Instructions:

(1) To receive credit you must work in a logical fashion, **SHOW ALL YOUR WORK**, **INDICATE YOUR REASONING**, and when applicable put your answer on the line (or in the box) provided.

(2) The “Mark Box” indicates the problems along with their points. Check that your copy of the exam has all of the problems.

(3) Allowed are a calculator and the class handouts, as indicated on the syllabus. Not allowed are other notes and books.

(4) This exam covers (from *Intro. to Vector Analysis* by Davis & Snider) sections: 1.1 – 1.12, 1.14, 2.1, 2.2.

1. Let \( \vec{A} = \langle 1, 2, 3 \rangle \) and \( \vec{B} = \langle -5, 1, -2 \rangle \). Let \( \theta \) be the angle between \( \vec{A} \) and \( \vec{B} \). Let \( \vec{A} = \vec{A}_\parallel + \vec{A}_\perp \) where \( \vec{A}_\parallel \) is parallel to \( \vec{B} \) and \( \vec{A}_\perp \) is perpendicular to \( \vec{B} \). Find:

\[
\begin{align*}
|\vec{A}| & = \\
|\vec{B}| & = \\
\vec{A} \cdot \vec{B} & = \\
\vec{A} \times \vec{B} & = \\
\cos \theta & = \\
\text{is } 0 \leq \theta \leq \frac{\pi}{2} \text{ or } \frac{\pi}{2} < \theta \leq \pi? & \\
\vec{A}_\parallel & = \\
\vec{A}_\perp & =
\end{align*}
\]
2. Consider the two straight lines parameterized by

\[ \vec{R}(t) = \langle 3 + 2t, 2 + t, t \rangle \]
\[ \vec{D}(s) = \langle 1, t, -2 + t \rangle . \]

The point of intersection of these lines is \underline{__________________________}.

The angle between these lines is \underline{__________________________}.
3. Let \( \vec{e}_1 = \frac{1}{\sqrt{2}} \langle 1, 1, 0 \rangle \) and \( \vec{e}_2 = \langle 0, 0, 1 \rangle \).

   a) \( \vec{e}_1, \vec{e}_2, \vec{e}_3 \) is a right-handed system of orthonormal vectors if \( \vec{e}_3 = \text{___________} \).

   b) A parameterization of the right-handed helix, with radius 1, pitch 6\( \pi \), axis parallel to \( \vec{e}_3 \), and axis passing through the origin, is

   \[
   \vec{R}(t) = \text{___________} \vec{e}_1 + \text{___________} \vec{e}_2 + \text{___________} \vec{e}_3 .
   \]

   c) Express the arc length of one wrap of this helix as an integral.

   \[
   AL = \text{_______________________________}
   \]

   d) Find the arc length of one wrap of this helix (i.e. calculate the above integral).

   \[
   AL = \text{_______________________________}
   \]

4. BAD PROBLEM – Never mind.