Dawson College: Fall 2019: Linear Algebra (Science): 201-NYC-05-S5: **Quiz 9** name: ________________________________

No books, watches, notes or cell phones are allowed. You must show all your work, the correct answer is worth 1 mark the remaining marks are given for the work.

Question 1.[1] *(1 mark each)* Given
$\mathcal{P}_1 : 2x + y - 3z = 6$,
$\mathcal{P}_2 : -6x - 3y + 9z = 1$,
$\mathcal{P}_3 : x + y + z = 1$, and
$\mathcal{L}_1 : \vec{x} = (1, 0, 1) + t(-4, -2, 6)$ where $t \in \mathbb{R}$.
Complete the following sentences with the word **perpendicular**, **parallel** or, **neither perpendicular nor parallel**, as appropriate.

a. $\mathcal{P}_1$ and $\mathcal{P}_2$ are ________________________________ to each other.

b. $\mathcal{P}_1$ and $\mathcal{P}_3$ are ________________________________ to each other.

c. $\mathcal{P}_1$ and $\mathcal{L}_1$ are ________________________________ to each other.

d. $\mathcal{P}_3$ and $\mathcal{L}_1$ are ________________________________ to each other.

Question 2. Given the plane $\mathcal{P} : 3x + 2y + z = 6$.

a. *(2 marks)* Find the x, y and z intercept of $\mathcal{P}$ and sketch $\mathcal{P}$, include the axes and their labels as shown in class.

b. *(4 marks)* Using projection(s) find the distance between the origin and $\mathcal{P}$.

c. *(3 marks)* Find the angle between $\mathcal{P}$ and the xz-plane (the plane that contains the x and z axis).

[1] Inspired from John Abbott Final Examinations.

Question 3. *(4 marks)* Find the closest point on $x - y = 0$ to the point $P(2, 3)$.

Question 4. Determine whether the following statement is true or false. If the statement is false provide a counterexample. If the statement is true provide a proof of the statement.

a. *(2 marks)* If $\vec{a}$ and $\vec{b}$ are orthogonal vectors, then for every nonzero vector $\vec{u}$, we have $\text{proj}_{\vec{a}}(\text{proj}_{\vec{b}}(\vec{u})) = \vec{0}$

b. *(2 marks)* If the relationship $\text{proj}_{\vec{a}}(\vec{u}) = \text{proj}_{\vec{a}}(\vec{v})$ holds for some nonzero vector $\vec{a}$, then $\vec{u} = \vec{v}$.