Happy Mitten Tree Day!

- Park your phones
- Grab a laptop & calculator
- Take out Desmos Discovery Booklet
- Start the warm up on circle table

$x = r \cdot \cos\theta$ $x^2+y^2=r^2$

$y = r \cdot \sin\theta$ $\tan\theta = \frac{y}{x}$

Honors Pre-Calculus Name______________________

Converting Polar Equations Warm-up

Convert each equation from rectangular to polar form.

1) $(x+1)^2 + y^2 = 1$ ← circle

$x^2+2x+1+y^2=1$

$x^2+y^2+2x+1=1$

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

$r^2+2r\cos\theta=0$

$r+2\cos\theta=0$

$\boxed{r=-2\cos\theta}$

2) $x^2 + (y+3)^2 = 9$

$\boxed{r=-6\sin\theta}$

3) $x^2 + (y+2)^2 = 4$

$\boxed{r=-4\sin\theta}$

Convert each equation from polar to rectangular form.

4) $r = 6\cos\theta$

$r^2 = 6r\cos\theta$

$x^2+y^2=6x$

$x^2-6x+9+y^2=9$

$\boxed{(x-3)^2+y^2=9}$

5) $r = 6\sin\theta$

$\boxed{x^2+(y-3)^2=9}$

Convert each equation from rectangular to polar form.

6) $(x-1)^2 + (y+1)^2 = 2$

$x^2-2x+\cancel{1}+y^2+2y+\cancel{1}=\cancel{2}$

$r^2-2r\cos\theta+2r\sin\theta=0$

$\boxed{r=2\cos\theta-2\sin\theta}$

7) $(x+3)^2 + (y-1)^2 = 10$

$\boxed{r=-6\cos\theta+2\sin\theta}$

Convert each equation from polar to rectangular form.

8) $r = -4\cos\theta - 2\sin\theta$

$\boxed{(x+2)^2+(y+1)^2=5}$

9) $r = 2\cos\theta + 4\sin\theta$

$\boxed{(x-1)^2+(y-2)^2=5}$

Sine ⇒ symmetry about the y-axis

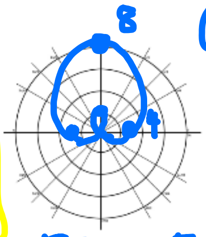
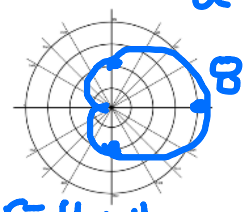
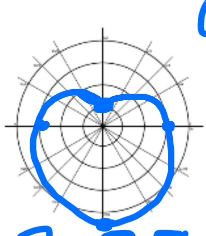
Cosine ⇒ symmetry about the x-axis

Overview: Family of Limaçons

$$r = a \pm b\sin\theta \quad \text{or} \quad r = a \pm b\cos\theta$$

Sketch a graph of each curve given below then describe the relationship between a and b that gives each of the following:

a is the intercepts

Limaçon with an inner loop	*Cardioid*	*Dimpled Limaçon*
a<b	a=b	a>b doesn't touch pole
		
Example $r=3+5\sin\theta$	$r=4+4\cos\theta$	$r=3-2\sin\theta$
a−b loop length a+b large distance	a+b= large distance	a−b dimple a+b large distance

Overview: Rose Curves $r = a\cos n\theta$ **or** $r = a\sin n\theta$

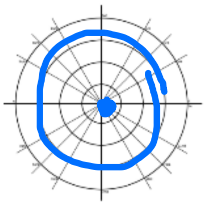
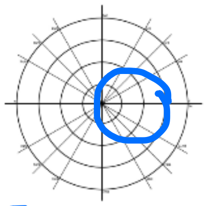
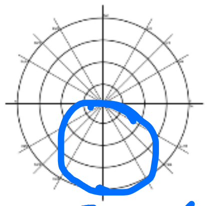
If n is odd, the rose has n petals   If n is even, the rose has 2n petals

a represents petal length

Describe the number of petals and length of each petal on the rose given below:

$r = 2\cos 3\theta$	$r = 5\cos 4\theta$	$r = 3\sin 2\theta$	$r = 4\sin 5\theta$
3 petals 2 units long	8 petals 5units	4 petals 3 units	5 petals 4 units long

Overview: Circles

$r = c$, (c is a constant)	$r = a\cos\theta$	$r = a\sin\theta$
		
Example: $r=3$	$r=3\cos\theta$	$r=-4\sin\theta$
Circle centered at the pole	diameter of 3	diameter of 4

Special Polar Curves

Below is a list of polar equations: Match the equation to the appropriate graph, then write the equation in the blank.

A. $r = 2 + 2\sin\theta$

B. $r = 4 + 4cos\theta$

C. $r = 2 + 5sin\theta$

D. $r = 3 + 2sin\theta$

E. $r = 6\sin(3\theta)$

F. $r = 8\sin(5\theta)$

G. $r = 2 + 4cos\theta$

H. $r = 2 + 4sin\theta$

I. $r = 4 - 3\ cos\theta$

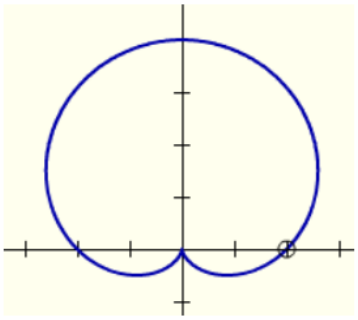
J. $r = 3 - 3cos\theta$

K. $r = 4\sin(2\theta)$

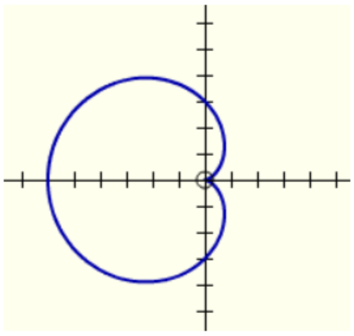
L. $r = 3 - 3\sin\theta$

Special Polar Curves

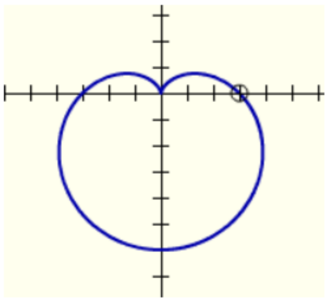
r = ___________



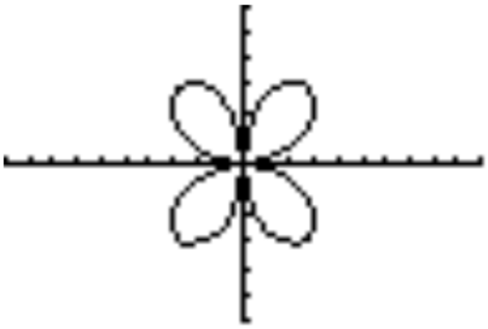
r = ___________



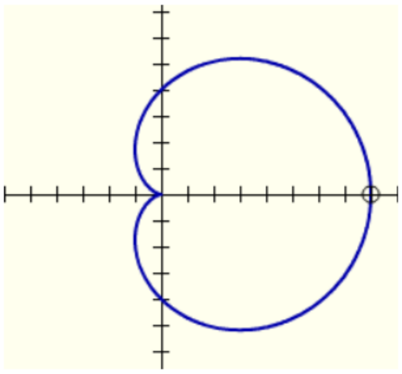
r = ___________



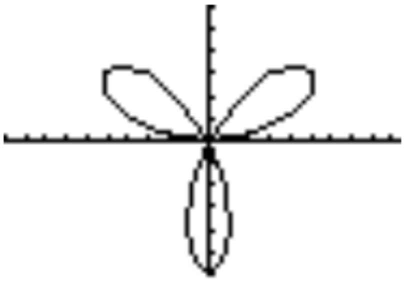
r = ___________



r = ___________

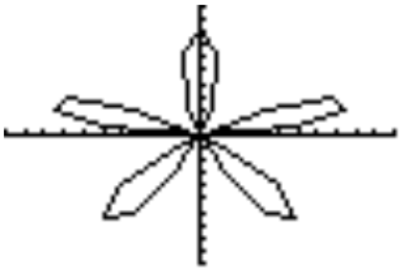


r = ___________

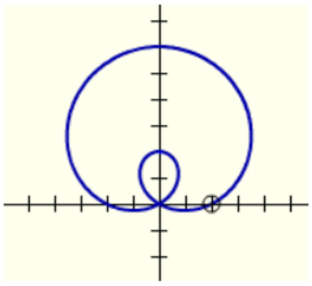


Special Polar Curves

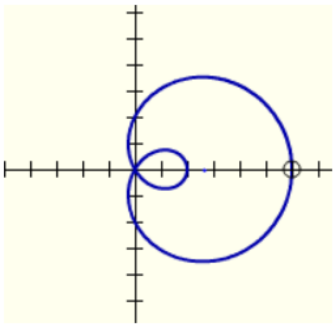
r = ____________



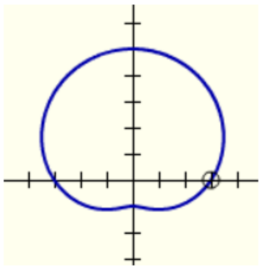
r = ____________



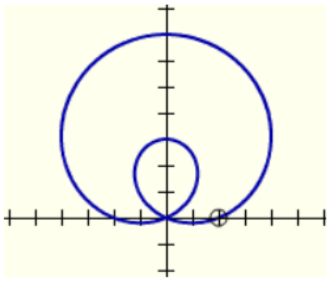
r = ____________



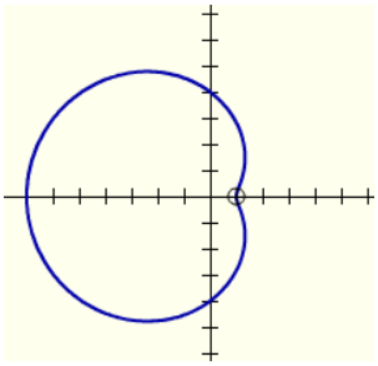
r = ____________



r = ____________



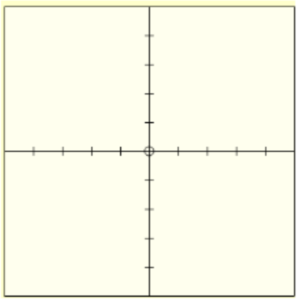
r = ____________



Special Polar Curves

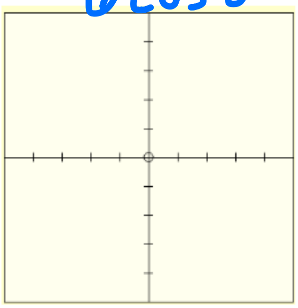
Identify the special curve and axis of symmetry. If the curve is a rose, identify the # of petals and petal length. Then sketch a graph.

$r = 4 + 3\sin\theta$

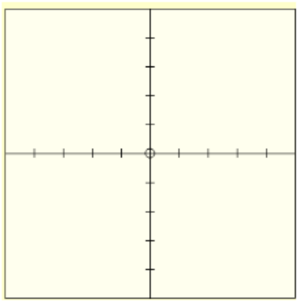


$r = 6\cos 3\theta$

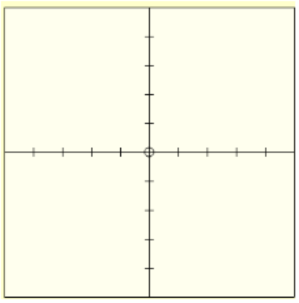
$6\cos\theta$



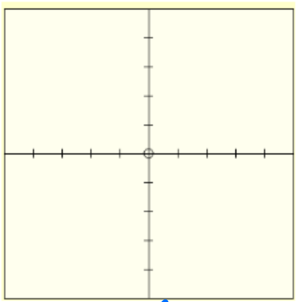
$r = 2 + 2\cos\theta$



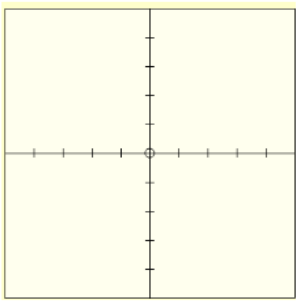
$r = 4 + 3\cos\theta$



$r = 2 - 4\sin\theta$

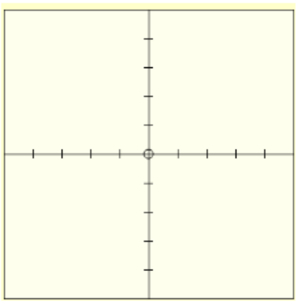


$r = 3 + 3\sin\theta$

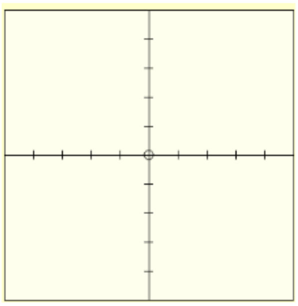


$r = 3\sin 4\theta$

$3\sin\theta$



$r = 3 + 5\cos\theta$



Polar Conics

Parabolas as Functions – Review

$y = -3(x+2)^2 + 4$ Horizontal/ Vertical $y=$ Vertex $(-2, 4)$

Opens down $-a$

Focal Length: $\frac{1}{12}$ "c"   Focus: $\left(-2, \frac{47}{12}\right)$ Directrix: $y = \frac{49}{12}$

$|a| = \frac{1}{4c}$

$3 = \frac{1}{4c}$

$12c = 1$

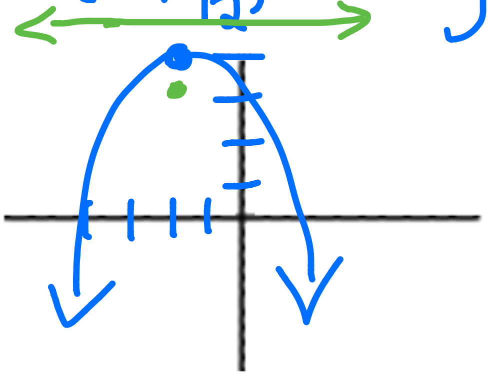
$c = \frac{1}{12}$

$4 - \frac{1}{12}$

$\frac{48}{12} - \frac{1}{12}$

$\frac{48}{12} + \frac{1}{12}$

$\frac{49}{12}$



$x = \frac{1}{4}(y+2)^2 - 5$ k h $x=$ Horizontal/Vertical   Vertex $(-5, -2)$

Opens right $+a$

Focal Length: 1 Focus: $(-4, -2)$ Directrix: $x = -6$

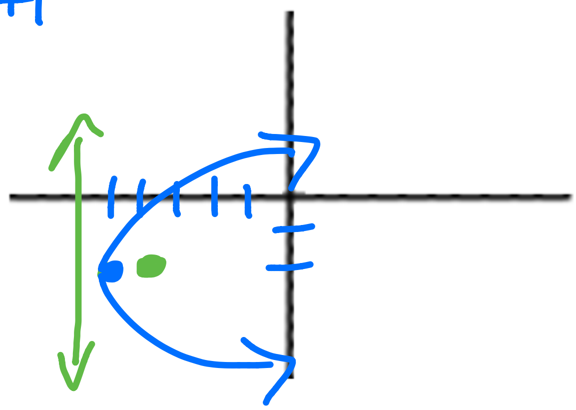
$a = \frac{1}{4c}$

$\frac{1}{4} = \frac{1}{4c}$

$1 = c$

$-5+1$

$-5-1=-6$



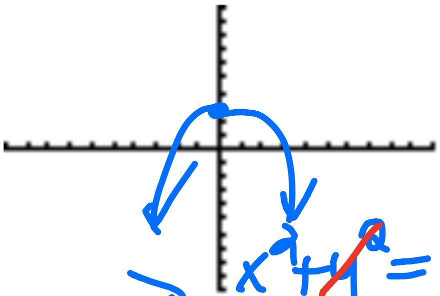
Since, $r^2=x^2+y^2$

$r=\sqrt{x^2+y^2}$

Polar Conics

Convert each polar equation to its rectangular form and graph.

$r=\frac{4}{1+\sin\theta}$



$r(1+\sin\theta)=4$

$r+r\sin\theta=4$

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

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

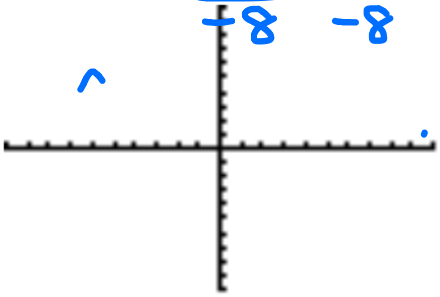
$x^2+\cancel{y^2}=16-8y+\cancel{y^2}$

$x^2=16-8y$ ← vertical parabola

$\frac{1x^2}{-8}-\frac{16}{-8}=\frac{-8y}{-8}$

$\boxed{y=-\frac{1}{8}x^2+2}$

$r=\frac{2}{1+\cos\theta}$



$r=\frac{3}{1-\sin\theta}$