Further Maths Vectors Relay - Page 1

1) Find the vector equation of the line passing through the points $(1,2,4)$ and $(5,6,4)$ in the form $\mathbf{r} = \mathbf{a} + \lambda\mathbf{b}$.
Pass on $|\mathbf{b}|^2$

3) You receive a from Question 2.
The line with equation $\mathbf{r} = \begin{pmatrix}1\\0\\1\end{pmatrix} + \mu\begin{pmatrix}a\\1\\1\end{pmatrix}$ is transformed by the matrix $\begin{pmatrix}1 & 0 & 1\\1 & a & 1\\0 & 0 & 1\end{pmatrix}$.
Find the equation of the image of the line in the form $\mathbf{r} = \mathbf{a} + \mu\mathbf{b}$.
Pass on $\mathbf{b}$

5) Receive a from Question 4.
Consider the line $\dfrac{x-3}{a-31} = \dfrac{y-2}{2}$.
Find the point of intersection with the line $\mathbf{r} = \begin{pmatrix}1\\5\end{pmatrix} + \mu\begin{pmatrix}14\\-4\end{pmatrix}$.
Pass on the $y-$coordinate of the point of intersection.

7) Receive the vector $\mathbf{v} = \begin{pmatrix}v_1\\v_2\\v_3\end{pmatrix}$ from Question 6.
Find the area of the triangle OAB where $A(v_1, v_2, v_3)$ and $B(2,1,3)$.
Give your answer in the form $\dfrac{1}{2}\sqrt{abcd}$.
Pass on b, c and d.

9) Receive the line l_1 from Question 8.
Find the shortest perpendicular distance between l_1 and the line $l_2 : \mathbf{r_2} = \begin{pmatrix}2\\8\\5\end{pmatrix} + \mu\begin{pmatrix}1\\5\\5\end{pmatrix}$.
Give your answer in the form $\sqrt{m}$.
Pass on $a = m - 7$ and $b = m - 4$.

11) Receive point $P(a, b)$ from Question 10.
Use calculus to find the minimum distance from P to the line $\mathbf{r} = \begin{pmatrix}-1\\-2\end{pmatrix} + \lambda\begin{pmatrix}3\\1\end{pmatrix}$.
Give your answer in the form $\sqrt{\dfrac{a}{b}}$.
Pass on a and b.

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2) Receive a from Question 1.

Find the angle between $\mathbf{u} = \begin{pmatrix} 1 \\ 3 \\ 4 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 2 \\ 3 \\ a^{\frac{1}{5}} \end{pmatrix}$.

Pass on the digit in the first decimal place.

4) Receive $\mathbf{v}$ from Question 3.

Find the shortest distance from $\mathbf{v}$ to the line $\mathbf{r} = \begin{pmatrix} 1 \\ 1 \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ 0 \\ 1 \end{pmatrix}$.

Give your answer in the form $\sqrt{a}$ and pass on a.

6) Receive a from Question 5.

Find a vector, $\mathbf{v}$, that is perpendicular to $\begin{pmatrix} a \\ 1 \\ 2 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ a \\ -1 \end{pmatrix}$.

Pass on the vector $\mathbf{v}$.

8) Receive from Question 7, b, c and d.

Let $\mathbf{n} = \begin{pmatrix} b \\ c \\ d \end{pmatrix}$. Find the vector equation of the line parallel to $\mathbf{n}$ that passes through the point $P(1,1,2)$.

Pass on the equation of the line in the form $\mathbf{r} = \mathbf{a} + \lambda n$.

10) Receive a, b and c from Question 9.

Find the coordinates of the image of point (a, b) when it is reflected in the line $\mathbf{r} = \begin{pmatrix} 0 \\ 1 \end{pmatrix} + t \begin{pmatrix} 2 \\ 1 \end{pmatrix}$.

Pass on the image point.

12) Receive from Question 11 a and b.

Establish whether the lines

$\mathbf{r_1} = \begin{pmatrix} a \\ b \\ 2 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 1 \\ 2 \end{pmatrix}$ and

$\mathbf{r_2} = \begin{pmatrix} 3 \\ 1 \\ 2 \end{pmatrix} + \mu \begin{pmatrix} 2 \\ b \\ a \end{pmatrix}$ intersect.