Name: Y. Lamontagne
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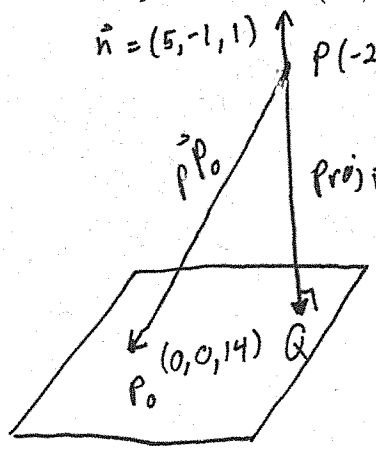
Quiz 9

This quiz is graded out of 10 marks. No books, calculators, 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. If you need more space for your answer use the back of the page.

Question 1. *(5 marks)* #5.21 Find the point of the plane which is closest to the point P. (using projections)

$5x-y+z=14$ and $P(-2,3,0)$



$$\text{proj}_{\vec{n}}\vec{PP_0} = \frac{\vec{PP_0}\cdot\vec{n}}{\vec{n}\cdot\vec{n}}\vec{n} = \frac{(+2,-3,+14)\cdot(5,-1,1)}{(5,-1,1)\cdot(5,-1,1)}(5,-1,1)$$

$$= \frac{+10+3+14}{25+1+1}(5,-1,1)$$

$$= \frac{+27}{27}(5,-1,1) = +(5,-1,1)$$

P_0: Let $x=y=0$ then $z=14$

$P_0(0,0,14)$

$$Q = P + \text{proj}_{\vec{n}}\vec{PP} = (-2,3,0)+(5,-1,1)$$
$$= (3,2,1)$$

$$\vec{PP_0} = P_0 - P = (0,0,14)-(-2,3,0) = (2,-3,14)$$

Question 2. *(5 marks)* #4.7a Determine a vector equation of the line of intersection of the given planes.

$x+3y-z=5$ and $2x-5y+z=7$

$$\begin{bmatrix}1 & 3 & -1 & 5\\ 2 & -5 & 1 & 7\end{bmatrix} \sim \overset{-2R_1+R_2\to R_2}{} \begin{bmatrix}1 & 3 & -1 & 5\\ 0 & -11 & 3 & -3\end{bmatrix} \sim \overset{-\frac{1}{11}R_2\to R_2}{} \begin{bmatrix}1 & 3 & -1 & 5\\ 0 & 1 & -\frac{3}{11} & \frac{3}{11}\end{bmatrix}$$

$$\sim \overset{-3R_2+R_1\to R_1}{} \begin{bmatrix}1 & 0 & -\frac{2}{11} & \frac{46}{11}\\ 0 & 1 & -\frac{3}{11} & \frac{3}{11}\end{bmatrix}$$

Let $z=t$, $t\in\mathbb{R}$

$$(x,y,z) = \left(\frac{46}{11}+\frac{2}{11}t, \frac{3}{11}+\frac{3}{11}t, t\right)$$

$$= \left(\frac{46}{11},\frac{3}{11},0\right)+t\left(\frac{2}{11},\frac{3}{11},1\right) \quad t\in\mathbb{R}$$

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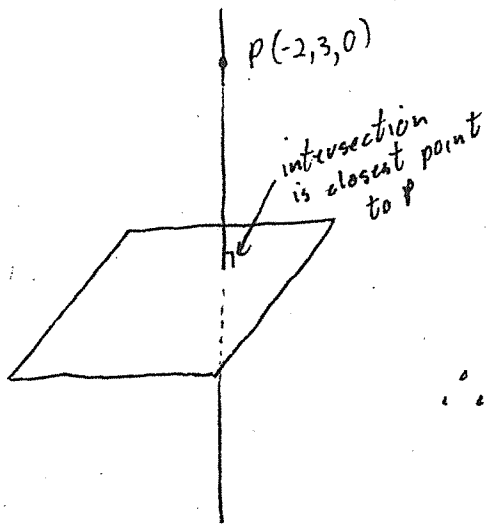

The line that passes through P and perpendicular to the plane: $(x,y,z) = P + t\vec{n}$ $t \in \mathbb{R}$ where $\vec{n} = (5,-1,1)$

$(x,y,z) = (-2,3,0) + t(5,-1,1) = (-2+5t, 3-t, t)$

sub into equation of plane

$5(-2+5t) - (3-t) + t = 14$

$-10 + 25t - 3 + t + t = 14$

$27t = 27$

$t = 1$

$\therefore$ closest point is $(x,y,z) = (-2,3,0) + 1(5,-1,1)$

$= (3,2,1)$