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| **Harder Transformations Using Matrices** |
| **(a)** | **(b)** | **(c)** |
| Find the single matrix that represents an enlargement about the origin with scale factor 3, followed by a rotation of $90°$ clockwise about the origin. |  Find the single matrix that represents a reflection in the y-axis, followed by a rotation of $180°$ about the origin. | $$P=\left(\begin{matrix}3&1\\0&-1\end{matrix}\right) Q=\left(\begin{matrix}0&2\\1&-1\end{matrix}\right)$$Matrices P and Q represent different transformations. Find the single matrix that represents transformation P followed by transformation Q.  |
| **(d)** | **(e)** | **(f)** |
| The point P $(4, -2)$ is mapped to the point Q following a reflection in the line $y=x$, then an enlargement with scale factor 2 about the origin. Use matrix algebra to find the coordinates of point Q. | The point $(a, b)$ is mapped to the point $(-5, 1)$ following a rotation of $180°$ about the origin, then a reflection in the x-axis. Using matrix algebra, find the coordinates $(a, b)$. | The matrix $\left(\begin{matrix}0&b\\-2&4\end{matrix}\right)$ maps the point $(a, -3)$ onto the point $(-9, 5)$. Use matrix algebra to find the values of $a$ and $b$. |
| **(g)** | **(h)** | **(i)** |
| The transformation matrix $\left(\begin{matrix}a&2b\\-a&3\end{matrix}\right)$ maps the point $(2, -1)$ to the point $(6, 7)$. Find the values of $a$ and $b$. | The transformation matrix $\left(\begin{matrix}b&2a\\a&-b\end{matrix}\right)$ maps the point $(6, 3)$ to the point $(24, b)$. Find the values of $a$ and $b$. | Point $(c, 4)$ is mapped to the point $(-2, d)$ by the transformation matrix $\left(\begin{matrix}c&-3\\2&-1\end{matrix}\right)$. Use matrix algebra to find the two possible values of $c$ and $d$. |