수학 문제 연구회

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Let $GL(2,\mathbb{R}) := \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} : a,b,c,d \in \mathbb{R}, \quad ad-bc \neq 0 \right\}$ be a set of real matrices. Solve the following statements:

1. Show that $GL(2,\mathbb{R})$ forms a group with matrix multiplication.
2. Find all subgroups of $GL(2,\mathbb{R})$ that are isomorphic to a cyclic group.
3. Find all subgroups of $GL(2,\mathbb{R})$ that are isomorphic to a dihedral group.

Here is an additional question: Classify all countable subgroups of $GL(2,\mathbb{R})$.