Question	Scheme	Marks	AOs
1(a)	$\begin{vmatrix} k & 3 & -1 \\ 3 & -1 & 1 \\ -16 & -k & -k \end{vmatrix} = k(k+k) - 3(-3k+16) - 1(-3k-16)$	M1	2.1
	Solves det = 0 $\Rightarrow 2k^2 + 12k - 32 = 0$ or $k^2 + 6k - 16 = 0$ To achieve k = 2 (k = – 8 must be rejected)	A1	1.1b
		(2)	
	Special case $\begin{vmatrix} 2 & 3 & -1 \\ 3 & -1 & 1 \\ -16 & -2 & -2 \end{vmatrix} = 2(2+2) - 3(-3\times2+16) - 1(-3\times2-16)$ Shows det = 0, therefore when k = 2 there is no unique solution	M1 A0	2.1 1.1b
(b)	Eliminates z to achieve **two** equations in x and y e.g. $5x + 2y = 1$ $-10x - 4y = -2$ $20x + 8y = 4$ Eliminates x to achieve **two** equations in y and z e.g. $11y - 5z = 13$ $22y - 10z = 26$ $-22y - 10z = -26$ Eliminates y to achieve **two** equations in x and z e.g. $11x + 2z = -3$ $22x + 4z = -6$ $-44x - 8z = 12$	M1 A1	3.1a 1.1b
	Must give a **reason:** e.g. Two equations are a linear multiple of each other e.g. shows they are the same equation therefore the equations are **consistent**.	A1	2.4
	Alternative Eliminates two different variables to form two equations, should be one equation from two of the three sections in the main scheme. e.g $5x + 2y = 1$ and $11y - 5z = 13$ rearranges and substitutes in to one of the original equations in three variables. e.g. $2x + 3\left(\frac{1-5x}{2}\right) - \left(\frac{-3-11x}{2}\right) = 3$	M1	3.1a
	Correct equations e.g $5x + 2y = 1$ and $11y - 5z = 13$	A1	1.1b
	Shows that the equations are a solution e.g. 3 = 3 therefore **consistent**	A1	2.4
(c)	The three **planes** form a **sheaf.**	B1	2.2a
		(1)	
			(6 marks)

Notes:

(a)

M1: Finds the determinant of the matrix corresponding to the system of equations.

A1: Sets determinant = 0 and solves their 3TQ to achieve $k = 2$ ($k = -8$ must be rejected)

(a) Special case

M1A0: Uses $k = 2$ and finds the determinant of the matrix corresponding to the system of equations
Shows that determinant = 0 and concludes that when $k = 2$ there is no unique solution

(b)

M1: A complete method eliminating one variable from the equations using two different pairs of equations. Condone if a different value of k is used

A1: Achieves two equations in the same two variables

A1: Must give a reason, shows that the equations are a linear multiple of each other therefore they are **consistent**.

(b) Alternative

M1: A complete method eliminating one variable from the equations using two different pairs of equations. Substitutes these equations into one of the original equations in three variables.

A1: Achieves two correct equations in two different variables

A1: Shows that the equation works therefore they are **consistent**.

(c)

B1: The three **planes** form a **sheaf.** They must have full marks in (b) to award this mark.