# 1-1.6-25

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**Question:** Three points $P\begin{pmatrix} h & k \end{pmatrix}$, $Q\begin{pmatrix} x_1 & y_1 \end{pmatrix}$ and $R\begin{pmatrix} x_2 & y_2 \end{pmatrix}$ lie on a line. Show that

$$\frac{h-x_1}{y_2-y_1} = \frac{k-y_1}{x_2-x_1}$$

**Solution:** Given:

| Point | x | y |
|---|---|---|
| P | $h$ | $k$ |
| Q | $x_1$ | $y_1$ |
| R | $x_2$ | $y_2$ |

Since the points P, Q, R are collinear, The matrix $\begin{pmatrix} P-Q & R-Q \end{pmatrix}$ must have rank 1.

$$\begin{pmatrix} P-Q & R-Q \end{pmatrix}^T = \begin{pmatrix} h-x_1 & x_2-x_1 \\ y-y_1 & y_2-y_1 \end{pmatrix}$$

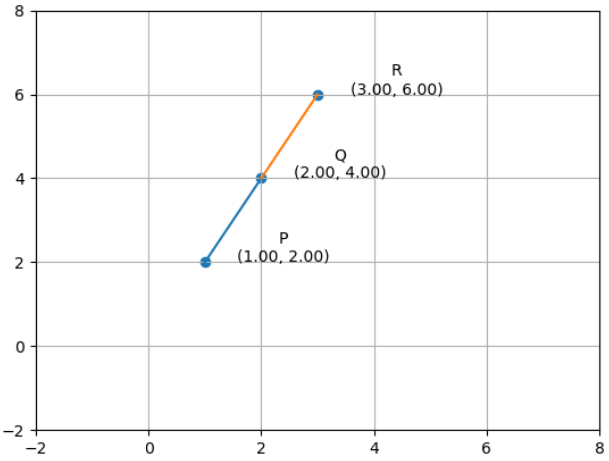
Using $R_2 \leftarrow R_2 - \frac{k-y_1}{h-x_1}R_1$

$$= \begin{pmatrix} h-x_1 & x_2-x_1 \\ 0 & y_2-y_1-\frac{(k-y_1)(x_2-x_1)}{h-x_1} \end{pmatrix}$$

Since matrix has rank 1, we can say

$$y_2-y_1-\frac{(k-y_1)(x_2-x_1)}{h-x_1} = 0$$

$$\frac{h-x_1}{y_2-y_1} = \frac{k-y_1}{x_2-x_1}$$




Console Output:

```
/mnt/D/Cl/EE1030/Question_3/Codes$ python3 main.py
Taking point P to be:
 [[1.]
 [2.]]
Taking point Q to be:
 [[2.]
 [4.]]
Taking point R to be:
 [[3.]
 [6.]]
Calculated LHS to be: 2.0
Calculated RHS to be: 2.0
```

Code for this plot can be found at:

| |
|---|
| Codes/main.py<br>Codes/main.c |