# ASSIGNMENT-MATRICES

## Contents

## 1 Problem

If E,F,G and H are respectively the mid-points of the sides of a parallelogram ABCD, show that
$$\text{ar(EFGH)} = \tfrac{1}{2}\,\text{ar(ABCD)}$$

## 2 Solution

1. Construct a parallelogram with vertices A,B,C and D.
2. Point mid-points E,F,G and H on sides AB,BC,CD and DA.

$$\mathbf{E} = \frac{\mathbf{A+B}}{\mathbf{2}}$$
$$\mathbf{F} = \frac{\mathbf{B+C}}{\mathbf{2}}$$
$$\mathbf{G} = \frac{\mathbf{C+D}}{\mathbf{2}}$$
$$\mathbf{H} = \frac{\mathbf{D+A}}{\mathbf{2}}$$

3. By joining the midpoints of adjacent sides of parallelogram ABCD, another parallelogram EFGH is formed.
4. Join EG.
5. Now draw a perpendicular from point H to line EG and mark as point P,similarly from point F to line EG and mark as point Q.

Then,
$$\mathbf{ar(AEGD)} = \|\mathbf{(E\text{-}G)(H\text{-}P)}\| - (1)$$
$$\mathbf{ar(EHG)} = \tfrac{1}{2}\,\|\mathbf{(E\text{-}G)(H\text{-}P)}\| - (2)$$

Similarly,
$$\mathbf{ar(BEGC)} = \|\mathbf{(E\text{-}G)(F\text{-}Q)}\| - (3)$$
$$\mathbf{ar(EFG)} = \tfrac{1}{2}\,\|\mathbf{(E\text{-}G)(F\text{-}Q)}\| - (4)$$

From (1) and (2),
$$\mathbf{ar(EHG)} = \tfrac{1}{2}\,\mathbf{ar(AEGD)} - (5)$$

From (3) and (4),
$$\mathbf{ar(EFG)} = \tfrac{1}{2}\,\mathbf{ar(BEGC)} - (6)$$

From (5) and (6),
$$\mathbf{ar(EHG)+ar(EFG)} = \tfrac{1}{2}\,\mathbf{ar(AEGD)} + \tfrac{1}{2}\,\mathbf{ar(BEGC)}$$

Hence,
$$\mathbf{ar(EFGH)} = \tfrac{1}{2}\,\mathbf{ar(ABCD)}$$
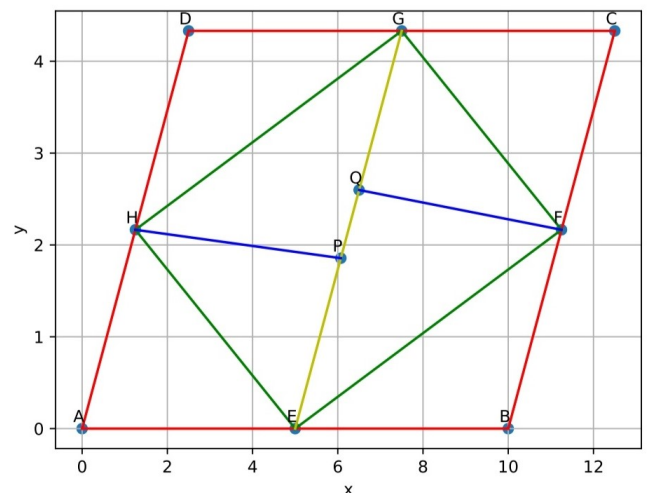


Figure

# 3 Construction

The parallelogram is constructed with m=10 and n=5,

| Symbol | Co-ordinates | Description |
|:------:|:------------:|:-----------:|
| m | 10 | AB |
| n | 5 | AD |
| A | $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ | point vector A |
| B | $\begin{pmatrix} m \\ 0 \end{pmatrix}$ | point vector B |
| D | $\begin{pmatrix} 0 \\ n \end{pmatrix}$ | point vector D |
| C | B+D | point vector C |

The figure above is generated using python code provided in the below source code link.

https://github.com/madind5668/FWC/blob/main/assigment-4/codes/main.py