As one of the HWs the coordinate transition map $x \mapsto 1/x$ came up for switching from one chart to another in the standard affine charts of $\mathbb{RP}^1$. Instead of viewing this map passively as a change of coordinates, we can look at it actively, as a transformation of $F : \mathbb{RP}^1 \to \mathbb{RP}^1$, defined within the single affine chart $Y \neq 0$.

Find the linear transformation $L : \mathbb{R}^2 \to \mathbb{R}^2$ which induces the map $f(x) = 1/x$ in this standard affine chart.