + 3\sin(\theta)$



3.4) $r = 4 - 3\sin(\theta)$



Obs: Para um traçado rápido do limaçon deve-se identificar o tipo e calcular as intersecções com os eixos a 90° e polar.

- P/ eixo polar faz-se $\theta = 0^\circ$ e $\theta = 180^\circ$;
- P/ eixo a 90° faz-se $\theta = 90^\circ$ e $\theta = 270^\circ$.

Se necessário, usar mais arcos côngruos.

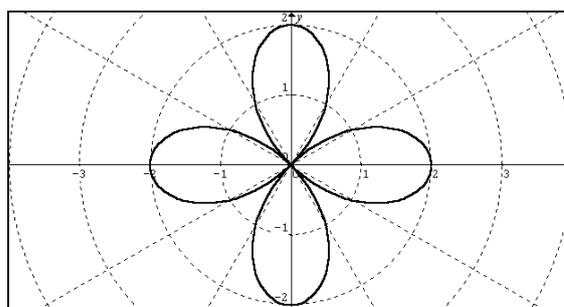
Rosácea

Equação polar: $r = a\cos(n\theta)$, $r = a\sin(n\theta)$;
 $a \neq 0$ e $n \in \mathbb{Z}^*$, com $|n| \neq 1$.

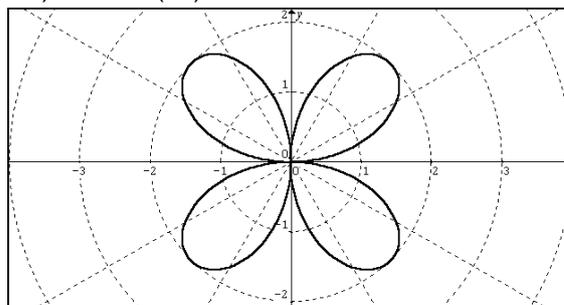
- Se n é par a rosácea tem $2n$ pétalas;
- Se n é ímpar a rosácea tem n pétalas.

O espaçamento entre os eixos das pétalas é dado por $360^\circ \div p$, onde p é o número de pétalas.

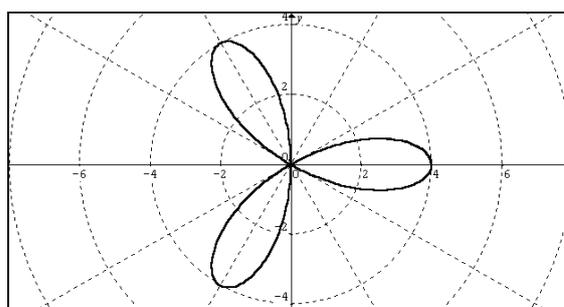
4.1) $r = 2\cos(2\theta)$



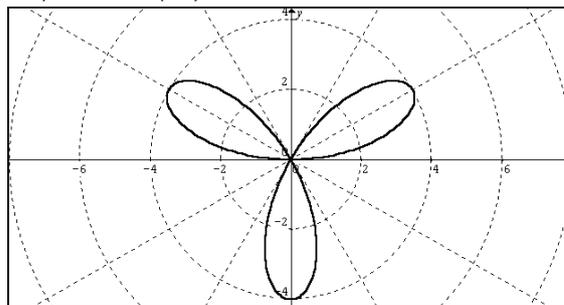
4.2) $r = 2\sin(2\theta)$



4.3) $r = 4\cos(3\theta)$



4.4) $r = 4\sin(3\theta)$



Obs: é importante determinar a extensão de r , bem como os pontos que são as pontas das pétalas.

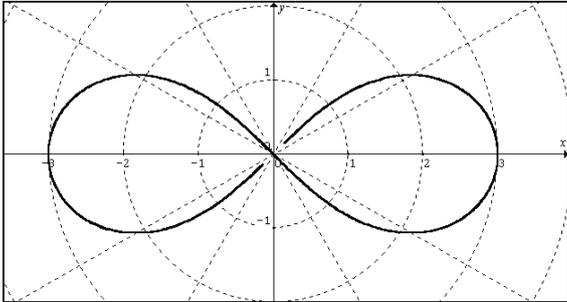
Lemniscata

Equação polar:

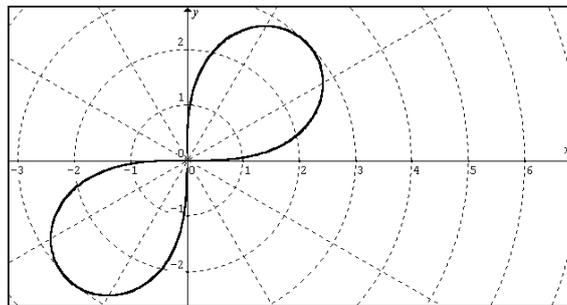
$$r^2 = a\cos(2\theta), \text{ ou } r^2 = a\sin(2\theta); a \neq 0.$$

Observar a extensão de θ , se $a > 0$, então $\cos(2\theta)$ ou $\sin(2\theta)$ devem ser > 0 e se $a < 0$ então $\cos(2\theta)$ ou $\sin(2\theta)$ devem ser < 0 (observe a variação de θ).

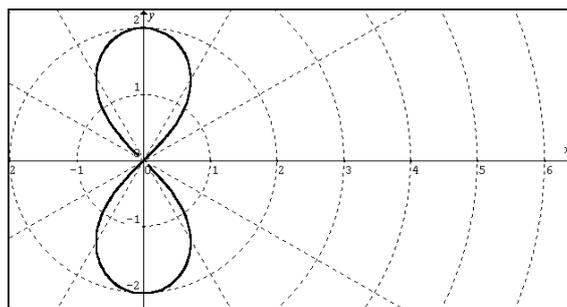
5.1) $r^2 = 9\cos(2\theta)$



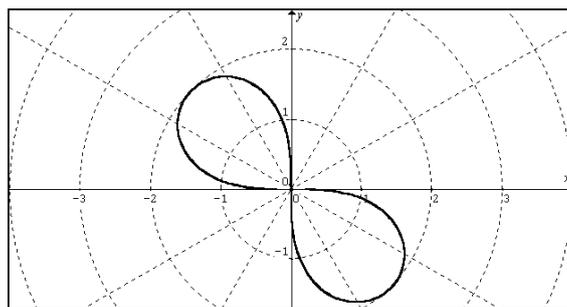
5.2) $r^2 = 9\sin(2\theta)$



5.3) $r^2 = -4\cos(2\theta)$



5.4) $r^2 = -4\sin(2\theta)$



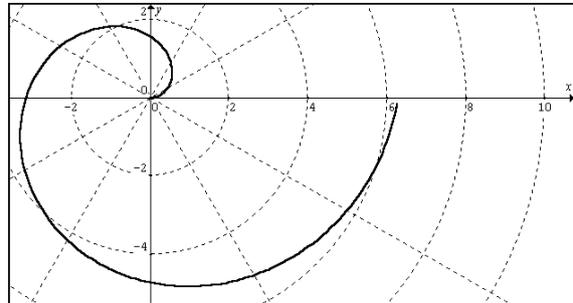
Espiral de Arquimedes

Equação polar:

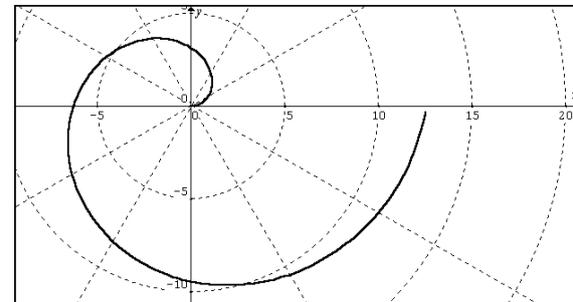
$$r = a\theta; \theta \geq 0 \text{ (sentido anti-horário) ou}$$

$$r = a\theta; \theta \leq 0 \text{ (sentido horário) e } a \neq 0.$$

6.1) $r = \theta$ (sentido anti-horário, $\theta \geq 0$)



6.2) $r = 2\theta$ (sentido anti-horário, $\theta \geq 0$)



Obs: O esboço da espiral faz-se atribuindo valores a θ e marcando o gráfico ponto a ponto.