





LIMACON: $R = A + B \cos \theta$


$A < B$: LIMACON WITH INNER LOOP 

$A = B$: CARDIOID 

$2B > A > B$: DIMPLED LIMACON 

$A > 2B$: CONVEX LIMACON 

USING THE P CASES DEFINITION 

NEG. P CASE 

A : INTERCEPT (H-) ON POS SIDE OF SUM

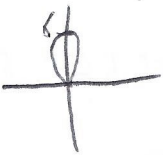
RULE CURVES:

$R = A \cos B \theta$

$R = A \sin B \theta$

$A+B$: INTERCEPT ON POSITIVE SIDE OF SUM

$r = b \sin \theta$



$r = -b \sin \theta$



$r = b \cos \theta$



$r = -b \cos \theta$



$|A|$ = PERIOD LENGTH

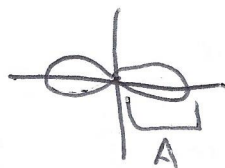
COS SUM MAXIMUM PERIOD $(\frac{\pi}{B})$ POS

SIN SUM MINIMUM PERIOD $(\frac{\pi}{B})$ NEG

b when $\theta = \pi$ has "0" period, but $2B$ period when $\theta = 0$

CENTRISCAPE

$R^2 = A^2 \cos^2 \theta$



number of PERIODS IF EVEN
double PERIODS IF ODD

$R^2 = A^2 \sin^2 \theta$



number of PERIODS IF EVEN = # of PERIODS
ODD = double PERIODS

$$R = 2 - 2 \cos \phi$$

$$R = 2 - 2 \cos(-\phi)$$

$$R = 2 - 2 \cos \phi$$



same axis

$$-R = 2 - 2 \cos(-\phi)$$

$$-R = 2 - 2 \cos \phi$$

$$R = -2 + 2 \cos \phi$$



$$\phi = \frac{\pi}{2}$$

$$-R = 2 - 2 \cos \phi$$

$$R = -2 + 2 \cos \phi$$



pole

$$R = 2 - 2 \cos \phi$$

pole axis $(R, \phi) \equiv (R, -\phi)$ or $(-R, \pi - \phi)$

$\frac{\pi}{2}$ axis $(R, \phi) = (-R, -\phi) \rightarrow$ or $(R, \pi - \phi)$

pole symmetry $(R, \phi) = (-R, \phi)$ or $(R, \pi + \phi)$

① IF CALCULATED SYMMETRY WORKS, THEN YOU MUST DOUBLE CHECK (WE NEED TO TEST FURTHER)

② IF CALCULATED SYMMETRY DOES NOT WORK, THEN YOU MUST TEST FURTHER USING ACTUAL POINTS $(R, \phi), (R, -\phi), (-R, -\phi), (-R, \phi)$

$$R = \frac{ep}{1 + e \cos \phi}$$

$$R = \frac{ep}{1 + e \sin \phi}$$

$0 < e < 1$ ellipse

$e = 1$ parabola

$e > 1$ hyperbola

$|p|$ = distance between the focus (pole) and the directrix

Directrix: $+ \cos =$ right focus
 $- \cos =$ left focus
 $+ \sin =$ above pole
 $- \sin =$ below pole

NEG NUMBER ON THE PILE MEANS UP OR LEFT/RIGHT