Name:_____

Student Number:_____

**Show all your work and give reasons for your answers. Good luck!**

# Part I

In part I essentially no partial credit is awarded. Hence work these problems carefully. Each problem in part I is 8 points.

(1) Find the angle between the vectors $< 1, 1, 1 >$ and $< 1, 2, 3 >$. (You can leave your answer in the form $\cos^{-1}(y)$, where $y$ is a number.)

(2) Find the area of the parallelogram spanned by the vectors $< 1, 1, 1 >$ and $< 1, 2, 3 >$.

(3) Given the vectors $\mathbf{a} =< 1, 1, 1 >$ and $\mathbf{b} =< 1, 2, 3 >$, find the component of $\mathbf{a}$ in the direction of $\mathbf{b}$: $comp_{\mathbf{b}}\mathbf{a}$.

(4) Find the equation of the line through the points $(1, 2, 3)$ and $(0, -1, 2)$

(5) Find the equation of the plane through the points $(1, 1, 1)$, $(1, 0, 0)$ and $(-1, 3, -1)$.

(6) Find the intersection of the plane $2x - 3y + z = 4$ and the line $\begin{cases} x = 1 + 2t \\ y = 2 - 3t \\ z = 4 + t \end{cases}$

(7) Find the equation of the plane perpendicular to the line $\begin{cases} x = 1 + 2t \\ y = 2 - 3t \\ z = 4 + t \end{cases}$ and through the point $(1, 2, 3)$.

(8) Find the distance from the point $(1, 2, 3)$ to the plane $2x - 3y + z = 4$.

# Part II

In part II partial credit is awarded. Also work these problems carefully. Each problem in part II is 13 points.

(9) Determine if the vectors $\mathbf{a} =< 1, 1, 1 >$, $\mathbf{b} =< -1, 0, 3 >$ and $\mathbf{c} =< 0, -1, 1 >$ are co-planar (i.e., lie in a common plane).

(10) Find the equation of the line of intersection of the planes $2x - 3y + z = 4$ and $-x + y - z = 7$.

(11) Determine if the following lines are parallel, skew, or intersecting.

If they intersect, find the point of intersection. Otherwise find the distance between them.

$$\begin{cases} x = 1 + 2t \\ y = 3t \\ z = 2 - t \end{cases} \quad \text{and} \quad \begin{cases} x = -1 + s \\ y = 4 + s \\ z = 1 + 3s \end{cases}$$