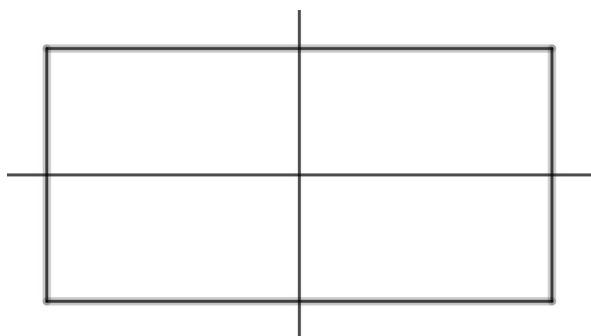


## Symmetries of a Rectangle

If you take a rectangle and rotate it  $180^\circ$  about the centre then it looks exactly the same as it did before. We say the rectangle has rotation symmetry.



The symmetries of the rectangle are:

- $e$  do nothing
- $a$  rotate  $180^\circ$  about the centre
- $b$  rotate  $180^\circ$  about the  $x$  axis
- $c$  rotate  $180^\circ$  about the  $y$  axis

We can combine symmetries.

$a*b$  means you do  $b$  and then you do  $a$ . This means you do  $b$  first.

Take a piece of card, in the shape of a rectangle.

If you do  $b$  and then do  $a$  it will end up in the same position as if you had just done  $c$ .

Try it.

So  $a*b$  is the same as  $c$ . So  $a*b=c$ .

Here is the combination table. You should check some of these.

*	$e$	$a$	$b$	$c$
$e$	$e$	$a$	$b$	$c$
$a$	$a$	$e$	$c$	$b$
$b$	$b$	$c$	$e$	$a$
$c$	$c$	$b$	$a$	$e$

Note:  $a*b$  goes in the  $a$  row and the  $b$  column.

The set  $\{e, a, b, c\}$  with the binary operation  $*$  forms a group.