Sec 10.2:
Vectors and Particle Motion

Parametric equations can be used to model particle motion in a coordinate plane (we get to get off the x-axis!)

Formulas for vectors and motion:

- position vector at time t: $\langle x(t), y(t) \rangle$
- velocity vector at time t: $\langle x'(t), y'(t) \rangle$
- acceleration vector at time t: $\langle x''(t), y''(t) \rangle$
- speed of the particle (magnitude of velocity vector): $\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}$
- length of the arc (distance traveled) from a to b: $\int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$

Please remember that the slope of the path is still given by $\frac{dy}{dx}$ and that the rate of change of that slope is given by $\frac{d^2y}{dx^2}$

A particle moves in the xy-plane so that at any time, t, the position of the particle is given by $x(t) = t^3 + 4t^2 \quad y(t) = t^4 - t^3$

(No Calculator)

Find the velocity vector when t=1.

Find the acceleration vector when t=2.

A particle moves in the xy-plane so that at any time t, $t \geq 0$, the position of the particle is given by $x(t) = t^2 + 3t$ $y(t) = t^3 - 3t^2$. Find the magnitude of the velocity vector when t=1.

(No Calculator)

The path of the particle moves in the xy-plane so that $x = \sqrt{3} - 4\cos t$ and $y = 1 - 2\sin t$, where $0 \le t \le 2\pi$. The path of the particle intersects the x-axis twice. Write an expression that represents the distance traveled by the particle between the two x-intercpets. Do not evaluate.

(No Calculator)

An object moving along a curve in the xy-plane has position $\langle x(t), y(t) \rangle$ at time t with $\frac{dx}{dt} = \sin\left(t^3\right)$ and $\frac{dy}{dt} = \cos\left(t^2\right)$. At time t=2, the object is at the position (1,4).

(2000 BC-1: Calculator)

a) Find the acceleration vector for the particle at t=2.

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(2000 BC-1: Calculator)

b) Write the equation of the tangent line to the curve at the point where t=2.

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(2000 BC-1: Calculator)

c) Find the speed of the vector at t=2.

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(2000 BC-1: Calculator)

d) Find the position of the particle at time t=1.