1–6 Find the length of the curve.

1. $\mathbf{r}(t) = \langle 2\sin t, 5t, 2\cos t \rangle, \quad -10 \leqslant t \leqslant 10$

4. $\mathbf{r}(t) = \cos t\,\mathbf{i} + \sin t\,\mathbf{j} + \ln \cos t\,\mathbf{k}, \quad 0 \leqslant t \leqslant \pi/4$

7–9 Find the length of the curve correct to four decimal places. (Use your calculator to approximate the integral.)

7. $\mathbf{r}(t) = \langle \sqrt{t}, t, t^2 \rangle, \quad 1 \leqslant t \leqslant 4$

8. $\mathbf{r}(t) = \langle t, \ln t, t \ln t \rangle, \quad 1 \leqslant t \leqslant 2$

10. Graph the curve with parametric equations $x = \sin t$, $y = \sin 2t$, $z = \sin 3t$. Find the total length of this curve correct to four decimal places.

This is not one you want to graph without technology. And technology may be helpful in confirming to you what the period of this weird curve is.

13–14 Reparametrize the curve with respect to arc length measured from the point where $t = 0$ in the direction of increasing t.

13. $\mathbf{r}(t) = 2t\,\mathbf{i} + (1 - 3t)\,\mathbf{j} + (5 + 4t)\,\mathbf{k}$

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?

17–20

(a) Find the unit tangent and unit normal vectors $\mathbf{T}(t)$ and $\mathbf{N}(t)$.

(b) Use Formula 9 to find the curvature.

17. $\mathbf{r}(t) = \langle 2\sin t, 5t, 2\cos t \rangle$

21–23 Use Theorem 10 to find the curvature.

21. $\mathbf{r}(t) = t^2\,\mathbf{i} + t\,\mathbf{k}$

26. Graph the curve with parametric equations

$$x = t \qquad y = 4t^{3/2} \qquad z = -t^2$$

and find the curvature at the point $(1, 4, -1)$.

You'll want to use a graphing utility on this one.

43–44 Find the vectors **T**, **N**, and **B** at the given point.

43. $\mathbf{r}(t) = \langle t^2, \frac{2}{3}t^3, t \rangle, \quad (1, \frac{2}{3}, 1)$

44. $\mathbf{r}(t) = \langle \cos t, \sin t, \ln \cos t \rangle, \quad (1, 0, 0)$