Hyperbola

Center: (h,k)

$X+?$ M.A. Horizontal

$Y+?$ M.A. Vertical

$$\frac{(x-h)^2}{a^2}-\frac{(y-k)^2}{b^2}=1$$

OR

$$\frac{(y-k)^2}{a^2}-\frac{(x-h)^2}{b^2}=1$$

c

ex. $\frac{(x-2)^2}{3^2}-\frac{(y-0)^2}{5^2}$

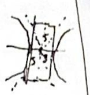
Center $(2,0)$

$a=3$

$c^2=a^2+b^2$

$c=\sqrt{34}=5.8$

Always on Major Axis



Ellipse

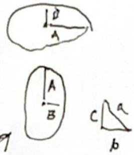
a is longer one

Center (h,k)

$(x-h)$ $(y-k)$

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

$$\frac{x^2}{b}+\frac{y^2}{a^2}=1$$



$\boxed{c^2=a^2-b^2}$

ex.

$$\frac{(x-(-2))^2}{6^2}+\frac{(y-6)^2}{3^2}$$

Center: $(-2,6)$

$a=6$

$b=3$

M.A. = Horizontal

Find c, the "foci"

$C=\sqrt{27}=5.2$

Always on Major Axis

$e=\frac{c}{a}$

Parabola

$(x-h)^2=4p(y-k)$ $+p$ $-p$

$(y-k)^2=4p(x-h)$ $+p$ $-p$

Vertex: (h,k)

ex

$6x=y^2-2y-11$

$(y-1)^2=4(\frac{6}{4})(x-(-2))$

Vertex $(-2,1)$

$p=1.5$

Directrix? $V-p$

Focus? $V+p$

If given (x,y) as point use it to find t first

Ex. $x=2t^2-3$
$y=8t+7$
Slope @ $t=-1$?

$$\frac{dy}{dx}=\frac{8}{4t}=\frac{2}{t}\Big|_{t=-1}$$

slope $=-2$

Parametric Equations

As $t|x|y$, graph

t increases as x increases

Slope? $\frac{dy/dt}{dx/dt}$, $\frac{dx}{dt}\neq 0$

In terms of t

eccentricity $\frac{c}{a}$

Ellipse; $e<1$

Circle; $e=0$

Hyperbola $e>1$

Approaching 1?

Parabola; $e=1$

Conic Section Examples

One square, Parabola

Two squares, same sign; Ellipse different coefficients

Two squares, same sign & coefficient = circle

Two squares, opp. signs? hyperbola

No squares; line

Trig

derivative of $\sin(2t)$? use chain Rule!

$\cos(2t)\cdot 2$

derivative of $(2-t)^{1/2}$? Use chain rule!

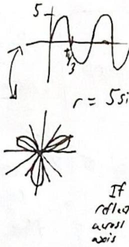
$(\frac{1}{2})(2-t)\cdot(-1)$

"Eliminate Parameter" means get rid of "t" and write in terms of $y=ax+b$

Cart - Polar

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

$\theta=\arctan(\frac{y}{x})$



Sketch Polar

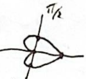
1. Set $\theta=\frac{\pi}{2}$

Increase $\frac{\pi}{2}$

$r=5\sin(3\theta)$ 2. Graph!

3. Translate to polar

If $-r$, reflect across axis



Calc: $d(\sin x, x)$..

Polar Coordinates

Pol → Cart | Cart → Pol

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

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

"Cardioid" = heart shaped curve.

$r=a\pm a\cos\theta$, x-axis

$r=a\pm a\sin\theta$, y-axis

Limacons

$r=a\pm b\cos\theta$, x-axis

$r=a\pm b\sin\theta$, y-axis

Slope of line?

Find x & y

Take derivative of x & y

$\frac{dy}{dx}=?$, plug in θ or t

$\csc(x)=\frac{1}{\sin(x)}$

$\sin(x)=\frac{1}{\csc(x)}$

$\sec(x)=\frac{1}{\cos(x)}$

$\cot(x)=\frac{1}{\tan(x)}$

$$y-y_1=m(x-x_1)$$

$x=4t$ $dx=4$

$y=3t^2$ $dy=3(2t)=6t$

$\frac{dy}{dx}=\frac{6t}{4}=\frac{3t}{2}$

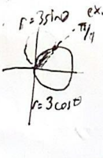
Area Bounded by Polar Curves

$$\int_a^b \frac{1}{2}r^2\,d\theta$$

Area Enclosed by Cardioid Curve

$$A=\frac{1}{2}\int_A^B (r(\theta))^2\,d\theta$$

ex.



$$\frac{1}{2}\int_0^{\pi/4}(3\sin\theta)^2\,d\theta+\frac{1}{2}\int_{\pi/4}^{\pi/2}(3\cos\theta)^2\,d\theta$$

TANGENT SLOPE POLAR CURVE

$$\frac{dy}{dx}=\frac{r\cos\theta+\frac{dr}{d\theta}\sin\theta}{-r\sin\theta+\frac{dr}{d\theta}\cos\theta}$$

ex. ~~$r=3\cos(3\theta)$~~

$\frac{dy}{dx}$ 2