1. Consider the curve defined parametrically by the equations

$$x(t) = 1 - t^2 \qquad y(t) = 2t^3 + 1$$

for $0 \leq t \leq 1$.

(a) (10 pts.) Calculate the area between the curve and the x-axis.

(b) (10 pts.) Calculate the length of the curve.

2. Consider the curve defined parametrically by the equations

$$x(\theta) = 2\theta - \pi \sin\theta \qquad y(\theta) = 2 - \pi \cos\theta$$

for $-\pi \leq \theta \leq \pi$.

(a) (10 pts.) Find the point where the curve intersects itself.

(b) (10 pts.) Write down the equation for each line tangent to the curve at the point you found in part (a).

3. (a) (10 pts.) Find the equation of the plane which goes through the points $(1, 1, -1)$, $(0, 1, 0)$ and $(1, -1, 0)$.

(b) (10 pts.) Compute the perpendicular distance from the point $(1, 1, 1)$ to the plane described in part (a).

4. Let $A = (2, 1, -1)$, $B = (3, 0, -2)$, $C = (3, 2, 1)$, and $D = (-2, 0, 1)$.

(a) (10 pts.) Find the area of the parallelogram that has AB and AC as adjacent sides.

(b) (10 pts.) Find the volume of the parallelepiped that has edges AB, AC, and AD.

5. (a) (10 pts.) Find a unit vector which is orthogonal to $\langle 1, -1, -1 \rangle$ and $\langle 1, 1, 2 \rangle$.

(b) (10 pts.) Find the line of intersection of the two planes

$$x - y - z = 2 \qquad x + y + 2z = -2$$