

Step-1

Given vectors $a = (2, -2, 1), b = (1, 2, 2)$.

We have to find the projection of b onto a .

Step-2

$P =$ The projection of b onto $a = \frac{a^T b}{a^T a} a \dots (1)$

$$\begin{aligned} a^T b &= \begin{bmatrix} 2 & -2 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 2 \end{bmatrix} \\ &= 2 - 4 + 2 \\ &= 0 \end{aligned}$$

$$\begin{aligned} a^T a &= \begin{bmatrix} 2 & -2 & 1 \end{bmatrix} \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix} \\ &= 4 + 4 + 1 \\ &= 9 \end{aligned}$$

Step-3

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$$P = \frac{0}{9} \begin{bmatrix} 2 \\ -2 \\ 1 \end{bmatrix}$$

By (1),

$$= \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Hence required projection is a zero vector.