

Section 1: Vectors in three dimensions

Exercise level 3

1. Use vectors to prove that the line joining the midpoints of two sides of a triangle is parallel to the third side and half of its length.

2. For $\mathbf{a} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} -1 \\ 1 \\ 1 \end{pmatrix}$, $\mathbf{d} = \begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix}$ and $\mathbf{e} = \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix}$, the points A, B, D and E have

position vectors \mathbf{a} , \mathbf{b} , \mathbf{d} and \mathbf{e} , respectively. Show that AB, AD and AE are edges of a cube.

Find the coordinates of vertex G which is diagonally opposite vertex A. Hence, or otherwise, find the angle that the diagonal of the cube makes with the base of the cube.