
 WORKSHOP PROBLEMS

1. Complete the following table of compositions of symmetries of the triangle.

\circ	I	R_{120°	R_{240°	M_{30°	M_{90°	M_{120°
I	I	R_{120°	R_{240°	M_{30°	M_{90°	M_{120°
R_{120°	R_{120°					
R_{240°	R_{240°					
M_{30°	M_{30°					
M_{90°	M_{90°	M_{30°		R_{120°		
M_{120°	M_{120°					

2. Complete the following table of compositions of reflections of the square.

\circ	M_{0°	M_{45°	M_{90°	M_{135°
M_{0°				
M_{45°				
M_{90°				
M_{135°				

3. Perform the following calculations:

(a) $\begin{bmatrix} 3 & -5 \\ -2 & 1 \end{bmatrix} \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

(b) $\begin{bmatrix} 3 & -5 \\ -2 & 1 \end{bmatrix} \begin{bmatrix} 0 & 5 \\ 3 & -4 \end{bmatrix}$

4. What geometric transformations do the following matrices describe?

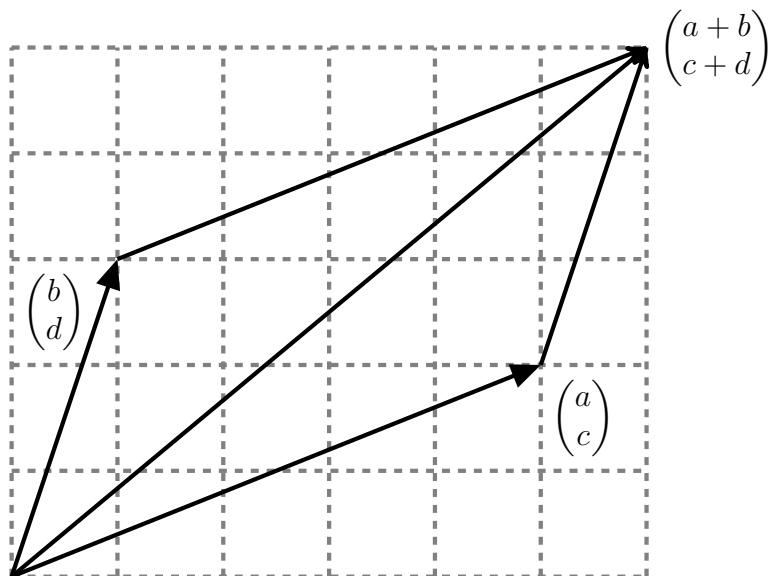
(a) $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

(b) $\begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$

(d) $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$

5. Find matrices which describe the symmetries of the square.
6. Find the area of the parallelogram in terms of a , b , c , and d .

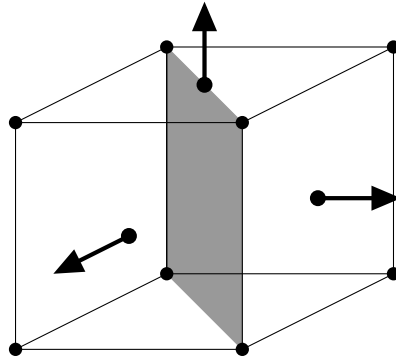


7. Verify a few of the entries in the table you made using the matrix description of the transformations and matrix multiplication. For example, $M_{0^\circ} \circ M_{45^\circ} = R_{270^\circ}$, and

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}.$$

8. What is the equation of the line obtained when $y = -x+2$ is transformed by $\begin{bmatrix} 1 & 2 \\ -1 & 4 \end{bmatrix}$?
9. Find the affine transformation corresponding to a *clockwise* rotation of 90° about the point $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$.
10. Find the affine transformation corresponding to a reflection about the line $y = \frac{1}{2}x + 1$.
11. Find the matrix which describes rotating the cube 120° around the vertex $(1, -1, 1)$.

12. Find the matrix which describes the reflection about the following plane of symmetry:



13. Find the matrix in three dimensions which represents the affine transformation

$$\mathbf{A} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} 5 \\ 6 \end{pmatrix}.$$