16. Planes $\pi_1$, $\pi_2$ and $\pi_3$ have equations:

\[
\begin{align*}
\pi_1 &: \quad x - 2y + z = -4 \\
\pi_2 &: \quad 3x - 5y - 2z = 1 \\
\pi_3 &: \quad -7x + 11y + az = -11
\end{align*}
\]

where $a \in \mathbb{R}$.

(a) Use Gaussian elimination to find the value of $a$ such that the intersection of the planes $\pi_1$, $\pi_2$ and $\pi_3$ is a line.

(b) Find the equation of the line of intersection of the planes when $a$ takes this value.

The plane $\pi_4$ has equation $-9x + 15y + 6z = 20$.

(c) Find the acute angle between $\pi_1$ and $\pi_4$.

(d) Describe the geometrical relationship between $\pi_2$ and $\pi_4$.

Justify your answer.

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**Answers**

(a) $a = 8$  
(b) $x = 22 + 9t, y = 13 + 5t, z = 2$  
(c) 0.75  
(d) Planes $\pi_2$ and $\pi_4$ are parallel because the normal of $\pi_4$ is a multiple of the normal $\pi_2$