Dot Product Between Vectors

Consider two vectors $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$ and $\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$.

- $\vec{A}\cdot\vec{B} = AB\cos\phi = AB_A = BA_B$.
- $\vec{A}\cdot\vec{B} = \vec{B}\cdot\vec{A}$.
- $\vec{A}\cdot\vec{B} = AB$ if $\vec{A} \parallel \vec{B}$.
- $\vec{A}\cdot\vec{B} = 0$ if $\vec{A} \perp \vec{B}$.
- $$\begin{aligned}\vec{A}\cdot\vec{B} &= (A_x\hat{i} + A_y\hat{j} + A_z\hat{k})\cdot(B_x\hat{i} + B_y\hat{j} + B_z\hat{k}) \\ &= A_xB_x(\hat{i}\cdot\hat{i}) + A_xB_y(\hat{i}\cdot\hat{j}) + A_xB_z(\hat{i}\cdot\hat{k}) \\ &+ A_yB_x(\hat{j}\cdot\hat{i}) + A_yB_y(\hat{j}\cdot\hat{j}) + A_yB_z(\hat{j}\cdot\hat{k}) \\ &+ A_zB_x(\hat{k}\cdot\hat{i}) + A_zB_y(\hat{k}\cdot\hat{j}) + A_zB_z(\hat{k}\cdot\hat{k}).\end{aligned}$$
- Use $\hat{i}\cdot\hat{i} = \hat{j}\cdot\hat{j} = \hat{k}\cdot\hat{k} = 1$,
  $\hat{i}\cdot\hat{j} = \hat{j}\cdot\hat{k} = \hat{k}\cdot\hat{i} = 0$.
- $\Rightarrow\ \vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$.