The first midterm covers Sections 12.1 - 12.5 of the textbook, except for skew lines (examples 3 and 10 from Section 12.5).

The practice exam problems below are pretty representative of what you can expect for the midterm in terms of the difficulty level, nature of problems, and length of the exam, but not in terms of specific questions or topics covered. The latter is due to the simple statistical fact that the topics that can be covered on any given exam represent only a small random snapshot of the entire exam material, and another such random snapshot is likely to result in different questions and topics. Thus, simply studying the problems below will not adequately prepare you. The only way to be fully prepared for the exam is to work through the entire exam material, including all assigned homework.

**Practice Exam Problems:**

1. Determine if the points $K(-1, -3, 2)$, $L(0, -1, 1)$ and $M(2, 3, -1)$ lie on the same line.

2. Show that the equation $x^2 + y^2 + z^2 - 2\sqrt{5}x + 4y = 0$ represents a sphere, and find its center and radius.

3. Let $a = \langle 1, 0, 1 \rangle$, $b = \langle 1, -2, 2 \rangle$, $c = \langle 1, -1, 0 \rangle$. Compute the following quantities:

   (a) The scalar projection of $b$ onto $a$.

   (b) The vector projection of $a$ onto $b$. (Note the order of the vectors here is different from that in part (a)!!)

   (c) The direction angles $\alpha$, $\beta$ and $\gamma$ for $a$.

   (d) The angle between $a$ and $b$.

   (e) The area of the parallelogram spanned by $a$ and $b$.

   (f) Two unit vectors that are orthogonal to both $a$ and $b$.

   (g) The volume of the parallelepiped spanned by the vectors $a$, $b$ and $c$. 
4. Given a line passing through two points $A$ and $B$ and a point $P$ outside this line, state a formula for the distance between the point $P$ and the line in terms of cross and/or dot products of the vectors $\overrightarrow{AB}$ and $\overrightarrow{AP}$.

5. Let $L$ denote the line with parametric equations $x = 2t$, $y = 2 + t$, $z = -1 + 2t$.
   
   (a) Find symmetric equations for $L$.
   (b) Find a vector in the direction of the line $L$.
   (c) Find the distance from $L$ to the origin.

6. Let $A = (0, 2, -1)$, $B = (2, 3, 1)$, $C = (0, 0, 1)$.
   
   (a) Let $P$ denote the plane passing through the origin and perpendicular to the line joining the points $A$ and $B$. Find an equation for $P$.
   (b) Let $Q$ denote the plane containing all three points $A$, $B$, $C$. Find an equation for $Q$.
   (c) Find a vector equation for the line of intersection of $P$ and $Q$.
   (d) Find the angle between $P$ and $Q$. 