## Appendix J.3: Vector Functions

A vector function is a way to describe the a graph, or path of an object, using vectors. Vector functions are basically the same as parametric curves.

Example: Find a vector function that represents the function $y = x^2 + 1$.

Example: Use the vector function $\mathbf{r}(t) = t^2\mathbf{i} + (t+2)\mathbf{j}$ to answer the following.

A) Is the point $(4, 5)$ on the graph of $\mathbf{r}(t)$? Justify your answer.

B) Sketch the graph of $\mathbf{r}(t)$.

| $t$ | $x$ | $y$ |
|---|---|---|
| $-3$ | 9 | $-1$ |
| $-2$ | 4 | 0 |
| $-1$ | 1 | 1 |
| 0 | 0 | 2 |
| 1 | 1 | 3 |
| 2 | 4 | 4 |
| 3 | 9 | 5 |

C) Find the Cartesian equation of $\mathbf{r}(t)$.

Example: Examine the vector function $\mathbf{r}(\theta) = \langle \sin\theta, \cos\theta \rangle$ where $\frac{-\pi}{2} \le \theta \le \frac{\pi}{2}$

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Example: Find the Cartesian equation of for parametric function.

$x = \sin(2\theta)$
$y = \sin(\theta)$

Example: Sketch the graph of the parametric curve. Give the Cartesian equation.

$x = 4\sin(t), \quad y = 3 + 4\cos(t)$

**Vector equation of a line**

Example: Find a vector equation of the line through the points $A(1, 4)$ and $B(3, 9)$.

Example: Find a vector equation of the line $y = 7x + 5$

Example: Are these lines parallel, orthogonal or neither? If they are not parallel, find the intersection point of these lines.

$\mathbf{L_1}(t) = (1 + 4t)\mathbf{i} + (9 + 16t)\mathbf{j}$

$\mathbf{L_2}(s) = (-1 + 3s)\mathbf{i} + (25 - 6s)\mathbf{j}$