

**Homework - Vectors and Motion Practice**

1. At time  $t$ , a particle moving in the  $xy$ -plane is at position  $(x(t), y(t))$ , where  $x(t)$  and  $y(t)$  are not explicitly given. For  $t \geq 0$ ,  $\frac{dx}{dt} = 4 + \sin t$  and  $\frac{dy}{dt} = 1.5e^{1.2t}$ . At time  $t = 0$ ,  $x(0) = 2$  and  $y(0) = -3$ .
- (a) Find the speed of the particle at time  $t = 2$ , and find the acceleration vector of the particle at time  $t = 2$ .
  - (b) Find the slope of the line tangent to the path of the particle at time  $t = 2$ .
  - (c) Find the position of the particle at time  $t = 2$ .
  - (d) Find the total distance traveled by the particle over the time interval  $0 \leq t \leq 2$ .

2. The velocity vector of a particle moving in the  $xy$ -plane has components given by  $\frac{dx}{dt} = 5\cos 3t$  and  $\frac{dy}{dt} = 3 - 4\sin t^2$ , for  $0 \leq t \leq 3$ . At time  $t = 0$ , the position of the particle is  $(-5, 4)$ .
- (a) For  $0 \leq t \leq 3$ , find all values of  $t$  at which the line tangent to the path of the particle is vertical.
- (b) Write an equation for the line tangent to the path of the particle at  $t = 1$ .
- (c) Find the speed of the particle at  $t = 1$ .
- (d) Find the acceleration vector for the particle at  $t = 1$ .