Tutorial answer sheet – Transformations

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1. (a)
$$\begin{bmatrix} 1 & 4 & 3 \\ 2 & 1 & 3 \end{bmatrix}$$
(The columns may be in a different order.)

   (b)
$$\begin{bmatrix} 1 & 3 & 3 & 2 \\ 1 & -2 & 3 & 4 \end{bmatrix}$$
(The columns may be in a different order.)

2. (a)
$$\begin{bmatrix} 0 & 0 & 3 & 3 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

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

   (c)
$$\begin{bmatrix} 0 & 0 & 5 & 5 \\ 0 & 3 & 3 & 0 \end{bmatrix}$$

3. (a)
$$\begin{bmatrix} 3 & 0 \\ 0 & 7 \end{bmatrix}$$

   (b)
$$\begin{bmatrix} 0.7 & 0 \\ 0 & 1.2 \end{bmatrix}$$

   (c)
$$\begin{bmatrix} 1 & 0 \\ 0 & 3 \end{bmatrix}$$

4.
$$\begin{bmatrix} \cos(40^\circ) & -\sin(40^\circ) \\ \sin(40^\circ) & \cos(40^\circ) \end{bmatrix} \begin{bmatrix} 2 \\ 6 \end{bmatrix} = \begin{bmatrix} -2.3246 \\ 5.8818 \end{bmatrix}$$

5.
$$\begin{bmatrix} \cos(-120^\circ) & -\sin(-120^\circ) \\ \sin(-120^\circ) & \cos(-120^\circ) \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 \\ 1 & 5 & 1 \end{bmatrix} = \begin{bmatrix} 0.366 & 3.330 & -0.634 \\ -1.366 & -4.232 & -3.098 \end{bmatrix}$$

6.
$$\begin{bmatrix} -5 \\ -3 \end{bmatrix}$$

7.
$$\begin{bmatrix} 4 \\ 1 \end{bmatrix}$$

8.
$$\begin{bmatrix} b \\ -a \end{bmatrix}$$

9.
$$\begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 1 & 3 & 4 \end{bmatrix}$$

10. A shear of scale factor 2 in the x direction.

11.
$$\begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

12.
$$\begin{bmatrix} 1 & 0 & -3 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$$

13. Translation of 4 units in the x direction and 3 units in the negative y direction.

14.
$$\begin{bmatrix} -0.1340 & -0.5 & 0 \\ 2.2321 & 0.8660 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

15.
$$\begin{bmatrix} 0.7660 & -0.6428 & 0.2340 \\ 0.6428 & 0.7660 & -0.6428 \\ 0 & 0 & 1 \end{bmatrix}$$

16. (a)
$$\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$$

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

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

(d)
$$\begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix}$$