

$$\det \begin{pmatrix} 1 & 1 & 0 & 0 \\ 2 & 0 & 1 & 0 \\ -3 & 1 & 0 & 1 \\ 0 & -1 & 1 & -2 \end{pmatrix}$$

expand along top row

$$= \det \begin{pmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ -1 & 1 & -2 & 0 \end{pmatrix} - \det \begin{pmatrix} 2 & 1 & 0 \\ -3 & 0 & 1 \\ 0 & 1 & -2 \end{pmatrix}$$

$$= 0 - \det \begin{pmatrix} 1 & 1 \\ -1 & -2 \end{pmatrix} - 2 \det \begin{pmatrix} 0 & 1 \\ 1 & -2 \end{pmatrix} + \det \begin{pmatrix} -3 & 1 \\ 0 & -2 \end{pmatrix}$$

$$= -(-2+1) - 2(-1) + 6 = 1 + 2 + 6 = 9.$$

$$\therefore B \wedge B(v_1, v_2, v_3, v_4) = 2 \times 9 = 18. \quad \checkmark$$