10-2 day 2 Vector Calculus

Learning Objectives:

I can model motion using a vector equation

I can find the velocity, speed, acceleration, and direction vector of a particle whose motion is described by a vector equation

I can find the displacement, total distance traveled, and position of a particle whose motion is described by a vector equation

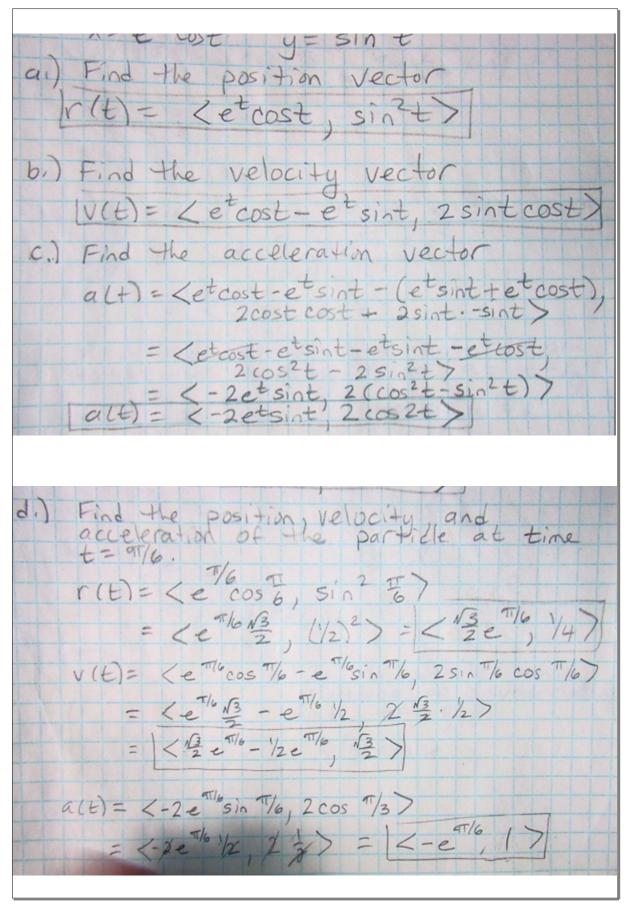
Velocity, Speed, Acceleration, and Direction of Motion

Suppose a particle moves along a smooth curve in the plane so that its position at any time t is (x(t), y(t)) where x and y are differentiable functions of t.

- 1. The particle's position vector is $p(t)=\langle x(t), y(t) \rangle$
- 2. The particle's velocity vector is $v(t) = \langle x'(t), y'(t) \rangle$
- 3. The particle's speed is the magnitude of the velocity vector $s(t) = |v(t)| = \sqrt{(x'(t))^2 + (y'(t))^2}$
- 4. The particle's acceleration vector is $a(t) = \langle x''(t), y''(t) \rangle$
- 5. The particles direction of motion is a unit vector called the direction vector and is given by $d(t) = \frac{v(t)}{|v(t)|}$

Ex1. A particle's position is given by
$$x(t) = e^t cos(t)$$
 $y(t) = sin^2(t)$

- a.) Find the position vector
- b.) Find the velocity vector
- c.) Find the acceleration vector
- d.) Find the position, velocity, and acceleration of the particle at time t = $\frac{\pi}{6}$



Apr 7-12:16 PM

e.) Find the speed at time $t = \frac{\pi}{6}$

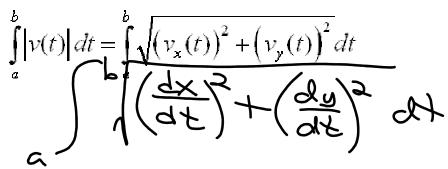
f.) Find the direction vector at time $t = \frac{\pi}{6}$

e.) Find the speed at time t= 17/6
S= v = \(\left(\frac{3}{2} \in \frac{\pi_6}{2} \right)^2 + \left(\frac{3}{2} \right)^2 \)
$= \sqrt{\left(\frac{\sqrt{3}}{2}e^{\pi 7/6} - \frac{1}{2}e^{\pi 7/6}\right)^2 + \frac{3}{4}}$
≈ 1.064
f.) Find the direction vector at time t= 7/6 TY - (1/2 e 11/6 1/2 e 11/6 1/2) 171 - 1,064
= < .581, .814)

Displacement and Total Distance Traveled

Suppose a particle moves along a smooth curve in the plane so that its position at any time t so that its velocity is given by $v(t) = \langle v_x(t), v_y(t) \rangle$.

- 1. The displacement of the object from time t=a to time t=b is given by the vector: $\left\langle \int_{a}^{b} v_{x}(t)dt, \int_{a}^{b} v_{y}(t)dt \right\rangle$
- 2. The total distance traveled from time t=a to time t=b is



ExQ. A particle's velocity is given by $v(t) = \left\langle \frac{1}{t}, t^2 \right\rangle$

$$v(t) = \left\langle \frac{1}{t}, t^2 \right\rangle$$

- a.) Find the displacement of the object from time t=1 to time t=5.
- b.) Find the total distance traveled from time t=1 to time t=5.
- c.) If the particle was at position (-2,3) at time t=1, what is the position of the particle at time t=5?

a.) Find the displacement of the object from
$$t=1$$
 to time $t=5$

$$= \left\langle \int_{t}^{t} dt \right\rangle, \left\langle \int_{t}^{t} dt \right\rangle$$

$$= \left\langle \ln |t| \right|_{s}^{t}, \left\langle \int_{t}^{t} dt \right\rangle$$

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Apr 7-12:18 PM

Homework

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