Parametric and Polar Equations
AP Review

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1. Find the Cartesian equation of the curve represented by $x = \sec^2 t - 1$ and $y = \tan t$, $-\frac{\pi}{2} < t < \frac{\pi}{2}$.

2. Find the Cartesian equation of the curve represented by $x = t$ and $y = \sqrt{1-t^2}$, $-1 < t < 1$.

3. Find the Cartesian equation of the curve represented by $x = 4t + 3$ and $y = 16t^2 - 9$, $-\infty < t < \infty$.

4. Find the equation of the tangent line to $x = t^2 + 4$ and $y = 8t$ at $t = 6$. $y-48 = \frac{2}{3}(x-40)$

5. Find the equation of the tangent line to $x = \sec t$ and $y = \tan t$ at $t = \frac{\pi}{4}$. $y-1 = \sqrt{2}(x-\sqrt{2})$

6. The motion of a particle is given by $x = -2t^2$ and $y = t^3 - 3t + 9$, $t \geq 0$. Find the coordinates of the particle when its instantaneous direction of motion is horizontal. $(-2, 7)$

7. The motion of a particle is given by $x = \ln t$ and $y = t^2 - 4t$. Find the coordinates of the particle when its instantaneous direction of motion is horizontal. $(\ln 2, -4)$

8. The motion of a particle is given by $x = 2\sin t - 1$ and $y = \sin t - \frac{t}{2}$, $0 \leq t < 2\pi$. Find the times when the horizontal and vertical components of the particle's velocity are the same. $t = \frac{2\pi}{3}$ and $\frac{4\pi}{3}$

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Consider the curve given by the parametric equations
$$x = 2t^3 - 3t^2 \quad \text{and} \quad y = t^3 - 12t$$

(a) In terms of t, find $\frac{dy}{dx}$. $\frac{3t^2-12}{6t^2-6t} = \frac{t^2-4}{2t^2-2t}$

(b) Write an equation for the line tangent to the curve at the point where $t = -1$. $y - 11 = -\frac{3}{4}(x+5)$

(c) Find the x- and y-coordinates for each critical point on the curve and identify each point as having a vertical or horizontal tangent.

t	(x, y)	type
-2	$(-28, 16)$	horiz.
0	$(0, 0)$	vert
1	$(-1, -11)$	vert
2	$(4, -16)$	horiz.