MA 213 In-Class Work

Sections 13.3 and 13.4

1 Find the length of the following curves.

13.3.1 $\mathbf{r}(t) = \langle t, 3\cos(t), 3\sin(t)\rangle \quad -5 \le t \le 5$

13.3.5 $\mathbf{r}(t) = \mathbf{i} + t^2\mathbf{j} + t^3\mathbf{k} \qquad 0 \le t \le 1$

2 *13.3.11* Let C be the curve of intersection of the parabolic cylinder $x^2 = 2y$ and the surface $3z = xy$. Find the exact length of C from the origin to the point $(6, 18, 36)$.

3 *13.3.13* Let $\mathbf{r}(t) = (5-t)\mathbf{i} + (4t-4)\mathbf{j} + 3t\mathbf{k}$.

a Find the arc length function for $\mathbf{r}(t)$ measured from the point $P = (4, 1, 3)$ in the direction of increasing t and then reparameterize the curve with respect to arc length starting from P.

b Find the point 4 units along $\mathbf{r}(t)$ (in the direction of increasing t) from P.

4 Find the velocity, acceleration and speed of a particle with the given position function. Sketch the path of the particle. Draw the velocity and acceleration vectors for the specified value of t.

13.4.3 $\mathbf{r}(t) = \langle -\frac{1}{2}t^2, t\rangle \qquad t = 2$

13.4.7 $\mathbf{r}(t) = t\mathbf{i} + t^2\mathbf{j} + 2\mathbf{k} \quad t = 1$

5 *13.4.15* Find the velocity and position vectors of a particle with acceleration vector $\mathbf{a}(t) = 2\mathbf{i} + 2t\mathbf{k}$, initial velocity $\mathbf{v}(0) = 3\mathbf{i} - \mathbf{j}$, and initial position $\mathbf{r}(0) = \mathbf{j} + \mathbf{k}$.

6 *13.4.23* A projectile is fired with an initial speed of 200 m/s and angle of elevation 60. Find

a the range of the projectile

b the maximum height reached

c the speed at impact

Additional Recommended Problems

7 *13.3.3* Find the length of the curve $\mathbf{r}(t) = \sqrt{2}t\mathbf{i} + e^t\mathbf{j} + e^{-t}\mathbf{k}$ for $0 \le t \le 1$. *Hint:* $e^{2t} + 2 + e^{-2t}$ is a perfect square.

8 *13.3.15* Suppose you start at the point $(0, 0, 3)$ and move 5 units along the curve $x = 3\sin t$, $y = 4t$, $z = 3\cos t$ in the positive direction. Where are you now?

9 Find the unit tangent vector for the following curves.

13.3.17 $\mathbf{r}(t) = \langle t, 3\cos(t), 3\sin(t)\rangle$

13.3.19 $\mathbf{r}(t) = \langle \sqrt{2}t, e^t, e^{-t}\rangle$

10 *13.4.25* A ball is thrown at an angle of $\pi/4$ to the ground. If the ball lands 90 m away, what was the initial speed of the ball?