**AP Calculus BC**
**Practice with Vectors and Parametric Equations**

**2015 #2 (calculators permitted)**
At time $t \geq 0$, a particle moving along a curve in the $xy$-plane has position $\big(x(t), y(t)\big)$ with velocity vector $v(t) = (\cos(t^2), e^{0.5t})$. At $t = 1$, the particle is at the point (3, 5).

a) Find the $x$-coordinate of the position of the particle at time $t = 2$.
b) For $0 < t < 1$, there is a point on the curve at which the line tangent to the curve has a slope of 2. At what time is the object at that point?
c) Find the time at which the speed of the particle is 3.
d) Find the total distance traveled by the particle from time $t = 0$ to time $t = 1$.

**2012 #2 (calculators permitted)**
For $t \geq 0$, a particle is moving along a curve so that its position at time $t$ is $\big(x(t), y(t)\big)$. At time $t = 2$, the particle is at position (1, 5). It is known that $\frac{dx}{dt} = \frac{\sqrt{t+2}}{e^t}$ and $\frac{dy}{dt} = \sin^2 t$.

a) Is the horizontal movement of the particle to the left or to the right at time $t = 2$? Explain your answer. Find the slope of the path of the particle at time $t = 2$.
b) Find the $x$-coordinate of the particle's position at time $t = 4$.
c) Find the speed of the particle at time $t = 4$. Find the acceleration vector of the particle at time $t = 4$.
d) Find the distance traveled by the particle from time $t = 2$ to $t = 4$.

**2010 #3 (calculators permitted)**
A particle is moving along a curve so that its position at time $t$ is $\big(x(t), y(t)\big)$, where $x(t) = t^2 - 4t + 8$ and $y(t)$ is not explicitly given. Both $x$ and $y$ are measured in meters, and $t$ is measured in seconds. It is known that $\frac{dy}{dt} = te^{t-3} - 1$.

a) Find the speed of the particle at time $t = 3$ seconds.
b) Find the total distance traveled by the particle for $0 \leq t \leq 4$ seconds.
c) Find the time $t$, $0 \leq t \leq 4$, when the line tangent to the path of the particle is horizontal. Is the direction of motion of the particle toward the left or toward the right at that time? Give a reason for your answer.
d) There is a point with $x$-coordinate 5 through which the particle passes twice. Find each of the the following.
   I. The two values of $t$ when that occurs
   II. The slopes of the lines tangent to the particle's path at that point
   III. The $y$-coordinate of that point, given $y(2) = 3 + \frac{1}{e}$