Section 12.3  
Worksheet #10

CALCULUS OF VECTOR-VALUED FUNCTIONS  
VELOCITY & ACCELERATION

Def: If the vector-valued function $r(t)$ traces out the position of an object at time $t$, then the object has

- velocity =
- acceleration =
- speed =

Ex 1: Suppose $r(t) = \langle t^2, t \rangle$ gives the position of an object at time $t$. Find the velocity, speed, and acceleration at times $t = \pm 1$ and 0 and sketch these on the curve traced out by $r$.

Observe:

- For $t < 0$, the acceleration vector is . . .

- For $t > 0$, the acceleration vector is . . .
Ex 2: An object starts from rest at the point $(0, 3, 0)$ and moves with an acceleration of $\mathbf{a}(t) = \langle 4t, 3\cos t, 3\sin t \rangle$, where $\|\mathbf{a}\|$ is measured in feet per second. Find the location of the object after $t = 2$ seconds.
When acceleration is due only to gravity:

**Thm:** An object with initial position \( \mathbf{r}_0 \), initial velocity \( \mathbf{v}_0 \), and a constant acceleration \( \langle 0, 0, -g \rangle \) has position . . .

**Ex 3:** Use the theorem above to solve the following:
A baseball is hit 4 feet above ground at 100 ft/sec and at an angle of \( \pi/6 \) with respect to the ground. Give a position function for the ball at any time \( t \). How far will the ball go before hitting the ground?