First Name:_____ Last Name: _____ Student ID: _____

Equations of Lines and Planes

1. Determine which of the following points lie on the line ℓ: $(x, y, z) = (2, -3, 4) + t(1, 3, 2)$.

a. $(3, 0, 6)$ b. $(-1, -12, -2)$ c. $(8, -8, 12)$

2. Given the line ℓ: $(x, y, z) = (8, 2, -3) + t(4, 1, -2)$

a. Find the point on the line with an x-coordinate of 120.
b. Does the line have an x-intercept, a y-intercept, or a z-intercept? If so, find them.

3. For each of the following, find the vector equation of the line that:

a. is parallel to $(6, 4, 1)$ and passes through the point $(3, 0, -4)$
b. passes through the points $(2, -4, 3)$ and $(-4, -8, 7)$
c. is parallel to the y-axis and passes through the point $(6, -2, -4)$
d. has x-intercept 5 and z-intercept -10

4. If the points (4, 2, 7), (6, 19, −4), and (80, b, c) lie on the same straight line, find the values of b and c.

5. Determine the angle between each pair of lines:

a. l_1: (x,y,z)=(4,5,−2)+t(3,−1,−1) and l_2: (x,y,z)=(4,5,−2)+s(−2,−3,2)

b. $l_1: \begin{cases} x = 20 + 3t \\ y = -10 + 2t \\ z = 4 \end{cases}$ and $l_2: \begin{cases} x = 20 + t \\ y = -10 + 5t \\ z = 4 \end{cases}$

6. Find, in parametric form, the equation of a line perpendicular to both

l_1: (x, y, z)= (3, 7, −2)+ t(3, −1, −1) and l_2: (x, y, z)=(8,−3,−3)+ t(−2,−3,2) that passes through (5,0,0).

7. Which of the following points are on the plane $3x - y + 2z - 12 = 0$?

a. (3, 9, 6)   b. (0, 2, 7)

c. (4, −2, −1)   d. (6, 3, −5)

8. Find a vector perpendicular to the plane:

a. $5x + 3y - 2z + 16 = 0$
b. $2x - z - 18 = 0$
c. $\vec{r} = (1,0,2) + s(6,1,-2) + t(2,-1,3)$

9. Find a scalar equation for each of the following planes:

a. The plane with normal vector (5, 1, −1) and passing through (3, 0, 2)
b. The plane with vector equation $\vec{r} = (1, 0, 2) + s(1, 1, 1) + t(2, -1, 3)$
c. $\begin{cases} x = 3 + 4s - t \\ y = s + 3t \\ z = -2 - s + 4t \end{cases}$
d. The plane that passes through the points (5, −2, 3), (−3, 1, 2), and (6, 0, 4).
e. The plane with a x-intercept of 12, a y-intercept of 3, and a z-intercept of −2.

10. Determine the values of k so that the points (1, 3, 1), (2, 4, 5), (−4, 1, 8), and (6, 1, k) are coplanar.

11. Find the angle between the pair of planes.

$6x + y - 2z + 24 = 0$

$2x - 5y + 3z - 1 = 0$