



**Math 151**  
**Week-In-Review 7**

**K.1, K.2, 3.7, 3.8**

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**Problem Statements**

1. Sketch a curve with the vector equation  $\mathbf{r}(t) = \langle t - 1, 2t^2 \rangle$ . Use a tangent vector to determine the direction of the curve as  $t$  increases.



2. If  $\mathbf{r}(t) = \langle t \cos(t), 4 \sin(t) \rangle$  represents the position of a particle at time  $t$ , find the velocity, acceleration, and speed of the particle when  $t = \frac{\pi}{3}$ .



3. Find a unit tangent vector to the curve  $\mathbf{r}(t) = \langle 2te^{5t}, t^t \rangle$  when  $t = 2$ .





5. The graph of the parametric equations  $x = r(\theta - \sin \theta)$ ,  $y = r(1 - \cos \theta)$  is called a cycloid.
- (a) What are the coordinates of  $x$  and  $y$  when  $\theta = 0$ ?

(b) Show that this cycloid has a vertical tangent at the origin.



6. The position of a particle is represented by  $f(t) = \frac{9t}{t^2 + 9}$ ,  $t \geq 0$ , where  $t$  is measured in seconds and  $f(t)$  is measured in feet.

(a) Find the velocity at time  $t$ .

(b) What is the velocity after 1 second?

(c) When is the particle at rest?

(d) When is the particle moving in the positive direction?



(e) Find the total distance traveled in the first 6 seconds.

(f) Find the acceleration at time  $t$ .

(g) When is the particle accelerating in the positive direction?

(h) When is the particle speeding up?

(i) When is the particle slowing down?



7. If a tank holds 5000 gallons of water, which drains from the bottom of the tank in 40 minutes, the Torricelli's Law gives the volume,  $V$ , of water remaining in the tank after  $t$  minutes according to the formula:  $V = 5000 \left(1 - \frac{1}{40}t\right)^2$ ,  $0 \leq t \leq 40$ .

(a) Find the rate at which water is draining from the tank after  $t$  minutes.

(b) Find the rate at which the water is draining after 5, 10, 20, and 40 minutes.

(c) At what time is water flowing out the fastest? The slowest?





8. A ball is thrown vertically upward with a velocity of 80ft/s. Its height after  $t$  seconds is  $s = 80t - 16t^2$ .
- (a) What is the maximum height reached by the ball?
  - (b) What is the velocity of the ball when it is 96ft above the ground on its way up? On its way down?
  - (c) With what velocity does the ball hit the ground?