$\therefore RG = \{\lambda_1.1 + \lambda_2.a + \lambda_3.a^2 \,|\, \lambda_i \in R\}$. What does $g.\alpha$ look like (where $g \in G$ and $\alpha \in RG$) ?

$$\begin{aligned} 1(\lambda_1.1 + \lambda_2.a + \lambda_3.a^2) &= \lambda_1.1 + \lambda_2.a + \lambda_3.a^2 \\ (*)\ a(\lambda_1.1 + \lambda_2.a + \lambda_3.a^2) &= \lambda_3.1 + \lambda_1.a + \lambda_2.a^2 \\ (**)\ a^2(\lambda_1.1 + \lambda_2.a + \lambda_3.a^2) &= \lambda_2.1 + \lambda_3.a + \lambda_1.a^2 \end{aligned}$$

Correspondance

$$1 \longleftrightarrow \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix},\ a \longleftrightarrow \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix},\ a^2 \longleftrightarrow \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

(these are the basis elements which are acted upon, permuted by left-multiplication by 3×3 matrices).

$\mathcal{T} : 1 \longrightarrow \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$,

$a \longrightarrow \begin{pmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$ from $(*)\, a(\lambda_1.1+\lambda_2.a+\lambda_3.a^2) \longleftrightarrow a \begin{pmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{pmatrix} = \begin{pmatrix} \lambda_3 \\ \lambda_1 \\ \lambda_2 \end{pmatrix}$,

$a^2 \longrightarrow \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{pmatrix}$ from $(**)\, a^2(\lambda_1.1 + \lambda_2.a + \lambda_3.a^2) \longleftrightarrow a^2 \begin{pmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \end{pmatrix} = \begin{pmatrix} \lambda_2 \\ \lambda_3 \\ \lambda_1 \end{pmatrix}$.