Vectors

1. Write the position vectors of the following points, both in $\hat{\imath}$, $\hat{\jmath}$, $\hat{k}$ notation, and as column vectors:
   (a) $(1, 0)$
   (b) $(0, 1)$
   (c) $(7, 4)$
   (d) $(-3, 12)$
   (e) $(-1, 2, 4)$
   (f) $(2, 4, -1)$
2. For each of the following vectors $\overrightarrow{v}$, calculate the magnitude $|\overrightarrow{v}|$:
   (a) $\overrightarrow{v} = 3\hat{\imath} - 4\hat{\jmath}$
   (b) $\overrightarrow{v} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$
   (c) $\overrightarrow{v} = 4\hat{\imath} - 12\hat{\jmath} + 3\hat{k}$
   (d) $\overrightarrow{v} = \begin{pmatrix} 7 \\ 0 \\ 2 \end{pmatrix}$.
3. For each of the following vectors $\overrightarrow{v}$, find the component in the direction of the vector $\overrightarrow{a}$:
   (a) $\overrightarrow{v} = 2\hat{\imath} - \hat{\jmath}$, $\overrightarrow{a} = \hat{k}$
   (b) $\overrightarrow{v} = 3\hat{\imath} - 2\hat{\jmath}$, $\overrightarrow{a} = \frac{1}{\sqrt{2}}\hat{\imath} + \frac{1}{\sqrt{2}}\hat{\jmath}$
   (c) $\overrightarrow{v} = 7\hat{\imath} - 6\hat{\jmath} + 49\hat{k}$, $\overrightarrow{a} = 8\hat{\imath} + 6\hat{k}$.
4. Let $\overrightarrow{v} = 2\hat{\imath} - 5\hat{\jmath}$ and $\overrightarrow{w} = 3\hat{\imath} + \hat{\jmath}$. Compute $\overrightarrow{v} + \overrightarrow{w}$, $2\overrightarrow{v}$, $-3\overrightarrow{w}$, and $2\overrightarrow{v} - 3\overrightarrow{w}$. Draw a diagram showing all of these vectors.
5. Write the position vectors of the points $P = (7, 4)$ and $Q = (12, -9)$. Hence find the distance from P to Q.
6. Find the coordinates of the point halfway between $(-1, 3)$ and $(6, 5)$.

7. Let A be the point $(5, 0, 4)$, and B the point $(0, 9, 2)$. Let C be the point on the line segment $\overrightarrow{AB}$ such that $|\overrightarrow{AC}| : |\overrightarrow{CB}| = 2 : 1$. Find the coordinates of C.

8. Suppose that $OABC$ is a parallelogram, where O is the origin, $A = (5, 9)$, and $B = (-2, 3)$. Find the coordinates of C.