Straight Lines Assignment

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Abstract—**This document contains the solution to Question 13 of Exercise 1 in Chapter 10 of the class 11 NCERT textbook.**

1) If three points $\mathbf{A} = \begin{pmatrix} h \\ 0 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} a \\ b \end{pmatrix}$ and $\mathbf{C} = \begin{pmatrix} 0 \\ k \end{pmatrix}$ lie on a line, show that

$$\frac{a}{h} + \frac{b}{k} = 1 \tag{1}$$

Solution: The collinearity matrix formed by the three points is singular. Using row reduction,

$$\begin{pmatrix} h & a & 0 \\ 0 & b & k \\ 1 & 1 & 1 \end{pmatrix} \xleftarrow{\substack{R_1 \to \frac{R_1}{h} \\ R_2 \to \frac{R_2}{b}}} \begin{pmatrix} 1 & \frac{a}{h} & 0 \\ 0 & 1 & \frac{k}{b} \\ 1 & 1 & 1 \end{pmatrix} \tag{2}$$

$$\xleftarrow{R_3 \to R_3 - R_1} \begin{pmatrix} 1 & \frac{a}{h} & 0 \\ 0 & 1 & \frac{k}{b} \\ 0 & 1 - \frac{a}{h} & 1 \end{pmatrix} \tag{3}$$

$$\xleftarrow{R_3 \to R_3 - \left(1 - \frac{a}{h}\right)R_2} \begin{pmatrix} 1 & \frac{a}{h} & 0 \\ 0 & 1 & \frac{k}{b} \\ 0 & 0 & 1 - \frac{k}{b}\left(1 - \frac{a}{h}\right) \end{pmatrix} \tag{4}$$

Since the matrix is singular,

$$1 - \frac{k}{b}\left(1 - \frac{a}{h}\right) = 0 \tag{5}$$

$$\implies \frac{a}{h} + \frac{b}{k} = 1 \tag{6}$$

as desired.