AP Calculus BC
Unit 11 – Parametric Equations & Polar Coordinates

Day 5 Notes: Polar Graphs & Tangents

Derivatives of Polar Equations

A polar equation must first be converted into parametric form before the dy/dx can be found.

Remember the conversions $x = r\cos\theta$ and $y = r\sin\theta$? We can use these to find dy/dx.

$$\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta}$$

Note: This is the same as a parametric derivative!

Example #1: Find dy/dx for $r = 3 - 2\cos\theta$ when $\theta = 0$.

Tangents

$$\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta}$$

1. Horizontal tangents occur where $\frac{dy}{d\theta} = 0$.
2. Vertical tangents occur where $\frac{dx}{d\theta} = 0$.
3. If $\frac{dy}{d\theta} = \frac{dx}{d\theta} = 0$ simultaneously...... cusp?

<u>Example #2</u>: Find the points (r, θ) of horizontal and vertical tangency for the polar curve $r = 4\cos\theta$.

<u>Tangents at the pole</u>

1. At the pole, $r = 0$. Find the values of θ where $r = 0$.
2. The radial lines $\theta = \alpha$ will be the tangents at the pole.

* It's possible to have more than one tangent at the pole.

<u>Example #3</u>: Find the tangents at the pole: $r = 3 + 3\cos\theta$.

<u>Example #4</u>: Find the tangents at the pole for the curve $r = 2\cos(3\theta)$.

AP Calculus BC **Name: ______________________________**
Unit 11 – Day 5 – Assignment

1) **Find dy/dx for $r = 2 + 3\sin\theta$.**

2) **Find dy/dx for $r = 3(1 - \cos\theta)$ at $\theta = \pi/2$.**

3) **Find dy/dx for $r = 3\sin\theta$ at $\theta = \pi/3$.**

4) **Find the points of horizontal and vertical tangency to the polar curve $r = 1 - \sin\theta$.**

5) Find the points of horizontal tangency to the polar curve $r = 2\csc\theta + 3$.

6) Sketch the graph of the polar equation and find the tangents at the pole for the polar curve $r = 2(1 - \sin\theta)$.

7) Sketch the graph of the polar equation and find the tangents at the pole for the polar curve $r = 2\cos 3\theta$.

8) Sketch the graph of the polar equation and find the tangents at the pole for the polar curve $r = 3\sin 2\theta$.