1) Given the line $r : 2x_1 - 3x_2 = 1$ on an affine plane, find the equations of the projection onto r in the direction $\vec{w}(1,1)$ and the equations of the reflection with respect to r in the direction $\vec{w}$.

2) Find the equations of the reflection with respect to the plane $\pi : 2x - y + z = 1$ in the direction $\vec{w}(0,1,2)$

3) Let f be an affinity with equations
$$\begin{cases} x_1' = 2x_1 + 3x_2 - 2 \\ x_2' = 2x_1 + 7x_2 - 3 \end{cases}$$, find, if possible, the fixed points and the invariant lines under f.

4) Let f be an affinity with equations
$$\begin{cases} x_1' = -2x_1 + x_2 - 1 \\ x_2' = 4x_1 + x_2 - 2 \end{cases}$$, find, if possible, the fixed points and the invariant lines under f.

5) Let A be an affine plane and let $R = (O, B)$ be a reference frame in A. Let f be an affinity such that; $(f(P))_R = (-1,1)$ with $(P)_R = (1,1)$; $(f(Q))_R = (-1,2)$ with $(Q)_R = (2,-1)$ and $(f(T))_R = (0,1)$ with $(T)_R = (1,0)$. Find, if possible, the fixed points and the invariant lines under f.

6) Is it the affinity with equations $\begin{cases} x' = 2x + 2y + 1 \\ y' = 3x + y + 3 \end{cases}$ a homology? Find, if possible, the invariant lines under f.

7) Let f be an affinity with $P(1,2)$ and $Q(-1,-2)$ as fixed points and taking $M(-1,0)$ to $M'(2,0)$.

   a) Is f a homology? If so, find its axis and its direction
   b) If there existed invariant lines under f, which would they be?.

8) If g is a homology with axis the line m and it takes the point P to the point P', sketch the image under g of the line passing through N and T.
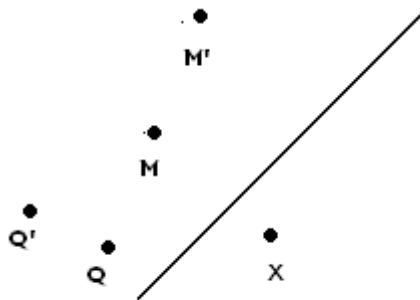
$N \bullet$

m

13) If h_1 is a homothety with centre Q that takes M to M' and h_2 is the homology that takes Q to Q' and has the line r as axis, sketch the image under $h_2 \circ h_1$ of X, X'. Explain carefully the steps you take in order to get X'.