

18.02 Recitation
Problems
21 November 2011

1. Convert the following points from Cartesian to spherical coordinates: $(1, 1, 0)$, $(0, 1, 1)$, $(1, 1, 1)$. What about $(0, 0, -3)$?

Convert the following points from spherical to Cartesian coordinates: $(1, \pi/2, \pi/2)$, $(2, \pi/6, \pi/3)$, $(3, -\pi/2, 3\pi/4)$.

2. What regions are described by these constraints in spherical coordinates?

- (a) $\rho = 2$
- (b) $\theta = \pi/2$
- (c) $0 \leq \phi \leq 3\pi/4$
- (d) $0 \leq \theta \leq \pi/4$
- (e) $1 \leq \rho \leq 2, 0 \leq \phi \leq \pi/2$

3. Set up bounds of integration for the following regions in spherical coordinates.

- (a) The part of the unit sphere in the first octant.
- (b) The region between the planes $z = 1$ and $z = 2$.
- (c) The region between the planes $x = 1$ and $x = 2$.
- (d) (5B1c) The region bounded by a sphere of radius 1 passing through the origin, and the cone $x^2 + y^2 = z^2$.

4. Find the center of mass of a solid hemisphere of radius a .

5. Let \vec{F} be a vector field pointing radially from the origin with magnitude of 1 at every point. What is the flux of \vec{F} across a sphere of radius a ?

6. Write down equations for these vector fields in three dimensions:

- (a) A field pointing directly away from the origin which has magnitude 1 at every point.
- (b) The gravitational field of a point mass at $(1, 0, 0)$.
- (c) A field which circles clockwise around the x -axis, with length equal to the distance from the axis.