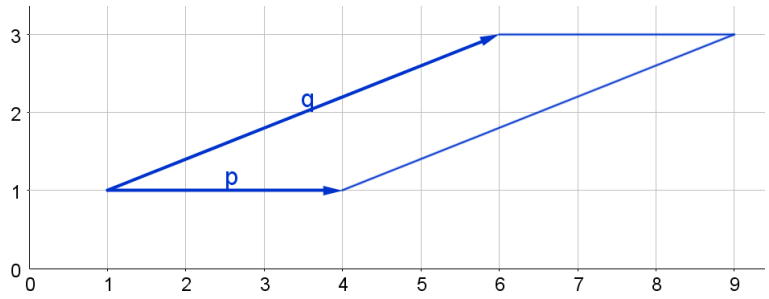
Areas of Parallelograms

Here are two parallelograms, defined by the vectors **p** and **q**.
Can you find their areas?

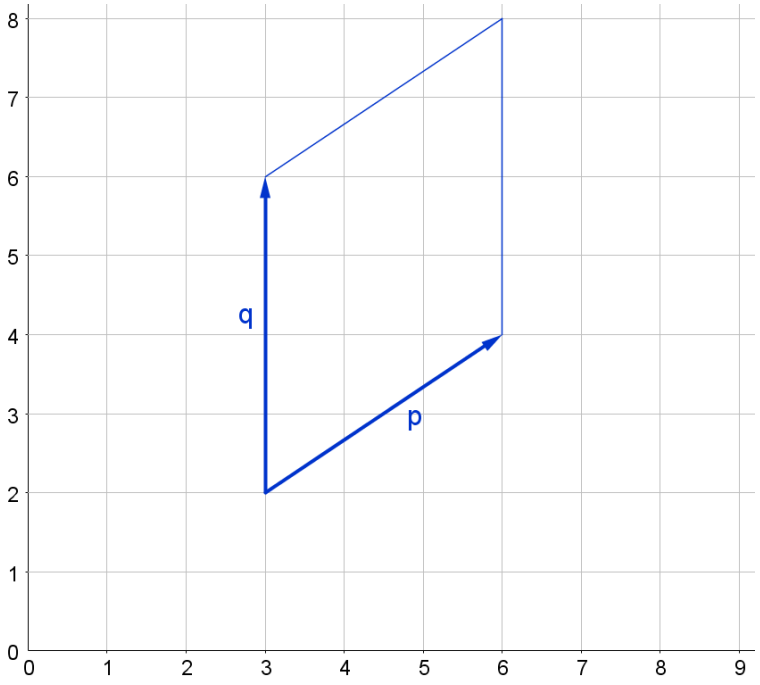
a) $\mathbf{p} = \begin{pmatrix} 3 \\ 0 \end{pmatrix}$

$\mathbf{q} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$



b) $\mathbf{p} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$

$\mathbf{q} = \begin{pmatrix} 0 \\ 4 \end{pmatrix}$



Choose different vectors **p** and **q**, where one vector is parallel to an axis, and find the areas of the corresponding parallelograms.

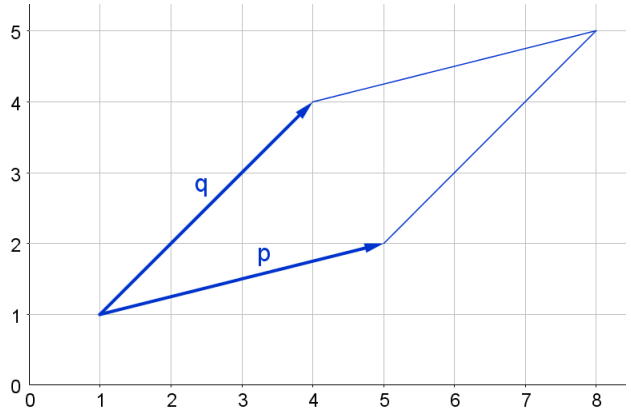
Can you discover a quick way of doing this?

Areas of Parallelograms

Here are two more parallelograms, again defined by vectors **p** and **q**.
This time, neither **p** nor **q** lies along an axis.
Can you find the areas of these parallelograms?

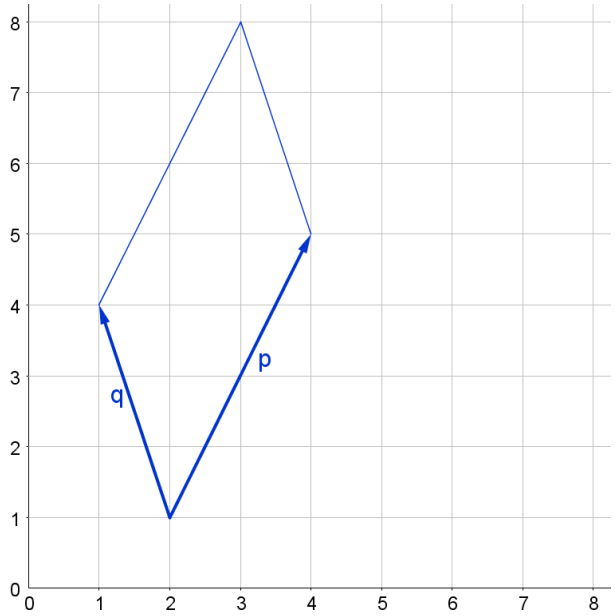
c) $\mathbf{p} = \begin{pmatrix} 4 \\ 1 \end{pmatrix}$

$\mathbf{q} = \begin{pmatrix} 3 \\ 3 \end{pmatrix}$



d) $\mathbf{p} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$

$\mathbf{q} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$



Choose some other vectors **p** and **q**, where neither **p** nor **q** is parallel to an axis.

Can you find a quick way of working out the areas of the corresponding parallelograms?

Can you find the area of the parallelogram defined by the vectors $\mathbf{p} = \begin{pmatrix} a \\ b \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} c \\ d \end{pmatrix}$?

If you have found a rule, does it ever give you negative areas?
If so, can you predict which vector pairs have this effect?