Ass 4
TOTAL = $\underline{18}$

(1) $\vec{a} = \begin{bmatrix} 3 \\ 0 \\ 2 \end{bmatrix}$, $\vec{b} = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$

(a) $\text{proj}_{\vec{b}} \vec{a} = \dfrac{\vec{a}\cdot\vec{b}}{\vec{b}\cdot\vec{b}} \vec{b}$

$= \dfrac{8}{6} \vec{b} = \begin{bmatrix} 8/3 \\ -4/3 \\ 4/3 \end{bmatrix}$

(2)

(b) $\text{proj}_{\vec{k}} \vec{a} = \dfrac{\vec{a}\cdot\vec{k}}{\vec{k}\cdot\vec{k}} \vec{k}$

(2)

$= \dfrac{2}{1} \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix}$

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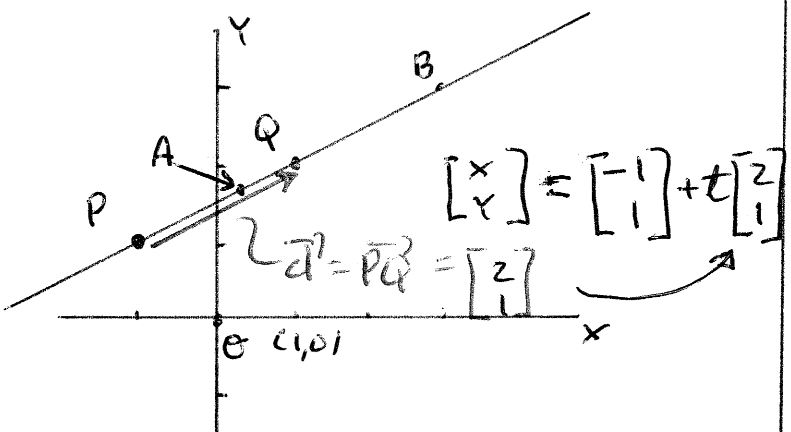
(2) Sketch optional but useful



$\vec{d} = \vec{PQ} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix} + t \begin{bmatrix} 2 \\ 1 \end{bmatrix}$

(a) Caution - many correct answers. Eg start at Q, reverse $\vec{d}$, etc.

(2)

$\begin{cases} x = -1 + 2t \\ y = 1 + t \end{cases} \quad t \in \mathbb{R}$

(b) Take $t = \frac{1}{2}$ to get midpoint

(1) $(0, \frac{3}{2})$

(c) take $t = \frac{2}{3}$ or 2, see diagram,

to get $A = (1/3, 5/3)$
or $B = (3, 3)$ (2)

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(3)

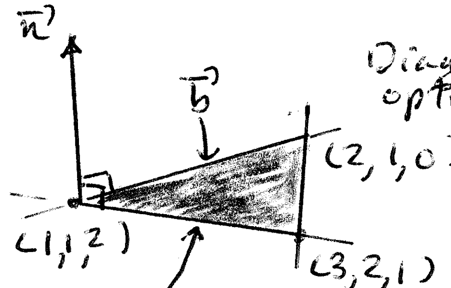

Diagram optional but reco.

$\vec{a} = \langle 2, 1, -1 \rangle$

$\vec{b} = \langle 1, 0, -2 \rangle$

Normal $\vec{n} = \vec{a} \times \vec{b} = \langle -2, 3, -1 \rangle$
(or any non-zero mult)

Equation $\boxed{-2x + 3y - z = -1}$ (4)

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(4) (a) $\vec{n} = \langle 2, -1, 1, -3 \rangle$ (1)

(b) $C = (3, 0, 0, 0)$ (1)

(c) $\vec{CP} = \langle -2, 1, -2, 1 \rangle$, so

$\text{Proj}^{n} = \dfrac{\vec{CP}\cdot\vec{n}}{\vec{n}\cdot\vec{n}} \vec{n} = \dfrac{-10}{15} \vec{n}$ (2)

$= -\dfrac{2}{3} \langle 2, -1, 1, -3 \rangle$

(d)
Distance $= \|\text{Proj}^{n}\|$ (1)
$= \dfrac{2}{3}\sqrt{4+1+1+9}$

$= \frac{2}{3}\sqrt{15} \simeq 2.582.$