2. c) $\overrightarrow{PC} = \begin{bmatrix} -1-3 \\ 0-2 \\ 1-1 \end{bmatrix} = \begin{bmatrix} -4 \\ -2 \\ 0 \end{bmatrix}$ $\quad \underline{n} = \begin{bmatrix} -3 \\ -3 \\ 3 \end{bmatrix}$

$$\underline{f} = \text{proj}_{\underline{n}} \overrightarrow{PC} = \frac{\overrightarrow{PC} \cdot \underline{n}}{\underline{n} \cdot \underline{n}} \underline{n}$$

$$= \frac{(-4)(-3) + (-2)(-3) + 0(3)}{(-3)^2 + (-3)^2 + 3^2} \begin{bmatrix} -3 \\ -3 \\ 3 \end{bmatrix}$$

$$= \frac{18}{27} \begin{bmatrix} -3 \\ -3 \\ 3 \end{bmatrix}$$

$$= \frac{2}{3} \begin{bmatrix} -3 \\ -3 \\ 3 \end{bmatrix}$$

$$= \begin{bmatrix} -2 \\ -2 \\ 2 \end{bmatrix}$$

$$\|\underline{f}\| = \sqrt{(-2)^2 + (-2)^2 + 2^2} = \sqrt{12} = \boxed{2\sqrt{3}}$$

Observe that $\underline{f} = \overrightarrow{PQ}$ so, if Q is the point (x, y, z) then

$$\begin{bmatrix} x-3 \\ y-2 \\ z-1 \end{bmatrix} = \begin{bmatrix} -2 \\ -2 \\ 2 \end{bmatrix}$$

So $x-3 = -2 \rightarrow x = 1$

$y-2 = -2 \rightarrow y = 0$

$z-1 = 2 \rightarrow z = 3$ so Q is the point $(1, 0, 3)$.