Q1. Identify each of the following transformations stating it's effect.

(i) $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$ (ii) $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ (iii) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$

(iv) $\begin{pmatrix} 1/2 & 0 \\ 0 & 7 \end{pmatrix}$ (v) $\begin{pmatrix} -3 & 0 \\ 0 & 1 \end{pmatrix}$ (vi) $\begin{pmatrix} 1/\sqrt{2} & -1/\sqrt{2} \\ 1/\sqrt{2} & 1/\sqrt{2} \end{pmatrix}$

(vii) $\begin{pmatrix} 1 & 3 \\ 2 & 1 \end{pmatrix}$ (viii) $\begin{pmatrix} 1/2 & \sqrt{3}/2 \\ -\sqrt{3}/2 & 1/2 \end{pmatrix}$ (ix) $\begin{pmatrix} 2 & 0 \\ 0 & -2 \end{pmatrix}$

Q2. Construct a transformation matrix for each of the following transformations in the 2-d plane.

(i) A reflection in the x-axis followed by a reflection the the y-axis.
(ii) A scaling in the x-direction by a factor of $\sqrt{3}$ and in the y-dir by a factor of 7.
(iii) A reflection in the x-axis followed by a scaling in the y-direction by a factor of 5/2.
(iv) A rotation counter-clockwise about 0 by 30°.
(v) A rotation clockwise about 0 by $5\pi/3$.
(vi) A reflection in the y-axis followed by a rotation counter-clockwise by $\pi/4$, followed by a scaling in the

x-direction by a factor of 3 and in the y-direction by a factor of 3/2.

(vii) A rotation by $\pi/2$ clockwise followed by a reflection in the x-axis followed by a shearing in the y-direction only by a shearing factor of 2.

Q3. For each of the transformations in Q2, apply them to the unit square with vertices $(0,0)$, $(1,0)$, $(1,1)$ and $(0,1)$ and then sketch the original square and it's image on the same diagram.

Q4. For each of the transformations in Q2, find the inverse transformation.

Q5. A rectangle has vertices $(15,-10)$, $(40,-10)$, $(40,20)$ and $(15,20)$. Using homogeneous coordinates find and sketch the image of this rectangle under the action of a counter-clockwise rotation about the origin by an angle of $3\pi/4$ followed by a translation by the vector $(-2,4)$.

Q6 A rectangle has vertices $(15,-10)$, $(40,-10)$, $(40,20)$ and $(15,20)$. Using homogeneous coordinates find and sketch the image of this rectangle under the

action of a counter-clockwise rotation about the origin by an angle of 225° followed by a translation by the vector (3, 4).

Q7. A rectangle has vertices (15, −10), (40, −10), (40, 20) and (15, 20). Using homogeneous coordinates find and sketch the image of this rectangle under the action of a clockwise rotation about the origin by an angle of $3\pi/4$ followed by a translation by the vector (5, −1).

Q8. A triangle has vertices (16, 8), (18, 12) and (22, 8). Using homogeneous coordinates find and sketch it's image under the action of a clockwise rotation by 45° about the origin followed by a translation by the vector (1, 2).

Q9. A rectangle has vertices (15, −5), (−25, −5), (−25, 15) and (15, 15). Using homogeneous coordinates find and sketch the image of this rectangle if it is subjected to the following transformations in succession:
(i) It is scaled uniformly by a factor of 1/2
(ii) It is rotated clockwise by $3\pi/2$
(iii) It is reflected in the y-axis

(iv) It is sheared uniformly by a factor of 2

(v) It is translated using the vector $(-3, 1)$.