DATE: _____

AP® CALCULUS BC FREE-RESPONSE QUESTIONS

2. For $t \geq 0$, a particle is moving along a curve so that its position at time t is $(x(t), y(t))$. 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 $t = 2$.

(c) Find the speed of the particle at time $t = 4$. Find the acceleration vector of the particle at time $t = 4$.

$|v(4)|$ $\langle x''(4), y''(4) \rangle$

a) $\left.\frac{dx}{dt}\right|_{t=2} = 0.271$

Horizontal movement of particle is to the right b/c $\left.\frac{dx}{dt}\right|_{t=2} > 0$

$\left.\frac{dy}{dx}\right|_{t=2} = \frac{\left.dy/dt\right|_{t=2}}{\left.dx/dt\right|_{t=2}} = 3.055$ Slope of the path is 3.055

c) $|v(4)| = \sqrt{(x'(4))^2 + (y'(4))^2}$

$= 0.575$

$a(4) = \langle x''(4), y''(4) \rangle$

$= \langle -0.041, 0.989 \rangle$

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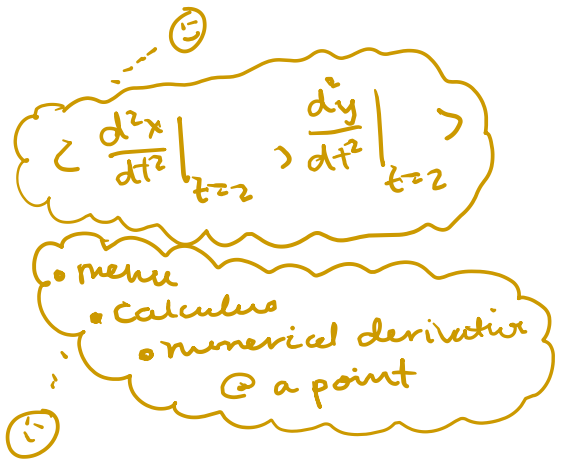
2. For $t \geq 0$, a particle moving in the xy-plane has the position vector $\langle x(t), y(t) \rangle$ at time t, where $\frac{dx}{dt} = -1 + e^{\sin t}$ and $\frac{dy}{dt} = \cos(t^2)$. At time $t = 2$, the position of the particle is $(5, 7)$.

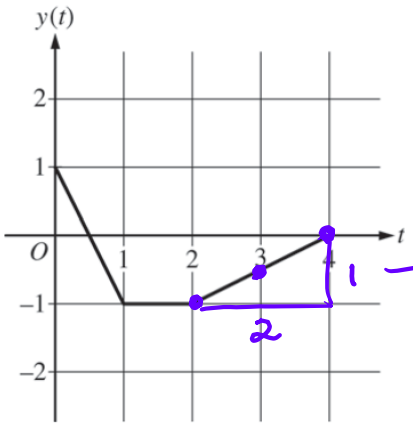
(a) Find the acceleration vector of the particle at time $t = 2$.

$\langle x''(2), y''(2) \rangle$

a) $a(2) = \langle x''(2), y''(2) \rangle$

$= \langle -1.033, 3.027 \rangle$





$\frac{dy}{dt}\Big|_{t=3} = \frac{1}{2}$

2. At time t, the position of a particle moving in the xy-plane is given by the parametric functions $(x(t), y(t))$, where $\frac{dx}{dt} = t^2 + \sin(3t^2)$. The graph of y, consisting of three line segments, is shown in the figure above. At $t = 0$, the particle is at position $(5, 1)$.

(b) Find the slope of the line tangent to the path of the particle at $t = 3$.

(c) Find the speed of the particle at $t = 3$.

$\frac{dy}{dx}$

$|v(t)|$

b) $\frac{dy}{dx}\Big|_{t=3} = \frac{dy/dt|_{t=3}}{dx/dt|_{t=3}} = \frac{1/2}{3^2 + \sin(3(3)^2)} = 0.050$

c) $|v(3)| = \sqrt{(x'(3))^2 + (y'(3))^2}$

$= 9.969$