

$$\begin{aligned}
 \hat{\mathbf{i}} \times \hat{\mathbf{j}} &= \det \begin{bmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} = \hat{\mathbf{i}} \det \begin{bmatrix} \cancel{\hat{\mathbf{i}}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} - \hat{\mathbf{j}} \det \begin{bmatrix} \hat{\mathbf{i}} & \cancel{\hat{\mathbf{j}}} & \hat{\mathbf{k}} \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} + \hat{\mathbf{k}} \det \begin{bmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \cancel{\hat{\mathbf{k}}} \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} \\
 &= \hat{\mathbf{i}} (0 \times 0 - 0 \times 1) - \hat{\mathbf{j}} (1 \times 0 - 0 \times 0) + \hat{\mathbf{k}} (1 \times 1 - 0 \times 0) = \hat{\mathbf{k}}
 \end{aligned}$$