

Math 2415
Paper Homework #3

1. **[12.5B: Planes]** Let $A = (2, 0, 1)$, $B = (3, 1, 0)$ and $C = (4, 3, 2)$.
- (a) Find the level set equation of the plane, \mathcal{P} , containing the points A , B , and C .
 - (b) Check that A , B , and C each satisfy the equation you derived in (a).
 - (c) Find a parametrization, $(x, y, z) = \mathbf{r}(s, t)$, of the plane, \mathcal{P} , containing A , B , and C .
 - (d) For each of the three points, A , B , and C , find values of the parameters (s, t) in the parameterization you found in (c).
 - (e) Let \mathcal{L} be the line passing through the point $(-1, 0, 2)$ that is parallel to the vector $(1, 2, 3)$. Find the point of intersection of this line with the plane, \mathcal{P} .
 - (f) Let \mathcal{Q} be the plane that contains the point $(3, 2, 5)$ and that is perpendicular to the line \mathcal{L} in (e). Find a parametrization of the line of intersection of the planes \mathcal{P} and \mathcal{Q} .
2. **[15.7A: Cylindrical Coordinates]** Consider the following points, curves, surfaces, and solids
- (i) The surface $r = 2$.
 - (ii) The curve where $r = 2$ and $z = 3$.
 - (iii) The curve where $r = 2$ and $\theta = \pi/4$.
 - (iv) The point $(r, \theta, z) = (2, \pi/4, 3)$.
 - (v) The solid where $r \leq 2$, $0 \leq \theta \leq \pi/4$ and $0 \leq z \leq 3$.

Now do the following problems:

- (a) Sketch (i)-(v) *altogether in one plot, with labels*.
 - (b) Convert the equation $r = 2$ to spherical coordinates.
 - (c) Parametrize the line where $r = 2$ and $\theta = \pi/4$.
 - (d) Find the rectangular and spherical coordinates of the point in (iv).
3. **[15.8A: Spherical Coordinates]**
- (a) Sketch the surface whose equation is given by $\phi = 5\pi/6$
 - (b) Convert the equation $\phi = 5\pi/6$ to cylindrical coordinates.
 - (c) Convert the equation $x^2 + y^2 - 3z^2 = 1$ to spherical coordinates. (The answer is not pretty, but that's OK.)
 - (d) Sketch the solid described by the inequalities $1 \leq \rho \leq 4$, $\pi/4 \leq \phi \leq \pi/2$.