Outline of topics

Note: Types of questions listing is not exhaustive. Look at examples + HW too!

1) Coordinates (§10.3, §12.1, §15.7, §15.8)
   a) Cartesian/rectangular \((x, y)\) or \((x, y, z)\)
   b) Polar (2D) and Cylindrical (3D) \((r, \theta)\) and \((r, \theta, z)\)
   c) Spherical (3D) \((\rho, \theta, \phi)\)

Types of questions:

→ Recognize solutions to simple equations.

Example: \(\phi = \frac{\pi}{3}\)

\(\phi = \frac{2\pi}{3}\) upwards pointing cone

\(\theta = \frac{\pi}{2}\) half plane

→ Convert between different systems

Example: \((\rho, \theta, \phi) = (x, y, z) \rightarrow (2, \frac{\pi}{4}, 0)\) cylindrical

\(\rightarrow (2, \frac{\pi}{4}, \frac{\pi}{2})\) spherical

\(\rho = 3 \iff x^2 + y^2 + z^2 = 9.\)

Not on exam: Complicated equations in polar/cylindrical/spherical coordinates. (If you completely understand the coordinate system the given equations should be clear.)

2) Spheres (§12.1)

Fully understand equations of spheres (standard form, completing the square, etc.)
Vectors (§12.2, §12.3, §12.4)

a) Vector definition: direction + magnitude

b) Vector equations: solve equations involving vectors.
   (e.g. Example 7 in §12.2, HW #8, 38 in §12.2)

c) Dot product; definition of projected vector \( \vec{a} \cdot \vec{b} \);
   \( \vec{a} \cdot \vec{b} = |\vec{a}| |\vec{b}| \cos \theta \); orthogonality \( \Rightarrow \vec{a} \cdot \vec{b} = 0 \).

Note on exam: "Direction angles & cosines" in §12.3

d) Cross product; definition via formula; definition via properties that \( \vec{a} \times \vec{b} \) is orthogonal to \( \vec{a} \), \( \vec{b} \), right
   hand rule and \( |\vec{a} \times \vec{b}| = |\vec{a}| |\vec{b}| \sin \theta \).

Area of \( \square \) and \( \triangle \).

Volume of parallelepiped

Note on exam: Physics (Force, Work, Torque)

Lines and planes (§12.5)

a) Equivalent ways of defining lines
   (pt + vector parallel to \( L \), parametric 3, vector equations,
   symmetric equations, 2 points on \( L \))

b) Equivalent ways of defining planes
   (pt + vector normal to \( E \), vector 3, scalar equations,
   3 points on \( E \))

c) Finding a line or plane given various information
   (HW #24, 28, 32, 37, 38 for instance)
d) Distances:
   1) Point to plane
   2) Line to plane (not intersecting)
   3) Plane to plane (not intersecting)
   4) Skew lines (HW #78)

5) Conics and quadrics
   a) Conics: Parabolas, ellipses, hyperbolas, other points, asymptotes
      Remember how to: given eqn, find: foci, vertices, directrix
      given some information among, determine equation and the rest of these.
   b) Quadrics: Be able to identify a surface given the equation defining it. Understand the geometry of quadrics, especially cross-sections.

Not on test: Shifted conics, 3; quadrics.