

1. (20 pts) A triangle has vertices at the points

$$A = (3, 1, 1), \quad B = (2, -1, 1), \quad \text{and} \quad C = (1, 0, -1).$$

- (a) Find an equation of the plane containing the triangle.
(b) Find the area of the triangle.

2. (15 pts) Find parametric equations for the line of intersection of the two planes

$$2x - y + 3z = 2 \quad \text{and} \quad 2x + y - z = 4.$$

3. (10 pts) Find a unit vector which is parallel to the plane $x - 5y + 2z = 3$ and orthogonal to the line $\langle x, y, z \rangle = \langle 2 + 3t, -1 + t, 4 - 2t \rangle$.

4. (15 pts) Let $\mathbf{r}(t) = \langle t^2 + 2, t + 1, 2t^2 - t + 3 \rangle$. Show that the path $\mathbf{r}(t)$ lies in a plane, and find an equation for the plane.

5. (25 pts) The position function of a moving particle is given by

$$\mathbf{r}(t) = \langle 4t - 3, 5t^2, t^2 + 3t \rangle.$$

- (a) Find the velocity $\mathbf{v}(t)$.
(b) Find the speed $\frac{ds}{dt}$.
(b) Find the acceleration $\mathbf{a}(t)$.
(d) Find the curvature $\kappa(t)$.

6. (15 pts) Find the length of the curve $\mathbf{r}(t) = \frac{1}{2}e^{2t} \mathbf{i} + (2t - 2)e^t \mathbf{j} + \frac{2}{3}t^3 \mathbf{k}$ for $0 \leq t \leq 1$.