Name:\_

Section:\_\_\_\_\_

1. a) Given a scalar equation 2x + y - z = 2, what is the normal to the plane? Find the vector equation of the plane.

b) Given three points (1, 0, -1), (0, 1, 1), (2, 1, 0), find an equation of the plane that contains those three points.

2. a) Find the vector equation of the line of intersection of planes x + y - z = 2 and 2x - y + 2z = 1. Hint: First find two points in the line of intersection to get the direction of the line.

b) Find the vector equation of the plane perpendicular to the above line of intersection and passing through (1,1,0).

3. a) Let V and W be two non-zero vectors which are not collinear. Joining the tips of these vectors by a line segment, one gets a triangle whose sides consists of the vectors V, W and the line segment between the tips of the vectors. Express the mid point of this line segment in terms of V and W.

b) Give a direction to the perimeter of a triangle (either clockwise or counterclockwise). With respect to the direction, each edge of the triangle can be considered as a vector. Show that the sum of these vectors is zero.

- 4. Let A(1,0,1), B(1,1,1), C(1,0,0) represent vectors in  $\mathbb{R}^3$ . Compute the volume of the parallelepiped which is determined by these vectors.
- 5. Let x + 2y + 3z + 1 = 0 and 2x + 4y + 6z + 1 = 0 be two planes in  $\mathbb{R}^3$ .
  - a) Show these two planes are parallel to each other.
  - b) Compute the distance between the planes.
- 6. Given a curve  $r = r(t) = (\cos 2t, t, \sin 2t), \ 0 \le t \le 2\pi$ ,
  - a) Compute the arc length from r(0) to  $r(2\pi)$ .
  - b) Reparametrize the curve by arc length.

c) Find the curvature, the unit tangent T, the unit normal N and the binormal B of the curve. **Hint: For** example,  $\kappa(t) = \frac{|r'(t) \times r''(t)|}{|r'(t)|^3}$ .

Good Luck!!