Chapter 9 comprehensive topic list

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I’ve compiled a pretty comprehensive list of questions that I’ve come across in the textbook and past exams. Note that some of these are harder than typical midterm questions, questions that I’ve seen often are highlighted in bold.

1 Chapter 9 - Vectors and the Geometry of Space

1.1 Section 9.1 - Three-Dimensional Coordinate Systems

1. Matching equations and inequalities with regions in $\mathbb{R}^3$
   Some of the examples we’ve seen
   (a) Basic planes
   (a) Cylinders
   (a) Spheres

2. Given clues, find the equation of a sphere

3. Given equation, find the center and radius of a sphere

4. Distance between two points

1.2 Section 9.2 - Vectors

1. Basic calculations with vectors
   (a) (Sums) $a + b$
   (b) (Scalar multiples) $3a$

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(c) (Linear combinations) $2a - b$
(d) (Magnitude) $\|a\|$

2. Graphing arrows to represent vectors

3. Calculating the unit vector with the same direction as a given vector

1.3 Section 9.3 - The Dot Product

1. Interpreting whether an expression (involving dot products) is meaningful

2. Calculating dot products (using definition, component formula)

3. Finding angle between vectors (using the dot product)

4. Checking whether vectors are orthogonal, parallel

5. Finding scalar and vector projections (of one vector onto another)

6. Calculating work done (as the dot product of two vectors)

1.4 Section 9.4 - The Cross Product

1. Interpreting whether an expression (involving cross products) is meaningful

2. Calculating cross products (using definition, component formula)

3. Finding a vector perpendicular to two given vectors (using the cross product)

4. Calculating area of a parallelogram determined by two vectors (as the magnitude of the cross product)
   Related: Finding area of a triangle (as half the area of a parallelogram)

5. Calculating volume of a parallelepiped (determined by three vectors) as a triple product

6. Calculating torque (as the cross product of two vectors)

7. Checking whether 3 vectors are co-planar (using triple products)
1.5 Section 9.5 - Equations of Lines and Planes

1. **Converting between each of the 3 line equation forms** (vector form, parametric form, symmetric form)

2. **Finding the equation of a line:**
   This basic question type can be posed in many different ways:
   (a) Given a direction and a point on the line
   (b) Parallel to a given line and passing through a given point
   (c) Perpendicular to a plane and passing through a given point
   (d) **Passing through two points**
   (e) Perpendicular to two given vectors and passing through a point
   (f) **Intersection of two planes**

3. Describing a line segment

4. Determining whether lines intersect.

5. **Converting between each of the 3 plane equation forms** (vector form, scalar form, linear equation form)

6. **Finding the equation of a plane:**
   This basic question type can be posed in many different ways:
   (a) Given a perpendicular direction and a point on the plane
   (b) Parallel to a given plane and containing a given point
   (c) **Passing through three points**
   (d) Parallel to two given vectors and containing a point
   (e) Containing a line and a point not on the line
   (f) **Containing two lines**

7. Finding point of intersection between line and plane

8. Calculating angle of intersection between planes

9. **Distance between a point and a plane** (using projections)

10. Distance between two planes

11. Distance between two lines