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4a. $\left[\begin{array}{ccc|c} 1 & 2 & 4 & 1 \\ -1 & 2 & 1 & 1 \\ 0 & 4 & 5 & 1 \end{array}\right]$ $R_2 = R_2 + R_1$ $\left[\begin{array}{ccc|c} 1 & 2 & 4 & 1 \\ 0 & 4 & 5 & 2 \\ 0 & 4 & 5 & 1 \end{array}\right]$

$0x_1 + 4x_2 + 5x_3 = 2$ ← contradiction!
$0x_1 + 4x_2 + 5x_3 = 1$

$\boxed{\vec{v} \text{ does NOT lie in } V}$

b. Since $R_3 = R_2 + R_1$, R_1 and R_2 are basises for V.

V is the span of $\left(\begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}\right)$ so V is in R^2

$\boxed{\dim(V) = R^2}$

c. ~~To make R_1 and R_2 orthogonal, we find θ between them~~
~~$-1+4+4 = |R_1||R_2| \cos\theta$ $\cos\theta = \frac{7}{\sqrt{21}\sqrt{6}} = \frac{7}{\sqrt{126}}$~~

To make R_1 and R_2 orthonormal, we must make each length 1.

$R_1 = \frac{R_1}{|R_1|} = \begin{bmatrix} 1/\sqrt{21} \\ 2/\sqrt{21} \\ 4/\sqrt{21} \end{bmatrix}$ $R_2 = \frac{R_2}{|R_2|} = \begin{bmatrix} -1/\sqrt{6} \\ 2/\sqrt{6} \\ 1/\sqrt{6} \end{bmatrix}$