Section 4: Finding distances

Exercise level 2

1. A line passes through the points A (6, -5, 1) and B(3, 1, -8).
   (i) Find a vector equation for the line.
   (ii) Show that the line is perpendicular to the plane $\mathbf{r}.\begin{pmatrix}1\\-2\\3\end{pmatrix}=-9$.
   (iii) Find the point of intersection of the line and the plane.
   (iv) Find the shortest distance from point A to the plane.

2. Find the shortest distance of the point from the plane in each case.
   (i) (1, 4, -2) and $2x-4y+z=3$
   (ii) (-3, 0, 1) and $\mathbf{r}.\begin{pmatrix}-2\\3\\1\end{pmatrix}=2$

3. Find the distance of the point P from the given line in each case.
   (i) $\mathbf{r}=\begin{pmatrix}1\\2\\0\end{pmatrix}+\lambda\begin{pmatrix}-2\\3\\1\end{pmatrix}$, P = (4, -1, 2)
   (ii) $\mathbf{r}=\begin{pmatrix}5\\-1\\3\end{pmatrix}+\lambda\begin{pmatrix}1\\4\\-1\end{pmatrix}$, P = (2, 0, -3)

4. A line has equation $\mathbf{r}=\begin{pmatrix}2\\1\\5\end{pmatrix}+\lambda\begin{pmatrix}0\\-3\\1\end{pmatrix}$.
   (i) Write down an equation for a line that is parallel to the line given above, and passes through the point (1, 3, -6).
   (ii) Find the distance between these two lines. Give your answer to 3 s.f.

5. Two lines have equations $\mathbf{r}=\begin{pmatrix}3\\5\\-2\end{pmatrix}+\lambda\begin{pmatrix}1\\0\\2\end{pmatrix}$ and $\mathbf{r}=\begin{pmatrix}0\\1\\3\end{pmatrix}+\lambda\begin{pmatrix}2\\5\\-1\end{pmatrix}$
   (i) Show that the lines are skew.
   (ii) Find the distance between the lines.

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6. Find the distance between the skew lines $\frac{x-7}{3}=\frac{y-3}{1}=\frac{z-1}{-2}$ and $\frac{x+8}{3}=\frac{y+1}{2}=\frac{z-3}{-1}$. Give the coordinates of the point on each line that is closest to the other line.