Exam 1 will be held at the beginning of class on September 28. It will cover the material of Chapters 12 and 13. Following is a brief outline of the main topics considered, with comments on what you could be responsible for. This is quite a lot; obviously, only a subset of this can be tested on a 50-minute exam, though I will try to test as much as I have time for.

§12.1: Three-Dimensional Coordinate Systems This material should be second nature to you by now. I don’t expect to test it explicitly, but it is implicit in nearly everything we do. Make sure you have mastered the material in this section.

§12.2: Vectors This material should also be quite natural. Aside from the more advanced applications (most of which would require a calculator), you may be tested on anything here.

§12.3: The Dot Product Make sure you are familiar with both the component (Definition 1) and geometric (Theorem 3) characterizations of the dot product, as well as its Properties (2). Know how to use the dot product to find angles between vectors, check for orthogonality, and compute scalar and vector projections. I will not ask you anything about direction angles or direction cosines, nor will there be questions about work.

§12.4: The Cross Product As with the dot product, you should be familiar with both the component and geometric characterizations of the cross product. When computing cross products from components, you may use any method you wish. Be familiar with the geometric applications of cross products to areas of parallelograms and volumes of parallelepipeds, as well as the algebraic properties of the cross product, except the vector triple product (Property 6 in Theorem 11), which I will not ask you to work with. I will not ask you about torque.

§12.5: Equations of Lines and Planes Know how to write, interpret, and work with the vector and parametric equations of lines and the vector and scalar equations of planes. (Recall that we aren’t too concerned with the symmetric equations here.) Develop a general fluency with working with lines and planes in various ways (intersections, angles, etc.). Know at least one way to find the distance between a point and a plane.
§12.6: Cylinders and Quadric Surfaces These will not be stressed. You should be generally familiar with these various surfaces and able to work with them, as they tend to arise in odd places, but I will not expect you to have the graphs, standard equations, or names of all of these things memorized.

§13.1: Vector Functions and Space Curves Most of this section is foundational to what follows, so it’s most likely to just be tested implicitly.

§13.2: Derivatives and Integrals of Vector Functions Know how to compute derivatives and integrals of vector functions. Understand the interpretation of \( \mathbf{r}' \) as a tangent vector, and be able to use it to compute the unit tangent vector \( \hat{T} \).

§13.3: Arc Length and Curvature Know how to compute arc length, such as with one of the forms given in Formulae 2 and 3. (They’re equivalent, so use whichever is clearest to you.) Recall that I will not ask you to work with the arc length function \( s(t) \), nor to reparametrize a curve with respect to arc length. Know how to compute curvature; I suggest memorizing both Formula 9 and Theorem 10, as these are the two most useful computational forms, depending on what information you have. Know how to compute the unit normal and binormal vectors \( \hat{N} \) and \( \hat{B} \), as well as their geometric significance. (The box at the end of the section contains a good summary of pretty much everything you need from here except arc length.)

§13.4: Motion in Space: Velocity and Acceleration Be familiar with the concepts and calculations of velocity, speed, and acceleration. In the unlikely event that I ask you anything that requires Newton’s Second Law of Motion, I will provide it to you in the appropriate form. The concepts of tangential and normal components of acceleration may be useful for their geometric implications, but you will not need to know the formulae for \( a_T \) and \( a_N \). I won’t ask you anything about Kepler’s laws.

To prepare for the exam, you’ll want to work a large number of practice problems. Remember to consult the list of suggested exercises (link on my website) for the covered sections; if you’ve exhausted those, consider the similar exercises usually found nearby (such as the evens corresponding to recommended odds).

The chapter reviews are another good source for preparation. The Concept Checks and True-False Quizzes test your understanding, and the Exercises provide additional practice. Nearly all of them are useful, but you might want to start with...
a bit more focus; at a glance, the following Exercises appear to be the most relevant to the exam:

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Review Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>1, 3, 4*, 6, 7, 10, 11, 15, 17–22, 24(a), 25</td>
</tr>
<tr>
<td>13</td>
<td>1, 2, 5, 6, 8, 9, 11–13, 16–18</td>
</tr>
</tbody>
</table>

* Something like 4(k) should of course be left in simplified exact form on the exam.

If you want still further practice, consult the webpages of the professors I’ve referenced at the bottom of the main Calculus III page on my website. Many of them have old materials from which I draw inspiration.