

MATH 223A Fall 2022
Assignment 4
Due: Wednesday September 21

Reading

Read carefully Sections 3.1 “Some Examples” and Section 3.2 “Graphs and Level Sets” in our text *Multivariable Calculus: A Linear Algebra Based Approach*.

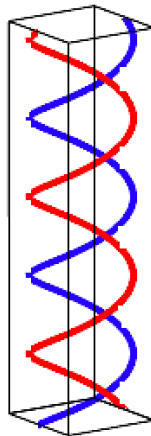
Optional Reading: Section 2.6.2: “Kepler’s Laws of Planetary Motion”

Writing

Write out careful and complete solutions of Exercises 35, 40, 42, 43 in Chapter 2 and Problem A below:

Problem A: Let $\mathbf{f}(t) = (a \cos t, a \sin t, bt)$ with a and b nonzero constants. Sketch the graph of this curve (a **helix**) for $0 \leq t \leq 5\pi$. Show that the speed is constant and the velocity vector is always orthogonal to the vector $\mathbf{r}(t) = (a \cos t, a \sin t, 0)$.

The choices $a = 1, b = \frac{1}{2}$ and $a = -1, b = \frac{1}{2}$ give the general configuration of the double helix portion of the DNA molecule shown here:



Some Answers and Hints

40. Are any of these vectors orthogonal to other vectors? Point in the same direction as other vectors?

42. Integration by parts on $t e^t$, change of variable $u = 1 + t^2$ on third component. Among the constants of integration may be 1, 0, and $-2/3$.

43. To find $\int \tan t \, dt$, begin by writing tangent as sine/cosine. To find $\int \ln t \, dt$, integration by parts may be useful.

A. Speed is $\sqrt{a^2 + b^2}$. One way to show orthogonality is to show dot product is 0.