Working in small groups (3 or 4 people), solve as many of the problems below as possible. Try to resolve questions within the group before asking for help. Each group member should then write up the solutions in their own words; please do not use this sheet for that purpose, but please turn in this sheet as well. Show your work! Full credit will only be given if your answer is supported by calculations and/or explanations as appropriate.

The dot product of 2 vectors \( \vec{u} \) and \( \vec{v} \) is just the (suitably scaled) projection of one vector along the other, as shown in the diagram at the right. It can be shown that this leads to the formula

\[ \vec{u} \cdot \vec{v} = |\vec{u}| |\vec{v}| \cos \theta \]

where \( |\vec{u}| \) is the length of \( \vec{u} \), and \( \theta \) the angle between \( \vec{u} \) and \( \vec{v} \). A unit vector is a vector whose length is 1. The unit vectors in the \( x \), \( y \), and \( z \) directions are usually denoted \( \hat{i} \), \( \hat{j} \), and \( \hat{k} \), respectively.

1. Determine the dot products \( \hat{i} \cdot \hat{i} \) and \( \hat{i} \cdot \hat{j} \).
2. Determine the length of the diagonal of a unit cube.
3. Determine the angle between the diagonal of a cube and an adjacent edge.