Advanced Mathematics Support Programme®

Problem A

A pizza takeaway offers **Regular, Large and Family** size pizzas, with four possible toppings **Hawaiian, Seafood, Meat Feast and Vegetarian.** The number of pizzas ordered of each size / topping can be expressed as a matrix.

$$\begin{array}{c} \\ R \\ L \\ F \end{array} \begin{array}{c} \begin{array}{cccc} H & S & M & V \end{array} \\ \begin{pmatrix} 2 & 3 & 0 & 1 \\ 5 & 7 & 8 & 4 \\ 6 & 4 & 3 & 3 \end{pmatrix} \end{array}$$

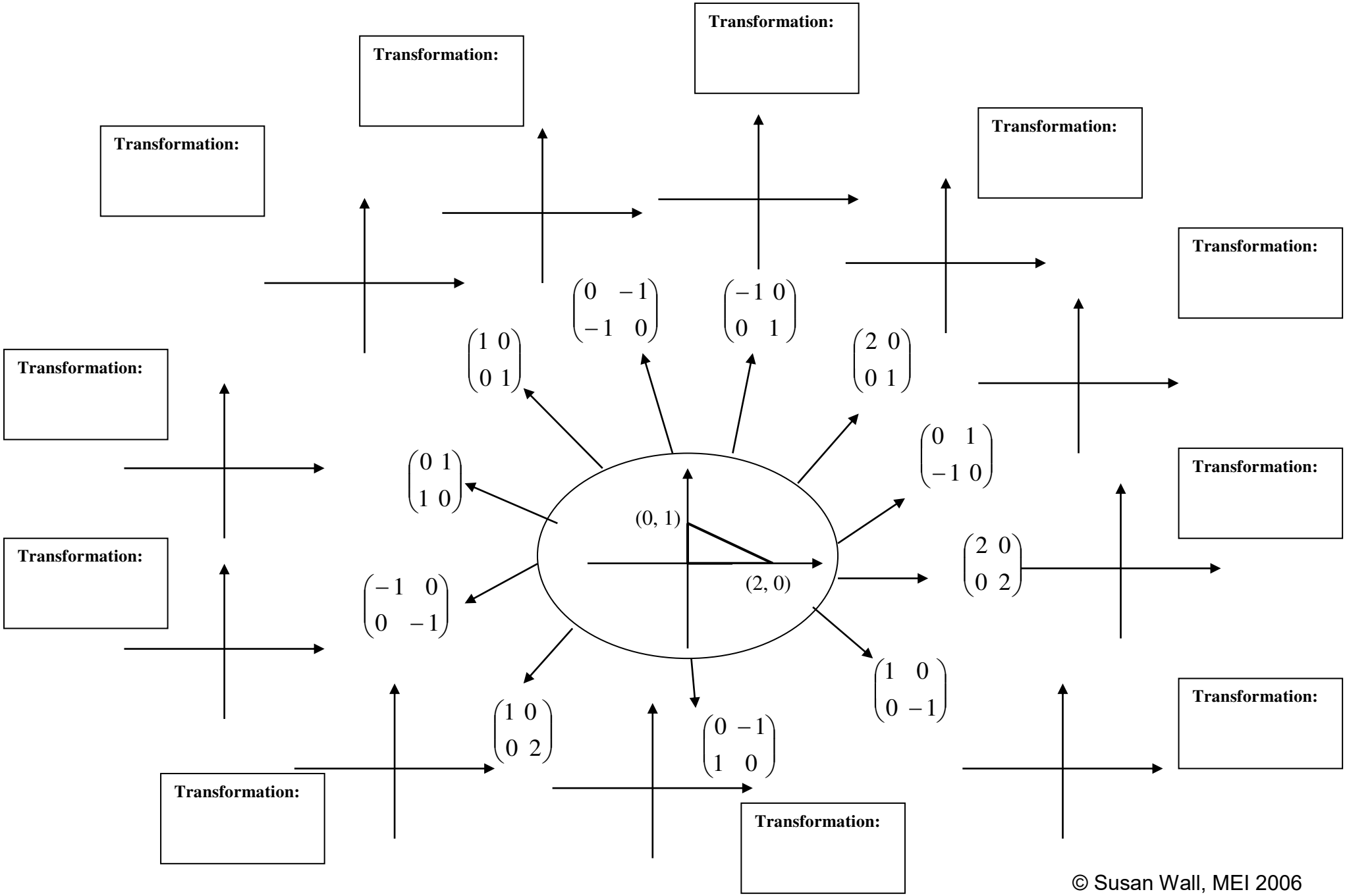
Given that a regular pizza requires 2 quantities of topping, a large pizza requires 3 quantities of topping and a family size pizza requires 4 quantities of topping, **write out the calculation to find the total quantities of each type of topping to make these orders.**

Problem B

The table below is a league table for the group stage for the FIFA Women's World Cup 2015 held in Canada. The top 2 teams in the group progress through to the next round; scoring 3 points for a win, 1 point for a draw and 0 points for losing a match.

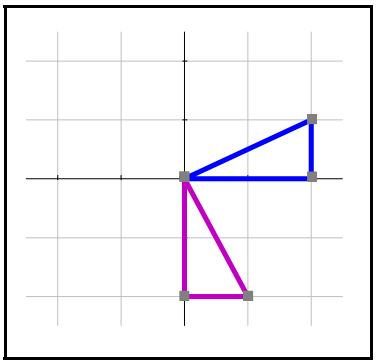
Group F	MP	W	D	L
FRANCE	3	2	0	1
ENGLAND	3	2	0	1
COLOMBIA	3	1	1	1
MEXICO	3	0	1	2

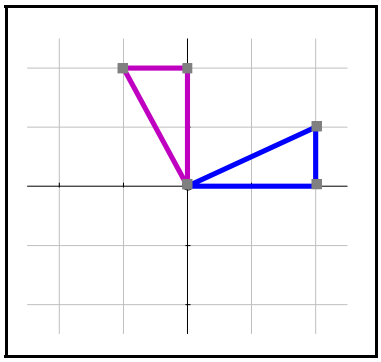
Calculate the total points for each team, writing out each calculation, and hence state which two teams progressed through to the next round.

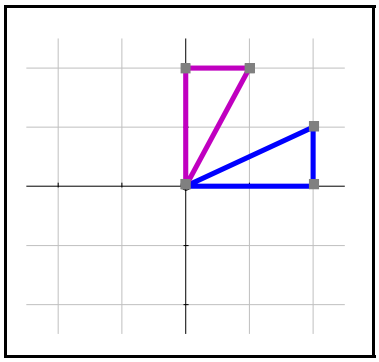


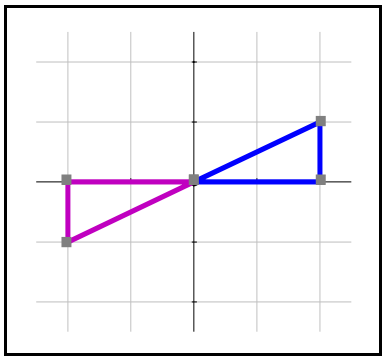
Matrix matchings

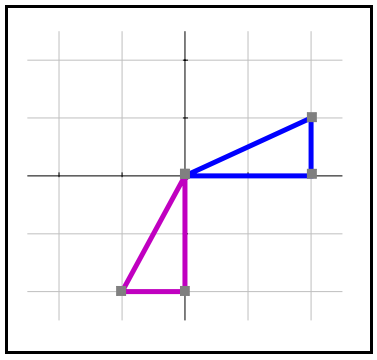
Cut out the diagrams, descriptions of transformations and matrices and match up each diagram with the appropriate transformation and the matrix which describes it.

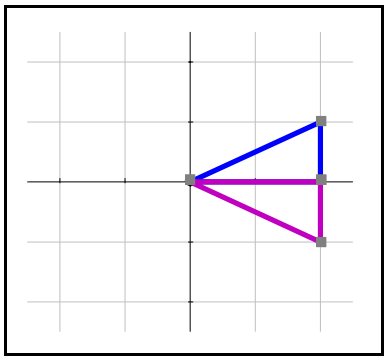


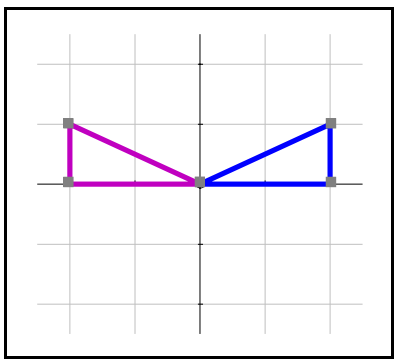


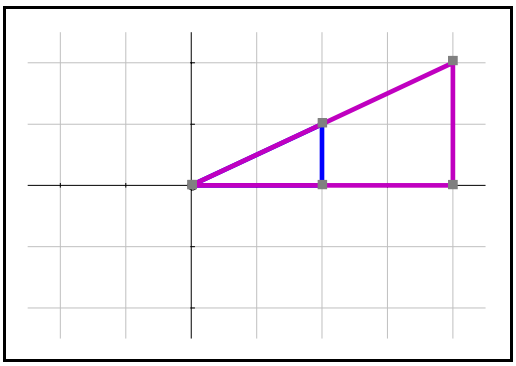


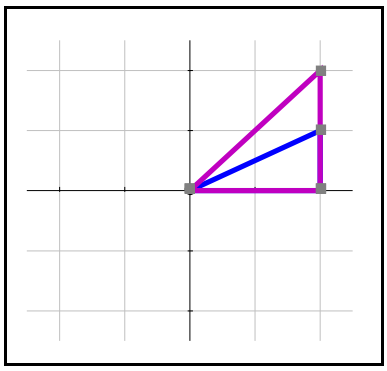


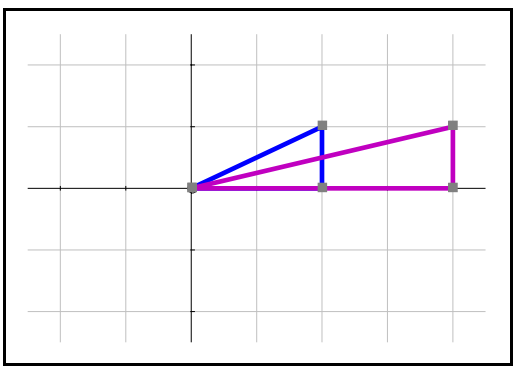












Matrix matchings

Rotation by 90° clockwise	$\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$
Rotation by 90° anticlockwise	$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$
Reflection in y-axis	$\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$
Reflection in x-axis	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$
Reflection in the line $y = x$	$\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$
Reflection in the line $y = -x$	$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$
Rotation by 180°	$\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$
Enlargement with scale factor 2, centre the origin	$\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$
Stretch with scale factor 2, in the direction of the x-axis	$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$
Stretch with scale factor 2, in the direction of the y-axis	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

Matrix matchings

Ordering complex numbers

$3+4i$	$1+2i$	$4-3i$
5	$-2+i$	$3i$

A follow up activity could be used to discuss if there is a complex number (z) such that the modulus of the complex numbers are in order as follows:

$1/z$ z z^* $-(z)$ $(z)^2$ $(z)^3$

$\frac{1}{z}$	z	z^*
$-(z)$	$(z)^2$	$(z)^3$

Categorising complex numbers

Think about pairs of complex numbers z and w and the three properties:

A: $z \times w$ is real

B: $z + z^* + w$ is imaginary

C: $|z| = |w|$

Can you find a pair of complex numbers which satisfies all three properties A, B and C?
If so write this pair in the central region where the three circles overlap.

How about a pair which doesn't satisfy any of the requirements?
Fill this in the region outside the three circles.

The task: To find one example for each of the other six regions.

Is it possible to find an example for every region?