45. We observe that $\left|\hat{\imath} \times \hat{\imath}\right| = \left|\hat{\imath}\right| \left|\hat{\imath}\right| \sin 0°$ vanishes because $\sin 0° = 0$. Similarly, $\hat{\jmath} \times \hat{\jmath} = \hat{k} \times \hat{k} = 0$. When the unit vectors are perpendicular, we have to do a little more work to show the cross product results. First, the magnitude of the vector $\hat{\imath} \times \hat{\jmath}$ is

$$\left|\hat{\imath} \times \hat{\jmath}\right| = \left|\hat{\imath}\right| \left|\hat{\jmath}\right| \sin 90°$$

which equals 1 because $\sin 90° = 1$ and these are all units vectors (each has magnitude equal to 1). This is consistent with the claim that $\hat{\imath} \times \hat{\jmath} = \hat{k}$ since the magnitude of $\hat{k}$ is certainly 1. Now, we use the right-hand rule to show that $\hat{\imath} \times \hat{\jmath}$ is in the positive z direction. Thus $\hat{\imath} \times \hat{\jmath}$ has the same magnitude and direction as $\hat{k}$, so it is equal to $\hat{k}$. Similarly, $\hat{k} \times \hat{\imath} = \hat{\jmath}$ and $\hat{\jmath} \times \hat{k} = \hat{\imath}$. If, however, the coordinate system is left-handed, we replace $\hat{k} \to -\hat{k}$ in the work we have shown above and get

$$\hat{\imath} \times \hat{\imath} = \hat{\jmath} \times \hat{\jmath} = \hat{k} \times \hat{k} = 0 \ .$$

just as before. But the relations that are different are

$$\hat{\imath} \times \hat{\jmath} = -\hat{k} \quad \hat{k} \times \hat{\imath} = -\hat{\jmath} \quad \hat{\jmath} \times \hat{k} = -\hat{\imath} \ .$$