Geometric and Asymptotic Group Theory

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Blatt 4

(1) Show that, for $|n| \geqslant 2$, $\left\langle \begin{pmatrix} 1 & n \\ 0 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 0 \\ n & 1 \end{pmatrix} \right\rangle$ is a free rank 2 subgroup of $SL(2,\mathbb{Z})$.

(2) Let $A = \begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$, and $B = AJ$. Show that $\langle J, B \rangle = \langle J \rangle * \langle B \rangle$.

(3) What is a result of applying the Ping-pong for RAAG to a free abelian group?

(4) For a graph Θ with vertices $v_1, \ldots, v_k$, show that $\langle v_1^{n_1}, \ldots, v_k^{n_k} \rangle \cong A(\Theta)$, for $n_i \neq 0$.