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We present a method by which torsion-free groups of automorphisms of a 2-dimensional hyperbolic building which act simply transitively on the vertex set can be constructed, and prove that any such group can be obtained by this construction. The method produces groups defined by finite presentations with strong small cancellation properties, and we prove that when the building is Fuchsian with a regular fundamental chamber, two such groups are isomorphic if and only if there is an isomorphism taking generators to generators and relators to relators. Using these results, we find and classify all the torsion-free vertex-regular groups of automorphisms of Bourdon's building $I_{5,5}$.

Rigidity of Vertex-Regular Actions on Fuchsian Buildings

by

Samantha T. Smith

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Major Professor, representing Mathematics

Chair of the Department of Mathematics

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Samantha T. Smith, Author

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1. INTRODUCTION

1.1. An Informal Overview

A 2-dimensional hyperbolic building is a metric space X constructed by gluing together copies of a hyperbolic polygon P, in such a way that X can be expressed as a union of copies of the hyperbolic plane $\mathbb{H}^2$ satisfying certain axioms (see Definition 2.4.0.1). Two-dimensional hyperbolic buildings share axioms similar to those of the simplicial complexes known as Tits buildings, but cannot be considered either a generalization or a special case, since 2-dimensional hyperbolic buildings need not have a simplicial structure, and Tits buildings need not be negatively curved. One can view 2-dimensional hyperbolic buildings as a higher-dimensional analogue of trees. Indeed, as trees arise as the universal cover of 1-dimensional cellular metric spaces, 2-dimensional hyperbolic buildings often arise as the universal cover of 2-dimensional cellular metric spaces ([13]).

The first example of a 2-dimensional hyperbolic building in the literature was produced by M. Bourdon in [4]. In his paper, Bourdon explored the geometric and combinatorial properties of the buildings he constructed, which later became known as Bourdon's buildings, and proved, in particular, that his buildings possess a property known as Mostow rigidity (see Theorem 2.4.2.2). Mostow rigidity provides a connection between the cellular metric structure of the building and the algebraic structure of its *cocompact lattices*, groups of cellular isometries from the building to itself with finite cell stabilizers

and compact orbit space. Later ([30]), Mostow rigidity was shown to hold for a much more general class of 2-dimensional hyperbolic buildings called Fuchsian buildings (see Definition 2.4.0.1).

In [18], R. Kangaslampi and A. Vdovina produced and studied a collection of torsion-free cocompact lattices of a simplicial Fuchsian building acting freely and transitively on the building's vertices. We will call such a torsion-free cocompact lattice *vertex-regular*. Kangaslampi and Vdovina used Mostow rigidity to produce a group invariant of those lattices, which they called the *dual graph* of the lattice, and used this dual graph to distinguish some of their groups. Still, the classification is not yet complete; in Section 2.5, we will produce examples of two non-isomorphic vertex-regular lattices with isomorphic dual graphs.

In this thesis, we consider the problem of constructing and completely classifying up to group isomorphism the vertex-regular cocompact lattices of any Fuchsian building. First, we will prove that each torsion-free vertex-regular cocompact lattice of a 2-dimensional hyperbolic building corresponds to a finite presentation $\langle S \mid R \rangle$ which can easily be determined from the orbit space, possessing properties described in the following theorem.

Main Theorem 1. *Suppose there exists a torsion-free vertex-regular cocompact lattice G of the 2-dimensional hyperbolic building X. Then*

- *the link at each vertex of X is graph-isomorphic to the same graph Γ, and*
- *Γ contains an even number of vertices.*

Moreover, there is a presentation $\langle S \mid R \rangle$ of G satisfying the following properties:

(i) The size of S is half the number of vertices of Γ,

(ii) each element of R has length equal to the number of sides of the hyperbolic polygon used to tile X, and

(iii) the Whitehead graph of $\langle S \mid R \rangle$ *is graph-isomorphic to* Γ.

We then prove that if two such lattices are isomorphic as groups, and the building is Fuchsian with regular 2-cells (i.e. all open 1-cells are pairwise isometric), Mostow rigidity implies that we can find an isomorphism taking the generators of the presentation of one lattice to the generators (and their inverses) of the presentation of the other lattice.

Main Theorem 2. *Let* X *be a Fuchsian building tiled by a regular hyperbolic polygon. Let* $G_1 = \langle S_1 \mid R_1 \rangle$ *and* $G_2 = \langle S_2 \mid R_2 \rangle$ *be any two torsion-free vertex-regular cocompact lattices of* X*, where* $\langle S_1 \mid R_1 \rangle$ *and* $\langle S_2 \mid R_2 \rangle$ *are the presentations obtained in Main Theorem 1. If* G_1 *and* G_2 *are isomorphic, then there is an isomorphism from* G_1 *to* G_2 *taking* $S_1^{\pm}$ *bijectively to* $S_2^{\pm}$.

We also show that the presentations $\langle S \mid R \rangle$ of Main Theorem 1 possess certain small cancellation properties, which depend on the local structure of the building and on the number of sides in the hyperbolic polygon P used to construct the building. Historically, small cancellation has been used to deduce "spelling theorems," results that place restrictions on the kinds of words in the generators of a finitely presented group which can possibly be trivial. Such theorems have been instrumental in the solutions to the word problem and isomorphism problem for certain classes of groups, including surface groups. We will use two spelling theorems in combination with Mostow rigidity to show that if two torsion-free vertex-regular cocompact lattices of a Fuchsian building are isomorphic, we can find an isomorphism taking generators to generators and relators to relators.

Main Theorem 3. *Let* X *be a Fuchsian building tiled by a regular hyperbolic polygon. Let* $G_1 = \langle S_1 \mid R_1 \rangle$ *and* $G_2 = \langle S_2 \mid R_2 \rangle$ *be any two torsion-free vertex-regular cocompact lattices of* X*, where* $\langle S_1 \mid R_1 \rangle$ *and* $\langle S_2 \mid R_2 \rangle$ *are the presentations obtained in Main Theorem 1. Let* $\psi : G_1 \to G_2$ *be a group isomorphism taking* $S_1^{\pm}$ *bijectively to* $S_2^{\pm}$*. Then for every relator* $r \in R_1$*, the image under* ψ *is a symmetrized relator,* $\psi(r) \in R_2^*$.

All together, these results have the following consequence. In finite time, using a simple computer algorithm, we can construct a collection of groups containing, up to isomorphism, all the torsion-free vertex-regular cocompact lattices of any Fuchsian building and completely classify the groups in this collection.

In general, the collection we construct may contain cocompact lattices of multiple distinct Fuchsian buildings, and an example of such a collection was exhibited in [18]. However, in the special case of Bourdon's buildings, we obtain a converse to Main Theorem 1 producing conditions on a finite presentation $\langle S \mid R \rangle$ which in fact characterize its torsion-free vertex-regular cocompact lattices. This allows us to produce, up to isomorphism, the exact set of torsion-free vertex-regular cocompact lattices of any of Bourdon's buildings. We then apply these results to obtain and classify all the torsion-free vertex-regular cocompact lattices of the simplest of Bourdon's buildings, denoted $I_{5,5}$.

Main Theorem 4. *Up to isomorphism, there are exactly 8,882 torsion-free vertex-regular cocompact lattices of* $I_{5,5}$.

We point out that every torsion-free vertex-regular cocompact lattice of one of Bourdon's buildings is word-hyperbolic (Proposition 2.4.0.1; [6], Proposition 8.19) and does not split essentially as a free product with amalgamation or an HNN-extension over a finite or cyclic subgroup ([5], [12]). The isomorphism problem was shown to be solvable for such groups by Z. Sela ([25]). Main Theorems 2 and 3 reaffirm and illustrate this result by providing a solution to the isomorphism problem for these lattices which can be practically implemented.

Our results have relevance to a well-known open question first posed in the 1980s by M. Gromov ([17]), who asked whether every word-hyperbolic group is residually finite, i.e. if every nontrivial element in the group remains nontrivial in some finite quotient. Although D. Wise has shown ([29]) that every torsion-free cocompact lattice of a Fuchsian building is residually finite if the polygon used to tile the building has at least 6 sides,

the groups acting on Bourdon's buildings that we have produced have the potential to be non-residually finite word-hyperbolic groups. The groups produced in [18] also have this potential; however, the groups we obtain possess different properties. While the groups produced in [18] were all positively presented with finite abelianization, we have obtained examples which are positively presented and others that are not positively presented; some have finite abelianization and others have infinite abelianization; some are even cyclically presented. Our presentations possess small cancellation properties that differ from those found in [18]. Finally, while the groups of [18] all have Kazhdan's property (T), none of our groups have Kazhdan's property (T).

1.2. A Statement of the Problem

In this thesis, we consider the problem of constructing all possible torsion-free groups acting by cellularly and isometrically on a Fuchsian building and freely and transitively on the set of vertices. We also seek an easy combinatorial technique by which these groups can be classified completely up to group isomorphism.

1.3. An Outline of the Thesis

We begin in Chapter 2 by presenting the terminology and known results which we will need throughout this thesis. We will also review the work of Cartwright et al. in [9] and Kangaslampi and Vdovina in [18], on which this thesis builds.

We then move in Chapter 3 to our main results. We will begin by showing that any torsion-free vertex-regular cocompact lattice of a Fuchsian building admits a straightforward finite presentation, and find conditions on a finite presentation which guarantee that the corresponding group is a torsion-free vertex-regular lattice of a Fuchsian building.

Next, we leverage Mostow rigidity to show that any group isomorphism between two such torsion-free lattices determines a group isomorphism taking generators to generators. We then investigate the small cancellation properties possessed by the presentations of these lattices, and use these to prove that any group isomorphism between two such lattices determines a group isomorphism taking generators to generators and relators to relators.

In Chapter 4, we apply the results of Chapter 3 to obtain, up to isomorphism, all the torsion-free vertex-regular lattices of one of Bourdon's buildings. (A complete list of the groups is presented in Appendix A.) We summarize the properties of these groups.

We will conclude in Chapter 5 with a discussion and ideas for future work.

2. MATHEMATICAL BACKGROUND

2.1. Polygonal Complexes

Much of what we will describe in this section follows the presentation of [6]. The reader is directed to this book for a more general treatment of polygonal complexes and CAT(-1) spaces. Below, we will present only what is needed for our work in this thesis.

Definition 2.1.0.1. *Let (X, d) be a metric space. A **geodesic** from a point $x \in X$ to a point $y \in X$ is a map $f : [0, \ell] \to X$ such that $f(0) = x$, $f(\ell) = y$, and $|t-s| = d(f(t), f(s))$ for all $0 \leq t, s \leq 1$. In particular, $d(x, y) = \ell$, and the image of f can be thought of as a path whose length realizes the distance between x and y. In a common abuse of language, we will call the image of f a geodesic if the map itself does not need to be specified.*

*The space X is called a **geodesic metric space** if for any choice of points x and y in X, there is a geodesic from x to y.*

*If (X, d) is a geodesic metric space, the **convex hull** of a subset $Y \subseteq X$ is the smallest subset Z of X containing Y satisfying the following property: If $x, y \in Z$ and $f : [0, \ell] \to X$ is a geodesic from x to y, then the image of f is contained in Z.*

*The hyperbolic plane $\mathbb{H}^2$ with the standard metric is a geodesic metric space. A **convex polygon** in $\mathbb{H}^2$ is a subspace of $\mathbb{H}^2$ with nonempty interior and which is equal to the convex hull of a finite set of points. The boundary of such a polygon consists of a union of geodesic segments, any two of which intersect in at most one point. If these geodesic segments have equal length, the polygon is said to be **regular**.*

Definition 2.1.0.2. *Let $\{\sigma_\alpha\}_{\alpha \in I}$ be a collection of convex polygons in the hyperbolic plane $\mathbb{H}^2$. A $M_{(-1)}$**-polygonal complex** is a quotient X of the disjoint union $\sqcup_\alpha \sigma_\alpha$ such that the quotient map $p : \sqcup_\alpha \sigma_\alpha \to X$ satisfies the following two properties:*

(1) For every $\alpha \in I$, the restriction of p to the interior of each face of σ_α is injective.

(2) *For all* $\alpha_1, \alpha_2 \in I$ *and* $x_1 \in \sigma_{\alpha_1}, x_2 \in \sigma_{\alpha_2}$*, if* $p(x_1) = p(x_2)$*, then there is an isometry* h *from the minimal closed cell* τ *containing* x_1 *to the minimal closed cell containing* x_2 *such that* $p = p \circ h$ *on* τ*.*

A group G acts on a $M_{(-1)}$-polygonal complex X by **cellular isometries** if, for every $g \in G$, the corresponding homeomorphism $X \to X$ is distance-preserving and maps open cells homeomorphically to open cells. We will call the action **vertex-regular** if, in addition, the homeomorphism acts freely and transitively on the set of vertices of X.

If a connected $M_{(-1)}$-polygonal complex X has only finitely many isometry types of cells, it follows from the work of M. Bridson ([6], Part I, Theorem 7.50) that X is a complete geodesic metric space under the metric defined as follows: Let $f : [a, b] \to X$ be a path in X, and suppose there exists a partition $a = t_0 < t_1 < \cdots < t_{p+1} = b$ such that, for all $i = 0, \ldots, p$, the image $f((t_i, t_{i+1}))$ is contained in an open cell σ_i° of X and $f|_{(t_i,t_{i+1})}$ is a geodesic in the metric on this open cell induced by $\mathbb{H}^2$. We then define the length of this path as

$$\ell(f) = \sum_{i=0}^{p} \ell_{\sigma_i^\circ}(f|_{(t_i,t_{i+1})}),$$

where $\ell_{\sigma_i^\circ}$ is the function giving the length of geodesic segments in $\sigma_i^\circ \subset \mathbb{H}^2$. The distance between two points is then defined as the minimum of the lengths of such paths between them.

Throughout the remainder of this thesis, the $M_{(-1)}$-polygonal complex X will always be connected with finitely many isometry types of cells. Moreover, we will only treat $M_{(-1)}$-polygonal complexes which are **locally finite**, meaning that every closed cell is disjoint from all but finitely many other closed cells.

Definition 2.1.0.3. *Let* X *be a* $M_{(-1)}$*-polygonal complex. For every* $x \in X$*, we define a metric space* $Lk(x, X)$ *called the* ***link*** *of* x *in* X*, as follows. The underlying set is a sphere* $S(x, \epsilon)$ *in* X *of radius* ϵ *centered at* x*, where* ϵ *is taken small enough that if* $0 < \epsilon' < \epsilon$*, then* $S(x, \epsilon)$ *and* $S(x, \epsilon')$ *are homeomorphic.*

This set has a natural graph structure in which vertices arise from the intersection of $S(x, \epsilon)$ with 1-cells, and edges arise from the intersection of $S(x, \epsilon)$ with 2-cells. This graph is finite since, by assuption, X is locally finite. If the graph is also connected, we can therefore define a metric on this graph by specifying that the length of each edge is equal to the angle between the edges in X corresponding to the endpoints.

For example, the link of any vertex in the hyperbolic plane tiled by right-angled pentagons is a cycle graph on four edges of length $\frac{\pi}{2}$, as depicted in Figure 2.1.

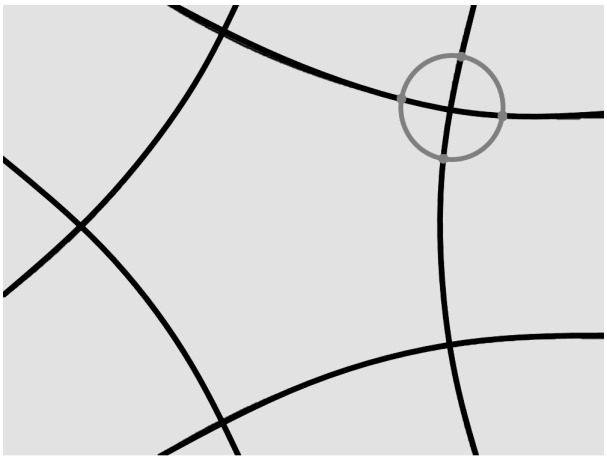

FIGURE 2.1: The link of a vertex in the hyperbolic plane.

2.1.1 The CAT(-1) Condition

Definition 2.1.1.1. *Let (X, d_X) be a geodesic metric space.*

Let $x, y, z \in X$ be arbitrary, and let $[x, y], [y, z], [x, z]$ be any geodesic segments connecting x to y, y to z, and z to x respectively. Denote $\Delta = [x, y] \cup [y, z] \cup [z, x]$.

Let p, q, r be any points in $\mathbb{H}^2$ satisfying $d(p, q) = d_X(x, y)$, $d(q, r) = d_X(y, z)$, and $d(p, r) = d_X(x, z)$, where d denotes the standard metric on $\mathbb{H}^2$. There exists a unique triangle $\overline{\Delta}$ in $\mathbb{H}^2$ whose vertices are p, q, r and whose edges are geodesic segments.

*For $c \in [x, y]$, we call $\overline{c} \in \mathbb{H}^2$ a **comparison point** for c if $\overline{c}$ is contained in the geodesic segment from p to q and $d(x, c) = d(p, \overline{c})$.*

We say that X is a ***CAT(-1) space*** *if for any choice of $x, y, z, [x, y], [y, z], and [z, x]$ in X, any choice of $p, q,$ and r in $\mathbb{H}^2$, and for any $a, b \in \Delta$, there exist comparison points $\overline{a}, \overline{b} \in \overline{\Delta}$ such that*

$$d(a, b) \leq d(\overline{a}, \overline{b}).$$

Loosely, CAT(-1) spaces have geodesic triangles which are thinner than triangles in $\mathbb{H}^2$ of comparable size. This condition is global and highly restrictive. For example, all CAT(-1) spaces are contractible (see [6], Part II, Proposition 1.4).

Thus, there is the following local alternative. We say that X is **locally CAT(-1)** if for any $x \in X$, there is a small ball $B(x, \delta)$ so that $B(x, \delta)$ is CAT(-1) in the subspace metric.

The next theorem, often known as *Gromov's Link Condition*, provides an easy way to check if a locally finite $M_{(-1)}$-polygonal complex is locally CAT(-1).

Theorem 2.1.1.1 (Gromov's Link Condition, [6], Part II, Theorem 5.2 and Lemma 5.6)**.** *Let X be an $M_{(-1)}$-polygonal complex. Then X is locally CAT(-1) if and only if for each vertex $v \in X$, every injective loop in $Lk(v, X)$ has length at least 2π.*

Remarkably, in the presence of simple connectivity, the local CAT(-1) condition and global CAT(-1) condition are equivalent. This is a consequence of Cartan-Hadamard Theorem. To avoid introducing additional terminology which will not be needed in this thesis, we present the theorem as applied only to $M_{(-1)}$-polygonal complexes. For the most general version of the result, see [6], Part II, Theorem 4.1.

Theorem 2.1.1.2. *Let K be a locally CAT(-1) $M_{(-1)}$-polygonal complex. Then the universal cover $\tilde{K}$ inherits a $M_{(-1)}$-polygonal complex structure from K: its cells are obtained by taking all possible lifts to $\tilde{K}$ of cells of K. Moreover, $\tilde{K}$, in the length metric induced by this $M_{(-1)}$-polygonal structure, is globally CAT(-1).*

2.2. Group Presentations

Let S be a nonempty set. In this thesis, we will always assume that S is finite. Denote the elements of S by $x_0, x_1, \ldots, x_n$, and let S^{-1} denote the set of symbols $x_0^{-1}, x_1^{-1}, \ldots, x_n^{-1}$. Denote by $S^{\pm}$ the disjoint union $S \sqcup S^{-1}$.

The **free group** generated by S, denoted $F(S)$, is the set of strings formed by elements of $S^{\pm}$. The group operation is concatenation, the identity element is the empty string, and the inverse of x_i is x_i^{-1} for all $i = 0, \ldots, n$.

Every word in the free group $F(S)$ can be expressed in the form $x_{i_1}^{\epsilon_1} \cdots x_{i_k}^{\epsilon_k}$, where $x_{i_1}, \ldots, x_{i_k} \in S$ and $\epsilon_1, \ldots, \epsilon_k \in \{1, -1\}$. This word will be called **positive** if $\epsilon_1 = \epsilon_2 = \cdots = \epsilon_k = 1$. It will be called **reduced** if $x_{i_j}^{\epsilon_j} \neq x_{i_{j+1}}^{-\epsilon_{j+1}}$ for all $j = 1, \ldots, k-1$. It will be **cyclically reduced** if in addition to being reduced, we have $x_{i_k}^{\epsilon_k} \neq x_{i_1}^{-\epsilon_1}$.

Let R be a set of elements of $F(S)$, possibly empty. In this thesis, we will always assume that R is finite. The **normal closure** of R in $F(S)$, denoted $N(R)$, consists of all products of conjugates $w^{-1} r^{\epsilon} w$, where $w \in F(S)$, $\epsilon \in \{1, -1\}$, and $r \in R$. Then $N(R)$ forms a normal subgroup of $F(S)$. The quotient $F(S)/N(R)$ is called **the group defined by the presentation** $\langle S \mid R \rangle$. In a slight abuse of notation, we will sometimes write $G = \langle S \mid R \rangle$ to mean that G is the group defined by the presentation $\langle S \mid R \rangle$. The elements of the set R are called the **relators** of the presentation. A presentation is said to be **positive** if each of its relators is positive.

If an element $r \in R$ is written $x_{i_1}^{\epsilon_1} \cdots x_{i_k}^{\epsilon_k}$, where $\epsilon_1, \ldots, \epsilon_k \in \{1, -1\}$ and $x_{i_1}, \ldots, x_{i_k} \in S$, we will often speak of a special conjugate of r called a **cyclic permutation**, which is obtained by conjugating r by some initial subword $x_{i_1}^{\epsilon_1} \cdots x_{i_j}^{\epsilon_j}$, $1 \leq j \leq k$. Informally, a cyclic permutation of r can be obtained by "rotating" the first letter of r to the end, or the last letter of r to the front, as many times as desired. By a **cyclic subword** of r, we mean a subword of some cyclic permutation of r.

Let g be an element of $F(S)$ written in the form $x_{i_1}^{\epsilon_1} \cdots x_{i_k}^{\epsilon_k}$, where $\epsilon_1, \ldots, \epsilon_k \in \{1, -1\}$, $x_{i_1}, \ldots, x_{i_k} \in S$, and $x_{i_1}^{\epsilon_1} \cdots x_{i_k}^{\epsilon_k}$ is reduced. The integer k is called the **length** of g (as measured in $F(S)$) and in this case we will write $|g| = k$.

To every presentation $\langle S \mid R \rangle$, we can associate a 2-complex in the following way: To a single 0-cell, attach an oriented 1-cell for every element of S. For each element r of R of length n, take an n-gon, and assign its edges labellings and orientations so that reading around the boundary spells out r. Then attach this 2-cell according to the labelling and orientation on the boundary. The result is called the **presentation 2-complex** of $\langle S \mid R \rangle$. It follows from the Seifert van Kampen theorem that the fundamental group of the presentation 2-complex of $\langle S \mid R \rangle$ is the group defined by $\langle S \mid R \rangle$.

For an example, Figure 2.2 depicts a schematic of the presentation 2-complex of the presentation

$$\langle a, b, c, d, e \mid ab^2ad, bc^2be, cd^2ca, de^2db, ea^2ec \rangle.$$

To assemble the presentation 2-complex from the schematic, identify every vertex of every pentagon to a single point, and identify edges with the same labelling, respecting orientation.

To every presentation $\langle S \mid R \rangle$, we can also associate a graph in the following way. For every generator $x \in S$, create two vertices x^- and x^+. If $x^\epsilon y^\delta$ is a cyclic subword of some relator R, draw an edge

- from x^- to y^+ if $\epsilon = \delta = 1$,
- from x^+ to y^- if $\epsilon = \delta = -1$,
- from x^+ to y^+ if $\epsilon = -1$ and $\delta = 1$,
- from x^- to y^- if $\epsilon = 1$ and $\delta = -1$.

The resulting graph is called the **Whitehead graph** of $\langle S \mid R \rangle$.

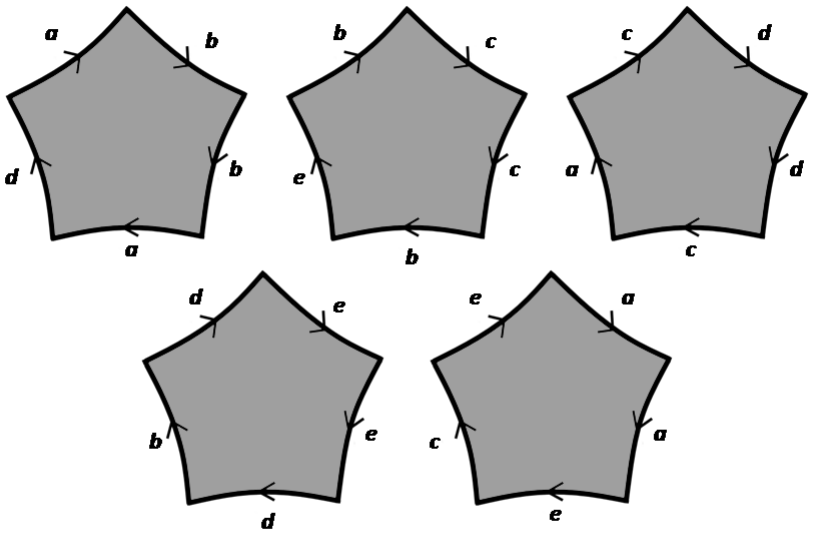

FIGURE 2.2: A depiction of a presentation 2-complex.

Note that the Whitehead graph of a presentation is naturally graph-isomorphic to the link of the vertex in the presentation 2-complex, if the latter is given the structure of an $M_{(-1)}$-polygonal complex. This is because a small sphere centered at this vertex will intersect each edge corresponding to a generator x in two points, which we label x^+ and x^-. Adopt the convention that x^+ is the first point and x^- is the second point encountered as we traverse the edge labelled x in the forward direction. Then any 2-cell around whose boundary we can read the cyclic subword xy determines an edge in the link between x^- and y^+, as shown in Figure 2.3.

2.3. Small Cancellation

The material in this section follows the presentation of [21]. The reader is directed to this book for a more general treatment of small cancellation theory.

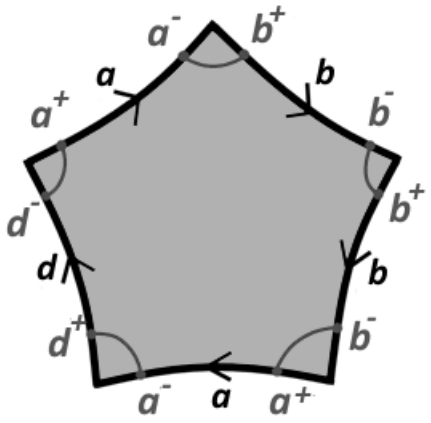

FIGURE 2.3: The relator ab^2ad gives five edges in the Whitehead graph.

The group defined by $\langle S \mid R \rangle$ remains unaltered if R is changed in any of the following ways:

- An element of R is replaced by a conjugate or an inverse.
- A conjugate or an inverse of an element of R is added to R.

Hence, the group defined by $\langle S \mid R \rangle$ remains unchanged if R is replaced by its **symmetrization** R^*. This set is the smallest subset of $F(S)$ which contains R and is closed under taking cyclic permutations and inverses.

Definition 2.3.0.1 (Small Cancellation Conditions)**.** *Let $\langle S \mid R \rangle$ be a group presentation.*

*Suppose that $r_1, r_2 \in R^*$, where r_1 and r_2 are distinct. If we can write $r_1 = bc_1$ and $r_2 = bc_2$, then b is a **piece** (of $\langle S \mid R \rangle$).*

*Let p be a positive integer. The presentation $\langle S \mid R \rangle$ satisfies the $C(p)$ **condition** if no element of R^* is a product of fewer than p pieces.*

*Let $\lambda > 0$. The presentation $\langle S \mid R \rangle$ satisfies the $C'(\lambda)$ **condition** if whenever $r \in R^*$ and $r = bc$ where b is a piece, then $|b| < \lambda |r|$.*

*Let q be a positive integer. The presentation $\langle S \mid R \rangle$ satisfies the $T(q)$ **condition** if, for every integer h satisfying $3 \leq h < q$, the Whitehead graph of $\langle S \mid R \rangle$ has no reduced*

cycles on h edges.

We emphasize that the small cancellation conditions are possessed by the presentation, and not by the group the presentation defines. Informally, these properties express that if two elements of the set of symmetrized relators are multiplied together, only a small amount of cancellation will occur, unless one element is the inverse of the other.

Groups defined by presentations satisfying $C'(\lambda)$-$T(q)$ for small λ and large q, or $C(p)$-$T(q)$ for large p and q, often possess additional special properties. The following properties, in particular, will be used in the proof of Theorem 3.2.0.2 to determine circumstances under which a map between two finitely presented groups determines a group isomorphism.

Theorem 2.3.0.1 ([21], Theorem 4.4)**.** *Let $\langle S \mid R\rangle$ have the $C(3)$ and $T(6)$ properties. Let w be a nontrivial, cyclically reduced word with $w \in N(R)$, i.e. w is trivial in the group defined by $\langle S \mid R\rangle$. Then either $w \in R^*$, or some cyclically reduced conjugate w^* of w can be written*

$$w^* = u_1 s_1 \cdots u_j s_j$$

where for every $k = 1, \ldots, j$, there exists $r_k \in R^*$ such that

$$r_k = s_k b_1 \cdots b_{i(s_k)}$$

where $b_1, \ldots, b_{i(s_k)}$ are pieces, and

$$\sum_{k=1}^{j} (2.5 - i(s_k)) \geq 3.$$

Theorem 2.3.0.2 ([21], Theorem 4.6)**.** *Let $\langle S \mid R\rangle$ have the $C'(\frac{1}{4})$ and $T(4)$ properties. Let w be a nontrivial, cyclically reduced word with $w \in N(R)$, i.e. w is trivial in the group defined by $\langle S \mid R\rangle$. Then either $w \in R^*$, or some cyclically reduced conjugate of w contains either*

1. *two disjoint subwords t_1, t_2, each satisfying $r_i = t_i c_i$ for some $r_i \in R^*$ and $|t_i| > \frac{3}{4}|r_i|, i = 1, 2$, or*

2. *four disjoint subwords $t_1, \ldots, t_4$, each satisfying $r_i = t_i c_i$ for some $r_i \in R^*$ and $|t_i| > \frac{1}{2}|r_i|, i = 1, \ldots, 4$.*

2.4. Hyperbolic Buildings

Fix an m-sided convex polygon P of the hyperbolic plane $\mathbb{H}^2$ whose edges are labelled, reading around the boundary, by $1, \ldots, m$, and whose vertices are labelled by one of the 2-sets $\{1, 2\}$, $\ldots$, $\{m-1, m\}, \{m, 1\}$ according to the edges to which the vertex is incident. Suppose every dihedral angle of P is of the form π/k, where k is an integer. Then the images of P under the group generated by the reflections through the edges of P form a tessellation of $\mathbb{H}^2$, and induce on $\mathbb{H}^2$ the structure of a labelled $M_{(-1)}$-polygonal complex ([22], Theorem IV.H.11). Denote this labelled complex by A_P.

Definition 2.4.0.1. *Let X be a connected $M_{(-1)}$-polygonal complex whose edges are labelled with integers $1, \ldots, m$ and whose vertices are labelled with 2-sets of integers $\{1, 2\}$, $\ldots$, $\{m-1, m\}, \{m, 1\}$. Let P be the labelled convex polygon described in the previous paragraph, and suppose that for every 2-cell c of X, which we call a **chamber**, there is a cellular isometry (an **isomorphism**) $c \to P$ which also preserves the labels of the edges and vertices.*

*We say that X is a **2-dimensional hyperbolic building** (of **type** P) if it has a family of subcomplexes, called **apartments**, isomorphic to A_P by a label-preserving isomorphism, with the following properties:*

1. *Given any two chambers, there is an apartment containing both.*

2. *For any two apartments A_1, A_2 that share a chamber, there is a label-preserving*

isomorphism from A_1 to A_2 fixing $A_1 \cap A_2$ pointwise.

*The polygon P is called the **fundamental chamber** of X.*

*We say that X is a **Fuchsian building** if in addition, there are integers $q_i \geq 3$, $i = 1, \ldots, k$, such that each edge of X labelled by i is contained in exactly q_i chambers.*

The $M_{(-1)}$-polygonal complexes which can occur as 2-dimensional hyperbolic buildings are severely limited, as shown by the following proposition.

Definition 2.4.0.2. *For two vertices u and v in a connected graph, define $D(u, v)$ to be the minimum integer k such that there exists a sequence of sequentially adjacent vertices $u = v_1, \ldots, v_{k-1} = v$. The **diameter** of a graph is $\max\{D(u, v)\}$, where the maximum is taken over all the vertices u and v of the graph. In other words, the diameter of a graph is the minimum number of edges needed to connect the vertices in the graph which are furthest apart.*

*The **girth** of a graph is the length of the shortest nontrivial cycle in the graph.*

*A **generalized n-gon** is a graph with diameter n and girth $2n$.*

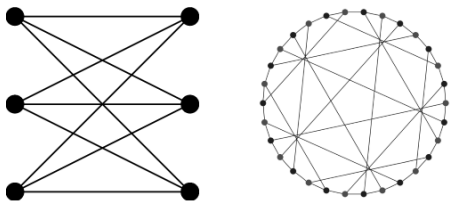

FIGURE 2.4: A complete bipartite graph (left) is a generalized 2-gon. The Tutte-Coxeter graph (right) is a generalized 4-gon.

Proposition 2.4.0.1 ([13], Proposition 1.5)**.** *If X is a 2-dimensional hyperbolic building, then X is CAT(-1) and, hence, contractible. Moreover, for every vertex v of X, there exists an integer $n \geq 2$ such that the link $Lk(v, X)$ is a generalized n-gon.*

Despite these restrictions, 2-dimensional hyperbolic buildings arise frequently as universal covers of $M_{(-1)}$-polygonal complexes, provided that their links are suitably nice.

Theorem 2.4.0.1 ([13], Theorémè 2.1'). *Let X be a CAT(−1) $M_{(-1)}$-polygonal complex, where each open 2-cell is isometric to the interior of fixed polygon P in $\mathbb{H}^2$, and each open 1-cell is isometric to the interior of some side of P. If, for every vertex v of X, there exists an integer $n \geq 2$ such that the link $Lk(v, X)$ is a generalized n-gon, then X is a 2-dimensional hyperbolic building.*

The following corollary is now a consequence of Theorem 2.1.1.2.

Corollary 2.4.0.1 ([13], Corollaire 2.4). *Let Y be a connected, locally CAT(−1) $M_{(-1)}$-polygonal complex, where each open 2-cell is isometric to the interior of a fixed polygon P in $\mathbb{H}^2$, and each open 1-cell is isometric to the interior of some side of P. If, for every vertex v of Y, there exists an integer $n \geq 2$ such that the link $Lk(v, Y)$ is a generalized n-gon, then the universal cover of Y is a 2-dimensional hyperbolic building.*

2.4.1 Bourdon's Buildings

Some of the most notable examples of Fuchsian buildings are those introduced by M. Bourdon ([4]). These buildings stand out among the Fuchsian buildings because they can be defined uniquely up to cellular isometry given information only about their fundamental chamber and vertex links.

Theorem 2.4.1.1 ([4], Proposition 2.2.1). *For every integer $p \geq 5$ and $q \geq 2$, there exists a 2-dimensional hyperbolic building $I_{p,q}$ whose chambers are regular hyperbolic p-gons with dihedral angles $\pi/2$ and edge lengths 1, and whose link at each vertex is the complete bipartite graph on $q + q$ vertices, $K(q, q)$.*

Moreover, suppose X is any simply connected polygonal 2-complex satisfying the following properties:

1. *Its 2-cells are isometric to a regular hyperbolic p-gon of angles $\pi/2$ and edge lengths 1, attached by their edges and vertices so that any two 2-cells have at most one edge or one vertex in common, and*

2. The link at each of its vertices is the graph $K(q, q)$.

Then X is cellularly isometric to $I_{p,q}$.

Definition 2.4.1.1. *Let $p \geq 5$ and $q \geq 2$ be integers. Define* ***Bourdon's building*** *$I_{p,q}$ to be the 2-dimensional hyperbolic building whose chambers are regular hyperbolic p-gons with dihedral angles $\pi/2$ and edge lengths 1, and whose link at each vertex is the complete bipartite graph on $q + q$ vertices, $K(q, q)$.*

Note that every edge of $I_{p,q}$ is contained in exactly q chambers, since every vertex in $K(q, q)$ is incident to exactly q edges. Hence, $I_{p,q}$ is Fuchsian if $q \geq 3$.

2.4.2 Lattices of Hyperbolic Buildings

For a 2-dimensional hyperbolic building X, we will call a cellular isometry $X \to X$ an **automorphism** of X. The cellular isometry need not be label-preserving. A **cocompact lattice** of X is a group G of automorphisms of X such that the orbit space X/G is compact and the stabilizer of each cell is finite.

Bourdon's buildings and, more generally, all Fuchsian buildings enjoy a special property known as *Mostow rigidity*, which restricts the potential group isomorphisms between cocompact lattices. This property is similar to the properties known as Mostow rigidity in the field of Riemannian geometry, but distinguishes itself by taking into account not only the building's geometric structure, but also its cellular structure.

Theorem 2.4.2.1 ([30], Corollary 1.3)**.** *Let X_1, X_2 be two Fuchsian buildings with regular chambers, and suppose G is a cocompact lattice of both X_1 and X_2. Then there is a cellular isometry $\phi : X_1 \to X_2$ which is G-equivariant, that is, $\phi g = g\phi$ for all $g \in G$.*

Now suppose that G_1 is a cocompact lattice of X_1 and G_2 is a cocompact lattice of X_2, where X_1 and X_2 are Fuchsian buildings with regular fundamental chambers. If $\Phi : G_1 \to G_2$ is an isomorphism, then $G_2 = \Phi(G_1)$ can be identified with G_1, and G_1 can

be thought of as a cocompact lattice of both X_1 and X_2. So there is a cellular isometry $\phi : X_1 \to X_2$ such that $\phi g = \Phi(g)\phi$ for all $g \in G$. This implies $\phi g \phi^{-1} = \Phi(g)$, and therefore, $\phi G_1 \phi^{-1} = G_2$. These observations are summarized below.

Theorem 2.4.2.2. *Let X_1, X_2 be two Fuchsian buildings with regular chambers, and suppose that G_i is a cocompact lattice of X_i for $i = 1, 2$. If G_1 and G_2 are isomorphic as groups, then there is a cellular isometry $\phi : X_1 \to X_2$ so that $\phi G_1 \phi^{-1} = G_2$ as subsets of the group of automorphisms of X_2.*

This theorem was first discovered in the case $X_1 = X_2 = I_{p,q}$ by M. Bourdon in [4].

2.5. Vertex-Regular Groups Acting on Buildings: A Brief Literature Review

To our knowledge and at the time of writing, there exist only two papers in which torsion-free vertex-regular groups of automorphisms of a building have been studied.

The first was written by Cartwright et al. in 1993 ([9]). At this time, the notion of a 2-dimensional hyperbolic building as presented in Definition 2.4.0.1 had not yet been developed, and instead, Cartwright et al. viewed buildings as an abstract simplicial complex without a metric structure. They proved that any group which acted by simplicial isomorphisms on the building, simply transitively on the vertex set, admitted a straightforward presentation, whose generators could be obtained by considering the vertices adjacent to a fixed vertex v in the building, and whose relators could be read off the boundaries of the 2-dimensional simplices containing v as a vertex ([9], Section 2). Because 2-dimensional simplices have three edges, the relators obtained by Cartwright et al. all had length 3, and thus they were referred to as triangle presentations. In Section 3 of [9], Cartwright et al. determined circumstances under which triangle presentations determined a group acting by simplicial isomorphisms on buildings satisfying certain additional properties.

Cartwright et al. later communicated their methods to Kangaslampi and Vdovina ([18]), who applied the technique to 2-dimensional hyperbolic buildings whose fundamental chamber was also simplicial. They obtained conditions under which a triangle presentation defined a torsion-free lattice of a building whose link at each vertex was the Tutte-Coxeter graph (a generalized 4-gon on 30 vertices and 45 edges), and constructed all such positive presentations using a computer algorithm.

Kangaslampi and Vdovina observed that most of the presentations they had obtained were redundant. In many cases, a permutation of the generators would take one presentation to another. Using this observation, they reduced their list of over 7100 triangle presentations to merely 45. Noting that the hyperbolic structure of their buildings allowed them to make use of Mostow rigidity, Kangaslampi and Vdovina associated to each presentation a group invariant called the *dual graph*, constructed in the following way. Define one vertex for each generator, and one vertex for each relator. Draw an edge between two vertices if they correspond to a generator and a relator containing that generator. Note that the resulting graph is bipartite: the vertices corresponding to generators can be colored black, and the vertices corresponding to relators can be colored white.

To show the dual graph is a group invariant, take two groups G_1 and G_2 defined by two triangle presentations and suppose they are isomorphic. Mostow rigidity produces a cellular isometry conjugating one group to another, $\phi G_1 \phi^{-1} = G_2$. We claim that ϕ determines a cellular isometry $\overline{\phi} : X/G_1 \to X/G_2$ between orbit spaces. So let σ be any cell of X/G_1. Fix one lift $\tilde{\sigma}$ of σ to X, and let $\overline{\phi}(\sigma)$ be the cell which is the orbit of $\phi(\tilde{\sigma})$ under the action of G_2. To show this is well-defined, note that any other lift of σ can be written $g_1(\tilde{\sigma})$ for some $g_1 \in G_1$. Then $\phi(g_1(\tilde{\sigma})) = (g_2\phi)(\tilde{\sigma})$ for some $g_2 \in G_2$. Since $\phi(\tilde{\sigma})$ and $(g_2\phi)(\tilde{\sigma})$ have the same orbit, $\overline{\phi}$ is well-defined. Now the cellular isometry $\overline{\phi}$, in turn, defines a color-preserving graph isomorphism of dual graphs.

Unfortunately, the dual graph is not sufficient to completely classify lattices of

Fuchsian buildings up to group isomorphism. For example, in this thesis we will obtain groups defined by presentations

$$\langle x_0, \ldots, x_4 \mid x_0^2 x_1 x_0 x_2, x_0 x_3 x_1^2 x_4, x_0 x_4 x_1 x_3^2, x_1 x_2^2 x_3 x_2, x_2 x_4^2 x_3 x_4 \rangle$$

and

$$\langle x_0, \ldots, x_4 \mid x_0^2 x_1 x_0 x_3, x_0 x_3 x_1^2 x_4, x_0 x_4^2 x_1 x_3, x_1 x_2^2 x_4 x_2, x_2 x_3^2 x_4 x_3 \rangle$$

which are torsion-free vertex-regular lattices of Bourdon's building $I_{5,5}$. The presentations have isomorphic dual graphs but define non-isomorphic groups. The latter claim is most easily checked by considering the derived series of the groups, since one can see via the software GAP (Groups, Algorithms, and Programming, [14]) that the abelianization of the derived subgroup of the first group is trivial, while for the second group this abelianization is of order 4, $Z_2 \times Z_2$.

Thus, Kangaslampi and Vdovina could only use the dual graph to produce 23 presentations defining groups which were necessarily pairwise non-isomorphic. There remains the possibility that, for example, all 45 of the presentations found by these authors could define non-isomorphic groups.

3. METHODS AND CONSTRUCTIONS

3.1. Constructing Torsion-Free Vertex-Regular Cocompact Lattices of a Fuchsian Building

We begin with a short lemma.

Lemma 3.1.0.1. *Let G be a torsion-free group acting cellularly on a polygonal complex X. If the action of G on X is vertex-regular, then the stabilizer of every cell of X is trivial and the action of G on X is free.*

Proof. If $g \in G$ stabilizes a cell c of X, then g permutes the vertices of c. Hence, some power of g fixes the vertices of c and is trivial, so g is trivial.

Now suppose that $g \in G$ is such that $gx = x$ for some $x \in X$. Let c be any cell of X containing x. Then g stabilizes c, so $g = 1$. □

Our first theorem shows that every torsion-free vertex-regular cocompact lattice of a 2-dimensional hyperbolic building admits a presentation of a simple type.

Theorem 3.1.0.1. *Suppose there exists a torsion-free vertex-regular cocompact lattice G of a 2-dimensional hyperbolic building X. Then*

- *the link at each vertex of X is graph-isomorphic to the same graph Γ, and*
- *Γ contains an even number of vertices.*

Moreover, there is a presentation $\langle S \mid R \rangle$ of G satisfying the following properties:

(i) The size of S is half the number of vertices of Γ,

(ii) each element of R has length equal to the number of sides of the fundamental chamber of X, and

(iii) the Whitehead graph of $\langle S \mid R \rangle$ *is graph-isomorphic to* Γ.

Note that (ii) and (iii) imply that the number of edges of the fundamental chamber of X *divides the number of edges of* Γ.

Proof. Let G be a torsion-free vertex-regular cocompact lattice of X. Since the action of G is transitive on vertices, and is cellular, it preserves the link at each vertex. It follows immediately that the link at each vertex is graph-isomorphic to the same graph; call it Γ.

We claim that the action of G on X is properly discontinuous, meaning that for any compact subset K of X, the set $\{g \in G \mid gK \cap K \neq \emptyset\}$ is finite. The set K is contained in the union of a finite collection $\{c_1, \ldots, c_\ell\}$ of cells of X. If $g \in G$ is such that $gK \cap K \neq \emptyset$, then g maps some cell c_i onto some cell c_j, $1 \leq i, j \leq \ell$. Because the stabilizer of each cell is trivial, the group element taking c_i to c_j is unique. We conclude that $\{g \in G \mid gK \cap K \neq \emptyset\}$ is finite, its size bounded above by $\ell(\ell - 1)$.

Since the action of G on X is also free, the orbit map $X \to Y := X/G$ is a covering projection, and

- $\pi_1(Y) \cong G$, since X is simply connected;
- Y has one vertex, since the action of G on the vertices of X is transitive;
- Y inherits a cellular structure from X, since the action of G on X is cellular; and
- the link at the single vertex of Y is isomorphic to Γ, since the action of G on X preserves the link at each vertex.

The first and second items imply that G has a presentation $\langle S \mid R \rangle$ whose presentation 2-complex is Y, and the fourth implies the Whitehead graph of $\langle S \mid R \rangle$ is Γ. In particular, the number of vertices in Γ is $2|S|$.

The third item implies that all the elements of R have length equal to the number of sides of any of the 2-cells in Y, which in turn is equal to the number of sides in the fundamental chamber. $\square$

Note that Theorem 3.1.0.1 implies that, up to isomorphism, the number of vertex-regular cocompact lattices of any 2-dimensional hyperbolic building X is finite, bounded above by $(2k)^p$, where $2k$ is the number of vertices in the link of any vertex of X and p is the number of edges in the link.

Definition 3.1.0.1. *Let G be a torsion-free vertex-regular cocompact lattice of a 2-dimensional hyperbolic building X. The presentation $\langle S \mid R\rangle$ determined by the orbit space X/G, satisfying properties (i)-(iii) of Theorem 3.1.0.1, will be called the* ***scaffolded presentation*** *of G.*

Conversely to Theorem 3.1.0.1, if a group is defined by a finite presentation whose presentation 2-complex satisfies certain metric and combinatorial properties, that group will be a torsion-free vertex-regular cocompact lattice of a 2-dimensional hyperbolic building. The following result was first observed without proof in [18]; we present our proof below.

Proposition 3.1.0.1 ([18])**.** *Let $G = \langle S \mid R\rangle$, and suppose that $\langle S \mid R\rangle$ satisfies the following properties:*

(i) The sets S and R are finite,

(ii) The length of each element of R is equal to a fixed integer m, $m \geq 3$,

(iii) the Whitehead graph of $\langle S \mid R\rangle$ is a generalized n-gon, and

(iv) $n > \frac{m}{m-2}$.

Then G is a torsion-free vertex-regular cocompact lattice of a 2-dimensional hyperbolic building X.

Proof. First, we show that the presentation 2-complex Y of G admits a metric turning it into a locally CAT(-1) $M_{(-1)}$-polygonal complex. Metrize the open 2-cells of Y so that

they are isometric to the interior of an m-sided regular polygon P whose dihedral angles are $\frac{\pi}{n}$ and whose edge lengths are 1. Since the girth of the Whitehead graph of $\langle S \mid R\rangle$ is a generalized n-gon, the length of the shortest embedded loop in Y is $2n\left(\frac{\pi}{n}\right) = 2\pi$. Since $n > \frac{m}{m-2}$, rearrangement produces $\pi(m-2) > m\left(\frac{\pi}{n}\right)$, and therefore P is hyperbolic. Metrize the open 1-cells of Y so that they are isometric to the interior of any side of P.

It is now immediate from Corollary 2.4.0.1 that the universal cover of Y is a 2-dimensional hyperbolic building X. The fundamental group of Y is the group G, and it acts on X by cellular isometries. Since X is contractible, Y is a finite-dimensional $K(G,1)$, and therefore G is torsion-free (see [7], Corollary 2.5). The action of G is vertex-regular, since Y has a single 0-cell. Finally, that G is a cocompact lattice of X follows from compactness of Y and Lemma 3.1.0.1. □

By Bourdon's uniqueness result (Theorem 2.4.1.1), any group defined by a presentation satisfying properties (i) - (iv) of Proposition 3.1.0.1 with Whitehead graph $K(q,q)$ is necessarily a cocompact lattice of one of Bourdon's buildings. Thus, we get the following equivalence.

Proposition 3.1.0.2. *Let G be a group, and let $p \geq 5, n \geq 1$ be integers. The following are equivalent:*

(1) G is a torsion-free vertex-regular cocompact lattice of Bourdon's building $I_{p,np}$.

(2) G admits a presentation $\langle S \mid R\rangle$ where the set S contains np elements, the set R contains n^2p elements, every element of R is a word of length p, and the Whitehead graph of $\langle S \mid R\rangle$ is graph-isomorphic to $K(np,np)$.

We remark that the restriction to the case $q = np$ is due to the observation in Theorem 3.1.0.1 that the number of edges of the fundamental chamber divides the number of edges in the link of any 2-dimensional hyperbolic building admitting a torsion-free vertex-regular cocompact lattice.

Proof. The forward direction is immediate from Theorem 3.1.0.1, since the fundamental chamber of $I_{p,np}$ is p-sided and the link at each vertex contains $2np$ vertices and n^2p^2 edges.

By Proposition 3.1.0.1, if $\langle S \mid R\rangle$ satisfies the properties of (2), it defines a torsion-free vertex-regular cocompact lattice of some 2-dimensional hyperbolic building X whose link at each vertex is $K(np, np)$ and whose fundamental chamber is isometric to the regular hyperbolic polygon of edge lengths 1 and dihedral angles $\frac{\pi}{2}$. By Theorem 2.4.1.1, X is cellularly isometric to $I_{p,np}$, and thus the group defined by $\langle S \mid R\rangle$ is a torsion-free vertex-regular cocompact lattice of $I_{p,np}$. □

3.2. Classifying Torsion-Free Vertex-Regular Cocompact Lattices of Fuchsian Buildings

In this section, we turn to the problem of classifying the torsion-free vertex-regular cocompact lattices of a Fuchsian building. We show that in the presence of a free and transitive action on the vertex set, the Mostow rigidity of Theorem 2.4.2.2 translates to a group-theoretic rigidity according to the following result.

Theorem 3.2.0.1. *Let X be a Fuchsian building with regular fundamental chamber. Let $G_1 = \langle S_1 \mid R_1\rangle$ and $G_2 = \langle S_2 \mid R_2\rangle$ be any two torsion-free vertex-regular cocompact lattices of X, where $\langle S_1 \mid R_1\rangle$ and $\langle S_2 \mid R_2\rangle$ are scaffolded presentations. If G_1 and G_2 are isomorphic, then there is an isomorphism from G_1 to G_2 taking $S_1^{\pm}$ bijectively to $S_2^{\pm}$.*

Proof. Denote by $2k$ the number of vertices in the link of any vertex of X. Denote the metric on X by d, and let c denote the length of any edge of P.

Let $i = 1$ or 2. Although we already know that G_i is isomorphic to $F(S_i)/N(R_i)$, we will require a systematic way to produce specific group isomorphisms $F(S_i)/N(R_i) \to G_i$ by which elements of S_i (viewed as a subset of $F(S_i)/N(R_i)$) can be identified with

automorphisms in $G_i \subset \mathrm{Aut}(X)$. We will do this using the following method: Let $Y_i := X/G_i$ denote the orbit space. Fix an orientation of each edge of Y_i, and fix an identification of the loops of Y_i with the elements of S_i. Now for each vertex w in X, we define a group isomorphism $\tau_w^i : F(S_i)/N(R_i) \to G_i$ by defining $\tau_w^i(x)$ for all $x \in S_i$. The oriented loop in Y_i corresponding to x lifts to an oriented edge in X beginning at w. The terminal endpoint of this edge is a vertex of X adjacent to w. There is a unique automorphism in G_i mapping w to this vertex. Define $\tau_w^i(x)$ to be this automorphism. It follows from covering space theory that τ_w^i is a group isomorphism for every vertex w.

Next, we make the following observation. Again, let $i = 1$ or 2. For any vertex w and for any $x \in S_i$, the vertices $\tau_w^i(x)(w)$ are adjacent to x by construction of τ_w^i. Therefore $d(w, \tau_w^i(x)(w)) = c$. Since G_i acts on X by isometries and τ_w^i is a group isomorphism, it follows that $d(\tau_w^i(x^{-1})(w), w) = c$; therefore $\tau_w^i(x^{-1})(w)$ is also adjacent to w. There are exactly $2k$ vertices adjacent to w, and exactly $2k$ elements of the form $\tau_w^i(x)(w)$, $x \in S_i^{\pm}$, so every vertex adjacent to w can be written $\tau_w^i(x)(w)$, $x \in S_i^{\pm}$. Since the action of G_i on X is free, we conclude that if $g \in G_i$ is such that $d(gw, w) = c$, then $g \in \{\tau_w^i(x)(w) : x \in S_i^{\pm}\}$.

Finally, fix a vertex v of X. By Mostow rigidity of X, there exists a cellular isometry ϕ of X such that $\phi G_1 \phi^{-1} = G_2$ as subgroups of $\mathrm{Aut}(X)$. Let $x \in S_1^{\pm}$ be arbitrary. Then $\tau_v^1(x)(v)$ is adjacent to v.

The isometry $\phi\tau_v^1(x)\phi^{-1}$ is an automorphism of X contained in G_2. Since ϕ acts on X by isometries, we get

$$\begin{aligned} d((\phi\tau_v^1(x)\phi^{-1})(\phi(v)), \phi(v)) &= d((\phi\tau_v^1(x))(v), \phi(v)) \\ &= d(\tau_v^1(x)(v), v) \\ &= c. \end{aligned}$$

We conclude that $\phi\tau_v^1(x)\phi^{-1} = \tau_{\phi(v)}^2(y)$ for some $y \in S_2^{\pm}$.

Thus, the desired isomorphism is conjugation by ϕ. $\square$

Thus, to check whether two groups defined by presentations $\langle S_1 \mid R_1 \rangle$ and $\langle S_2 \mid R_2 \rangle$ are isomorphic, one must only check $(k!)2^k$ possible assignments of elements of S_1 to elements of $S_2^{\pm}$.

Nevertheless, the problem of group isomorphism between vertex-regular cocompact lattices of a Fuchsian building remains difficult, as it is not easy, in general, to tell if a given generator assignment even defines a group homomorphism.

However, we show that scaffolded presentations $\langle S \mid R \rangle$ also satisfy small cancellation properties which further simplify the isomorphism problem considerably.

Theorem 3.2.0.2. *Let X be a Fuchsian building with regular fundamental chamber. Let $G_1 = \langle S_1 \mid R_1 \rangle$ and $G_2 = \langle S_2 \mid R_2 \rangle$ be any two torsion-free vertex-regular cocompact lattices X, where $\langle S_1 \mid R_1 \rangle$ and $\langle S_2 \mid R_2 \rangle$ are scaffolded presentations. Let $\psi : G_1 \to G_2$ be a group isomorphism taking $S_1^{\pm}$ bijectively to $S_2^{\pm}$. Then for every relator $r \in R_1$, the image under ψ is a symmetrized relator, $\psi(r) \in R_2^*$.*

Proof. Let m denote the number of sides of the fundamental chamber of X. The link of any vertex in X is a generalized n-gon, $n \geq 2$ (Proposition 2.4.0.1).

We begin by proving the following claim: If $n = 2$, then $m \geq 5$. So suppose for eventual contradiction that $n = 2$ and $m = 3$ or 4. Let α denote the dihedral angle of the fundamental chamber. Since X is CAT(-1), by Gromov's Link Condition, the length of the shortest embedded loop in the link at every vertex is $\geq 2\pi$. At the same time, since $n = 2$, the length of the shortest embedded loop in the link at every vertex is 4α. Thus $\alpha \geq \frac{\pi}{2}$, which is impossible for a hyperbolic 3-gon or 4-gon.

Thus, the following two cases are exhaustive:

- Case 1: $m \geq 5$.
- Case 2: $n \geq 3$.

Proof of Case 1: We start with the following lemma.

Lemma 3.2.0.1. *Let $\langle S \mid R\rangle$ be a scaffolded presentation, where the fundamental chamber of the building X has $m \geq 5$ sides. Then $\langle S \mid R\rangle$ satisfies the $C'(1/4)$ and $T(4)$ small cancellation conditions.*

Proof. Since $m \geq 5$, all the elements of R have length ≥ 5. At the same time, the Whitehead graph of $\langle S \mid R\rangle$ is a generalized n-gon, $n \geq 2$ (Proposition 2.4.0.1), and thus has no double edges. It follows that the longest piece of $\langle S \mid R\rangle$ has length 1, for if there were a piece of the form xy, there would be two edges with endpoints x^- and y^+. Since $1 < \frac{1}{4}(5) \leq \frac{1}{4}(m)$, we can say that $\langle S \mid R\rangle$ is $C'(1/4)$.

To show $\langle S \mid R\rangle$ is $T(4)$, it suffices to observe that the shortest cycle in a generalized n-gon, $n \geq 2$, is of length ≥ 4. □

Now suppose that $G_1 = \langle S_1 \mid R_1\rangle, G_2 = \langle S_2 \mid R_2\rangle$, and $\psi : G_1 \to G_2$ are as described in the theorem's hypothesis, and let $r \in R_1$ be arbitrary. Write $r = y_1^{\epsilon_1} y_2^{\epsilon_2} \cdots y_m^{\epsilon_m}$ where $y_1, \ldots, y_m \in S_1$ and $\epsilon_1, \ldots, \epsilon_m \in \{1, -1\}$. Then $\psi(r)$ can be written

$$\psi(r) = z_1^{\delta_1} \cdots z_m^{\delta_m}$$

where $z_1, \ldots, z_m \in S_2$ and $\delta_1, \ldots, \delta_m \in \{1, -1\}$.

By Theorem 2.3.0.2, either $\psi(r) \in R_2^*$, or some cyclically reduced conjugate of $\psi(r)$ contains either

1. two disjoint subwords, each of length $> \frac{3}{4}m$, or
2. four disjoint subwords, each of length $> \frac{1}{2}m$.

These last two cases are impossible, since they both imply that the length of $\psi(r)$ is greater than m.

We conclude that $\psi(r) \in R_2^*$.

Proof of Case 2: We again start with a lemma.

Lemma 3.2.0.2. *Let $\langle S \mid R\rangle$ be a scaffolded presentation, where the link of any vertex of X is a generalized n-gon, $n \geq 3$. Then $\langle S \mid R\rangle$ satisfies the $C(3)$ and $T(6)$ small cancellation conditions.*

Proof. Once again, because the Whitehead graph of $\langle S \mid R\rangle$ has no double edges, every piece of $\langle S \mid R\rangle$ has length 1. Since every element of R has length $m \geq 3$, it follows that $\langle S \mid R\rangle$ satisfies $C(3)$.

Since the shortest cycle in the Whitehead graph of $\langle S \mid R\rangle$ has length $2n \geq 6$, $\langle S \mid R\rangle$ is $T(6)$. □

Suppose that $G_1 = \langle S_1 \mid R_1\rangle, G_2 = \langle S_2 \mid R_2\rangle$, and $\psi : G_1 \to G_2$ are as described in the theorem's hypothesis, and let $r \in R_1$ be arbitrary. Write $r = y_1^{\epsilon_1} y_2^{\epsilon_2} \cdots y_m^{\epsilon_m}$ where $y_1, \ldots, y_m \in S_1$ and $\epsilon_1, \ldots, \epsilon_m \in \{1, -1\}$. Then $\psi(r)$ can be written

$$\psi(r) = z_1^{\delta_1} \cdots z_m^{\delta_m}$$

where $z_1, \ldots, z_m \in S_2$ and $\delta_1, \ldots, \delta_m \in \{1, -1\}$.

Denote $w = \psi(r)$. By Theorem 2.3.0.1, either $w \in R_2^*$, or some cyclically reduced conjugate w^* can be written

$$w^* = u_1 s_1 \cdots u_j s_j$$

where for every $k = 1, \ldots, j$, there exists $r_k \in R_2^*$ such that

$$r_k = s_k b_1 \cdots b_{i(s_k)},$$

the $b_1 \ldots, b_{i(s_k)}$ are pieces, and

$$\sum_{k=1}^{j} (2.5 - i(s_k)) \geq 3.$$

We claim that $w \in R_2^*$. Otherwise, since every element of R_2^* has length m, and all the pieces have length 1, we get

$$m = |r_k| = |s_k| + i(s_k)$$

for every $k = 1, \ldots, j$.

Since w^* has length m, we get

$$\begin{aligned} m &= |w^*| \\ &\geq \sum_{k=1}^{j} |s_k| \\ &= \sum_{k=1}^{j} (m - i(s_k)) \\ &\geq \sum_{k=1}^{j} (m - 2.5) + 3 \\ &= j(m - 2.5) + 3 \\ &\geq m + 0.5, \end{aligned}$$

since $j \geq 1$ and $m \geq 3$. This is clearly impossible.

We conclude that $w \in R_2^*$ in this case also. □

4. VERTEX-REGULAR COCOMPACT LATTICES OF $I_{5,5}$

4.1. A Description of the Method

In this section, we will apply the results of Chapter 3 to the simplest possible choice of Bourdon's building $I_{p,np}$, namely $I_{5,5}$. With this choice of p and n, Proposition 3.1.0.2 takes the following form:

Corollary 4.1.0.1. *Let G be a group. Then G is a torsion-free vertex-regular cocompact lattice of $I_{5,5}$ if and only if it admits a presentation $\langle S \mid R\rangle$ satisfying the following four properties:*

(i) S contains 5 elements,

(ii) R contains 5 elements,

(iii) every element of R is a word of length 5, and

(iv) the Whitehead graph of $\langle S \mid R\rangle$ is $K(5,5)$.

To ease notation and increase legibility, we will refer to one of these presentations by a 25-digit serial number xxxxx-xxxxx-xxxxx-xxxxx-xxxxx, composed of five subsequences of length five, each written using the digits 0 through 9. For $i = 0, \ldots, 4$, the digit i represents the generator x_i in the 5-element generating set S. For $i = 5, \ldots, 9$, the digit i represents the inverse generator x_{i-5}^{-1} in S^{-1}. Each length five subsequence represents a relator of the group.

For example, the serial number 00102-03484-08669-12189-22374 corresponds to the group generated by $x_0, \ldots, x_4$ with relators

$$x_0^2 x_1 x_0 x_2,\ x_0 x_3 x_4 x_3^{-1} x_4,\ x_0 x_3^{-1} x_1^{-2} x_4^{-1},\ x_1 x_2 x_1 x_3^{-1} x_4^{-1},\ x_2^2 x_3 x_2^{-1} x_4.$$

To simplify our search for presentations satisfying conditions (i) - (iv) of Corollary 4.1.0.1, we introduce the following proposition.

Proposition 4.1.0.1. *Let G be a group defined by a presentation $\langle S \mid R \rangle$, where S satisfies the properties (i) - (iv) of Corollary 4.1.0.1. Suppose that for every generator $x \in S$, the vertices x^+ and x^- in the Whitehead graph are oppositely colored. Then G admits a presentation $\langle S \mid R' \rangle$, where S and R' satisfy properties (i) - (iv) as well as the additional property*

(v) all the words in R' are positive.

Proof. First, note that replacing the generator x with x^{-1} will swap the coloring of x^- and x^+. By doing this repeatedly, we can guarantee that all the vertices of the form x^- are black and the vertices of the form x^+ are white. Thus, there are no cyclic subwords of the form xy^{-1} or $x^{-1}y$; there can only be those of the form $x^{-1}y^{-1}$ or xy. By replacing a relator with its inverse if necessary, we can then guarantee that every relator is positive. □

With this proposition in mind, we use the following algorithm to find presentations satisfying properties (i) - (iv) of Proposition 4.1.0.1.

(1) Generate all possible length 5 sequences from the digits 0 through 4.

(2) From this list, eliminate any cyclic redundances. For example, given sequences 00102 and 01020, we remove 01020.

(3) From this list, eliminate any sequences which will create double edges in the associated Whitehead graph. For example, we remove the sequence 00011 and the sequence 12012.

(4) From the remaining set of sequences, form all possible subsets of size 5. These subsets will form our serial numbers.

(5) Generate the corresponding Whitehead graph, and check for double edges.

(6) If the Whitehead graph has no double edges, it is automatically $K(5,5)$, and we keep the serial number.

We enact this algorithm using a program we have written with the computer software GAP (Groups, Algorithms, and Programming, [14]). As a result, we obtain the following.

Proposition 4.1.0.2. *There are 71,424 positive presentations $\langle S \mid R \rangle$ satisfying properties (i) - (v) of Proposition 4.1.0.1.*

Now we find the vertex-regular lattices of $I_{5,5}$ which do not admit positive presentations using the following algorithm.

(1) Generate all possible length 5 sequences from the digits 0 through 9.

(2) From this list, eliminate cyclic redundances.

(3) From this list, eliminate inverses. For example, given sequences 01234 and 98765, we remove 98765.

(4) From this list, eliminate sequences which represent relators that are not cyclically reduced, as these will create loops in the Whitehead graph. For example, we remove 01602.

(5) From this list, eliminate sequences which will result in double edges in the Whitehead graph. For example, we remove 00011 and 12012, as well as 01365.

(6) From the remaining set of sequences, form all possible subsets of length 5. These subsets will form our serial numbers.

(7) Generate the corresponding Whitehead graph, and check if it is isomorphic to $K(5,5)$.

(8) If it is isomorphic to $K(5,5)$, check if there is at least one generator x such that x^- and x^+ are equally colored.

(9) If there is at least one generator x such that x^- and x^+ are equally colored, we keep the serial number.

We also enact this algorithm in GAP, obtaining the following;

Proposition 4.1.0.3. *There are 21,156,862 presentations $\langle S \mid R\rangle$ satisfying properties (i) - (iv) of Corollary 4.1.0.1, as well as the additional property*

(v') there exists an element $x \in S$ such that x^+ and x^- have equal colors.

We remark that the algorithms we have presented up to this point can be adapted to find the positive and non-positive scaffolded presentations of the torsion-free vertex-regular cocompact lattices of $I_{p,q}$ for any choice of integers $p \geq 5$ and $q \geq 2$. If p does not divide q^2, no such lattice exists. If p divides q^2, the scaffolded presentations of these lattices can be represented by serial numbers with q^2 digits in base $(2q)$, consisting of $\frac{q^2}{p}$ subsequences of length p.

We now apply Theorem 3.2.0.2 to classify the groups defined by these 71,424 + 21,156,862 presentations up to isomorphism. To reduce computation time, we make use of the following two corollaries. Note that although Corollary 4.1.0.2 can be generalized to any $I_{p,q}$, Corollary 4.1.0.3 can only be generalized to $I_{5,5n}$.

Corollary 4.1.0.2. *Suppose $G_1 = \langle S_1 \mid R_1\rangle$ satisfies the properties (i) - (v) of Proposition 4.1.0.1, and $G_2 = \langle S_2 \mid R_2\rangle$ satisfies the properties (i) - (v') of Proposition 4.1.0.3. Then G_1 and G_2 are not isomorphic.*

Proof. Suppose by way of contradiction that G_1 and G_2 are isomorphic. By Theorem 3.2.0.2, there exists an isomorphism $\psi : G_1 \to G_2$ taking $S_1^{\pm}$ bijectively to $S_2^{\pm}$ and such that $\psi(r) \in R_2^*$ for all $r \in R_1^*$. Let $z \in S_2$ be such that z^+ and z^- are equally colored

in the Whitehead graph of $\langle S_2 \mid R_2 \rangle$. Then there exists $y \in S_1^{\pm}$ such that $\psi(y) = z$. If $y \in S_1$, there exists a relator in R_1 containing the cyclic subword y^2; in this case, denote by r this relator. If $y \in S_1^-$, there exists a relator in R_1 containing the cyclic subword y^{-2}. In this case, denote by r the inverse of this relator.

Then $\psi(r) \in R_2^*$, and hence, an element of R_2 contains a cyclic subword equal to either z^2 or z^{-2}. In either case, there is an edge between z^+ and z^- in the Whitehead graph, contradicting assumption. □

Corollary 4.1.0.3. *Suppose $G_1 = \langle S_1 \mid R_1 \rangle$ and $G_2 = \langle S_2 \mid R_2 \rangle$ satisfy the properties (i) - (v) of Proposition 4.1.0.1. If G_1 and G_2 are isomorphic, then there is an isomorphism from G_1 to G_2 taking S_1 bijectively either to S_2 or to S_2^{-1}.*

Proof. Suppose that G_1 and G_2 are isomorphic. By Theorem 3.2.0.1, there is an isomorphism $\psi : G_1 \to G_2$ taking S_1 injectively into $S_2^{\pm}$. Suppose that for some generators $x, y \in S_1$ we have $\psi(x) \in S_2$ and $\psi(y) \in S_2^{-1}$.

Since the Whitehead graph of $\langle S_1 \mid R_1 \rangle$ is complete bipartite, there exists a relator containing xy as a cyclic subword. Without loss of generality, suppose this relator is written $xyz_1z_2z_3$ with $z_1, z_2, z_3 \in S_1$. Then $\psi(x)\psi(y)\psi(z_1)\psi(z_2)\psi(z_3)$ is product of 5 letters in $S_2^{\pm}$ which is trivial in G_2.

Note that since G_2 admits a presentation in which every relator is positive of length 5, there exists a group homomorphism $\lambda : G_2 \to Z_5$ from G_2 to the cyclic group of order 5 which takes each generator of G_2 to the sole generator of Z_5. Then $\lambda(\psi(x)\psi(y)) = 0$ in Z_5. At the same time, $\lambda(\psi(x)\psi(y)\psi(z_1)\psi(z_2)\psi(z_3)) = 0$ in Z_5. This implies $\lambda(\psi(z_1)\psi(z_2)\psi(z_3)) = 0$ in Z_5. But this is impossible, since no sum of three integers in $\{1, -1\}$ is congruent to 0 modulo 5. □

In light of Corollaries 4.1.0.2 and 4.1.0.3, we use the following algorithm to determine which of the presentations found define isomorphic groups:

For the presentations satisfying properties (i) - (v) of Proposition 4.1.0.1:

(1) For each of the 71,424 presentations found, consider all 240 possible injections from the set $\{0, 1, \ldots, 4\}$ into either the set $\{0, 1, \ldots, 4\}$ or the set $\{5, 6, \ldots, 9\}$.

(2) This map induces a map on serial numbers. If the image of one serial number under this map can be matched to another serial number after reordering, cyclically permuting, and/or inverting its subsequences, we identify the groups they define to the same isomorphism class.

For the presentations satisfying properties (i) - (v) of Proposition 4.1.0.3:

(1) For each of the 21,156,862 presentations found, consider all 3840 possible functions from the set $\{0, 1, \ldots, 4\}$ into the set $\{0, 1, \ldots, 9\}$ such that if $x, y \in \{0, 1, \ldots, 4\}$ are distinct, their images in $\{0, 1, \ldots, 9\}$ are not congruent modulo 5.

(2) This map induces a map on serial numbers. If the image of one serial number under this map can be matched to another serial number after reordering, cyclically permuting, and/or inverting its subsequences, we identify the groups they define to the same isomorphism class.

After applying this algorithm, we obtain the following.

Theorem 4.1.0.1. *Of the 71,424 presentations satisfying properties (i) - (v) of Proposition 4.1.0.1, exactly 308 define groups that are distinct up to isomorphism.*

Of the 21,156,802 presentations satisfying properties (i) - (v') of Proposition 4.1.0.3, exactly 8,574 define groups that are distinct up to isomorphism.

Hence, there are exactly 8,882 torsion-free vertex-regular cocompact lattices of $I_{5,5}$.

The complete list of torsion-free vertex-regular cocompact lattices we have obtained, together with the source code used to construct and classify those lattices, can be found in the data set [28]. We direct the reader to the data set's README file for more details.

4.2. Properties of the Groups Found

In this section, we briefly list and explain some properties of the 8,882 groups found in Theorem 4.1.0.1. To avoid introducing a large amount of terminology which is beyond the scope of this thesis, we direct the reader to the given citations for definitions of the terms below.

We first consider the properties possessed not only by the torsion-free vertex-regular cocompact lattices of $I_{5,5}$, but by any cocompact lattice of any 2-dimensional hyperbolic building. All such lattices are word-hyperbolic, since they act properly discontinuously, cocompactly, by isometries on a 2-dimensional hyperbolic building, which is a CAT(-1) space. For an introduction to word-hyperbolicity of groups, see [6], Part III. As a consequence, the groups have no Baumslag-Solitar subgroups, and the groups are not simple. The groups have trivial center and trivial Frattini subgroup ([20]). Moreover, the groups do not split non-trivially as a graph product of groups, since they are torsion-free with no $\mathbb{Z}^2$ subgroups ([16]).

To any word-hyperbolic group, we can associate a compact metric space called the *hyperbolic boundary*. The topological properties of the boundary inform the algebraic properties of the group. For an introduction to the hyperbolic boundary and its connections to the associated group, see the 2002 survey paper written by N. Benakli and I. Kapovich ([2]). The boundary of any cocompact lattice of a 2-dimensional hyperbolic building is 1-dimensional and connected ([12], Corollary A.9). As a consequence, the group is non-elementary, and therefore SQ-universal ([11], [23]). The group is not virtually free, but it contains the free group on two generators as a subgroup, and hence is not virtually solvable and has exponential growth. If the group is torsion-free, it has geometric and cohomological dimension 2 ([3]).

For any torsion-free vertex-regular cocompact lattice of a 2-dimensional hyper-

bolic building, the presentation 2-complex of the associated scaffolded presentation is an Eilenberg-Maclane space for the lattice, because the universal cover of this complex is contractible. It follows that the group is aspherical. If in particular the building is $I_{p,np}$, the group has Euler characteristic $1 - np + n^2p \geq 1$, since the Eilenberg-Maclane space has one 0-cell, np 1-cells, and n^2p 2-cells. As a consequence, the group is not amenable, and it is not a virtual 3-manifold group ([24]).

Next, we consider the properties possessed by cocompact lattices of one of Bourdon's buildings $I_{p,q}$, not necessarily torsion-free or vertex-regular. The hyperbolic boundary of any such group is homeomorphic to the Menger curve, a 1-dimensional, connected, locally connected, compact topological space with no local cut points ([12], Main Theorem). Therefore, the group is not a virtual surface group, since the boundary is not a circle. The group does not split as a free product with amalgamation over a finite or cyclic subgroup of infinite index in both factors ([5]). The group does not split as an HNN-extension over a finite subgroup with infinite index in the base group ([10], [15], [17]). If the group is torsion-free, it is hence both Hopf and co-Hopf ([26], [27]).

In the special case of the torsion-free vertex-regular cocompact lattices of $I_{5,5}$, none of the groups has Kazhdan's property (T), since at least one of the groups has infinite abelianization. For an introduction to Kazhdan's property (T), see the 2008 survey paper written by B. Bekka, P. de la Harpe, and A. Valette ([1]).

4.3. Cyclically Presented Groups

Our technique produces the four serial numbers

(1) 00121-02332-03044-11343-14224

(2) 00121-02203-04114-13443-23324

(3) 00102-03133-04434-11214-22423

(4) 00123-02114-03422-04431-13324

corresponding to groups which are isomorphic, respectively, to the groups with serial numbers:

(1) 00131-11242-22303-33414-44020

(2) 00141-11202-22313-33424-44030

(3) 00102-11213-22324-33430-44041

(4) 00143-11204-22310-33421-44032

via the permutations $2 \leftrightarrow 3$, $2 \leftrightarrow 4$, $3 \leftrightarrow 4$, and $2 \leftrightarrow 4$.

These latter serial numbers correspond to positive *cyclic presentations*. These are presentations of the form

$$\langle x_0, \ldots, x_n \mid r, \theta(r), \theta^2(r), \ldots, \theta^n(r) \rangle$$

where $\theta : F(\{x_0, \ldots, x_n\}) \to F(\{x_0, \ldots, x_n\})$ is the group homomorphism defined by $\theta(x_i) = x_{i+1}$ for all $i = 0, \ldots, n$, indices modulo $n + 1$.

Thus, we have obtained four length five positive cyclic presentations defining pairwise non-isomorphic aspherical groups.

5. CONCLUSIONS

5.1. Discussion of the Results

We begin by remarking that the main results of this paper can be used to complete the classification of the groups produced in [18]. Each of the positive triangle presentations presented in [18] satisfies the small cancellation conditions $C(3)$-$T(6)$.

The most critical aspect of the proofs of Theorems 3.2.0.1 and, by extension, 3.2.0.2 was the Mostow rigidity of Fuchsian buildings, the most general class of 2-dimensional hyperbolic buildings for which Mostow rigidity is known to hold. If the reader encounters a building which is not Fuchsian, but is Mostow rigid and in which every edge of the building has equal length, the conclusions of these theorems will still be true.

Indeed, Theorem 3.2.0.1 will remain true even for Mostow rigid polygonal complexes which are not buildings and which are not hyperbolic. If the reader encounters this case, we encourage them to study the number of sides of the 2-cells and the girth of the link at each vertex to see if their groups possess presentations satisfying the $C(3)$-$T(6)$ or $C'(1/4)$-$T(4)$ properties, or other small cancellation properties yielding similar spelling theorems. If so, the reader will be able to apply Theorem 3.2.0.2 as well. However, we do not know if any such polygonal complexes exist.

5.2. Directions for Future Work

The authors Kangaslampi and Vdovina, together with L. Carbone, went on to produce groups with torsion acting simply transitively on the vertex set of simplicial 2-dimensional hyperbolic buildings ([8]). We are interested to see if this method can be adapted to produce groups with torsion acting simply transitively on the vertex set of

other hyperbolic buildings and, in particular, $I_{5,5}$. We are also interested to see if there is any generalization of Theorems 3.2.0.1 and 3.2.0.2 to the torsion-case, since our current proofs will not work in this situation, as the action on the building is no longer guaranteed to be free.

Since the groups we have found are hyperbolic, we are interested in methods which can be applied to these groups to study their residual finiteness. To this point, we have not found any technique or theorem which can be successfully adapted to our case.

Our groups also provide examples of hyperbolic groups whose boundary is nonempty and connected, i.e. they are one-ended. Thus, it may be worthwhile to investigate these groups for surface subgroups, in response to M. Gromov's famous open question: Does every one-ended hyperbolic group have a surface subgroup? A preliminary investigation was conducted by Kangaslampi and Vdovina in the case of a simplicial 2-dimensional hyperbolic building in [19].

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APPENDICES

A APPENDIX Groups Acting on $I_{5,5}$

In this section we give serial numbers for the complete set of pairwise non-isomorphic torsion-free vertex-regular cocompact lattices of $I_{5,5}$. Table 0.1 contains the presentations satisfying properties (i) - (v) of Proposition 4.1.0.1, and Table 0.2 contains the presentations satisfying properties (i) - (v') of Proposition 4.1.0.3. Groups in these tables are further subcategorized by their abelian invariants and the abelian invariants of their derived subgroups. In each case, we computed as many abelian invariants as was possible, stopping only when the derived subgroup stabilized or technological restrictions prevented further calculations.

Define $G_0 = G$ and let $G_n = [G_{n-1}, G_{n-1}]$ denote the nth derived subgroup. Denote by $H_i = G_i/G_{i+1}$ the abelianization of the nth derived subgroup.

$H_0 = Z_{25}, H_1 = 1$	
00102-03044-11213-14334-22324	00102-03044-11213-14334-22423
00102-03044-11312-14334-22324	00102-03044-11312-14334-22423
00102-03044-11214-13223-24334	00102-03044-11323-12422-14334
00102-03044-11233-13432-14224	00102-03044-11332-12343-14224
00102-03113-04234-12214-24433	00102-03113-04324-12214-23344
00102-03113-04234-12244-14332	00102-03113-04324-12334-14422
00102-03114-04133-12342-22443	00102-03114-04133-12432-22344
00102-03114-04413-12342-22433	00102-03114-04413-12432-22334
00102-03114-04133-12442-22343	00102-03114-04413-12332-22434
00102-03114-04233-12134-22443	00102-03114-04423-12134-22433
00102-03114-04233-12244-13432	00102-03114-04243-12344-13322
00102-03114-04323-12244-13342	00102-03114-04423-12434-13322
00102-03114-04243-12232-13344	00102-03114-04243-12322-13344
00102-03114-04323-12242-13344	00102-03114-04323-12422-13344
00102-03133-04234-11224-14432	00102-03133-04324-11422-12344
00102-03134-04233-11412-22443	00102-03144-04243-11334-12322

00102-03134-04233-11224-14432	00102-03144-04243-11322-12334
00102-03134-04233-11244-14322	00102-03134-04233-11432-12244
00102-03144-04243-11234-13322	00102-03134-04423-11224-14332
00102-03144-04233-11224-13432	00102-03144-04233-11322-12434
00102-03234-04413-11422-12433	00102-03134-04433-11224-14232
00102-03134-04433-11422-12324	00102-03234-04433-11224-13142
00102-03234-04433-11422-12413	00102-03134-04433-11232-14224
00102-03234-04433-11424-12213	00102-03143-04234-11332-12244
00112-02103-04224-13234-14433	00112-02103-04224-13344-14323
00112-02103-04234-13144-22433	00112-02103-04324-13144-22334
00112-02103-04234-13224-14433	00112-02103-04324-13344-14223
00112-02133-03224-04341-14423	00112-02133-03224-04431-14234
00112-02234-03143-04421-13324	00112-02234-03321-04413-14243
00112-02331-03224-04143-13442	00112-02331-03224-04413-14342
00112-02133-03234-04431-14224	00112-02233-03134-04241-14432
00112-02233-03134-04421-14324	00112-02233-03424-04431-13214
00112-02313-03441-04224-14332	00112-02213-03104-14334-23244
00112-02213-03234-04241-14433	00112-02231-03243-04214-13344
00112-02231-03443-04214-13324	00112-02213-03244-04331-14234
00112-02231-03244-04133-14342	00112-02231-03424-04133-14432
00112-02231-03044-13242-14334	00112-02231-03044-13424-14332
00112-02231-03044-13324-14342	00112-02231-03044-13342-14324
00112-02233-03141-04324-13442	00112-02233-03244-04131-14342
00112-02233-03424-04131-14432	00112-02313-03341-04224-14432
00112-02331-03413-04224-14432	00112-02234-03243-04421-13314
00112-02234-03321-04243-13144	00112-02331-03044-13224-14342
00112-02331-03044-13432-14224	00123-02114-03442-04331-13224
$H_0 = Z_{25}, H_1 = Z_2^4$	
00102-03144-04243-11332-12234	
$H_0 = Z_{25}, H_1 = Z_{11}^2$	
00123-02114-03422-04431-13324	00121-02203-04114-13443-23324

$H_0 = Z_{125}, H_1 = 1$	
00102-03044-11213-14224-23343	00102-03044-11312-14224-23343
00102-03044-11424-12232-13343	00102-03044-11424-12322-13343
$H_0 = Z_2 \times Z_{25}, H_1 = 1$	
00102-03044-11214-13243-22334	00102-03044-11334-12242-14323
00102-03044-11412-13423-22433	00102-03044-11224-13142-23343
00102-03044-11224-13343-14232	00102-03044-11422-12413-23433
00102-03044-11233-13214-22434	00103-02044-11223-13214-24334
00102-03044-11314-12342-22433	00102-03044-11334-12143-22324
00102-03044-11433-12134-22423	00102-03044-11413-12432-22334
00102-03044-11342-12314-22433	00102-03443-04114-12423-13322
00102-03113-04334-12244-14232	00102-03114-04433-12232-13424
00102-03114-04433-12322-13424	00102-03213-04244-11433-12234
00102-03224-04433-11213-14234	00102-03123-04134-11422-24433
00103-02412-04314-11332-22344	00102-03123-04334-11324-14422
00102-03213-04334-11244-14223	00102-03213-04114-12243-23344
00102-03244-04233-11343-12214	00102-03443-04224-11232-13314
00112-02321-03304-13144-22434	00112-02403-04421-13314-22343
$H_0 = Z_2 \times Z_{25}, H_1 = Z_3$	
00102-03144-04133-11232-22434	
$H_0 = Z_2 \times Z_{25}, H_1 = Z_7$	
00102-03044-11412-13243-22334	
$H_0 = Z_2 \times Z_{25}, H_1 = Z_{11}$	
00102-03044-11422-12324-13433	00102-03113-04124-14322-23344
$H_0 = Z_3 \times Z_{25}, H_1 = 1$	
00102-03113-04144-12342-22433	00102-03113-04414-12342-22433
00102-03223-04244-11433-12134	00102-03344-04143-11323-12242
00102-03113-04234-12144-22433	00102-03143-04224-11344-12332
00102-03114-04133-12232-24434	00102-03114-04413-12422-23433
00102-03133-04234-11214-22443	00102-03133-04234-11412-22443
00102-03133-04324-11214-22344	00102-03133-04344-11224-14232

00102-03134-04433-11412-22423	00102-03234-04433-11314-12422
00102-03143-04424-11234-13322	00102-03234-04413-11433-12422
00103-02124-04432-11314-22334	00102-03413-04324-11442-12233
$H_0 = Z_3 \times Z_{25}, H_1 = Z_2^2$	
00102-03114-04413-12242-23343	00102-03133-04324-11412-22344
$H_0 = Z_3 \times Z_{25}, H_1 = Z_2^4$	
00102-03134-04423-11412-22433	
$H_0 = Z_3 \times Z_{25}, H_1 = Z_{11}$	
00102-03114-04133-12232-24344	00102-03133-04344-11422-12324
$H_0 = Z_4 \times Z_{25}, H_1 = 1$	
00102-03044-11314-12332-22434	00102-03044-11434-12133-22324
$H_0 = Z_4 \times Z_{25}, H_1 = Z_5$	
00102-03044-11343-12332-14224	
$H_0 = Z_5^2, H_1 = Z_5, H_2 = 1$	
00102-03044-11233-13224-14342	00102-03044-11234-13322-14243
00102-03044-11423-12434-13322	00102-03304-11342-12244-14323
00102-03113-04244-12234-14332	00102-03113-04424-12234-14332
00102-03114-04413-12322-24334	00112-02103-04314-13324-22344
00112-02131-03324-04143-22344	
$H_0 = Z_5^2, H_1 = Z_5^5$	
00102-03044-11233-13424-14322	
$H_0 = Z_5^2, H_1 = Z_5 \times Z_{11}^2$	
00102-03044-11243-13322-14234	
$H_0 = Z_5^2, H_1 = Z_2^4 \times Z_5$	
00102-03113-04424-12334-14322	
$H_0 = Z_5^2, H_1 = Z_5 \times Z_{31}$	
00121-02203-04334-11324-14423	
$H_0 = Z_5 \times Z_{25}, H_1 = \mathbb{Z}^{20} \times Z_5^{17}$	
00121-02332-03044-11343-14224	
$H_0 = Z_7 \times Z_{25}, H_1 = 1$	
00102-03044-11214-13343-22324	00102-03044-11214-13433-22324

00102-03044-11314-12422-23343	00102-03044-11412-13343-22324
00102-03044-11412-13433-22324	00102-03113-04414-12242-23433
00102-03304-11312-14434-22324	
$H_0 = Z_7 \times Z_{25}, H_1 = Z_{29}$	
00102-03044-11214-13433-22423	
$H_0 = Z_{11} \times Z_{25}, H_1 = 1$	
00102-03133-04344-11214-22324	00102-03133-04434-11214-22324
00102-03233-04344-11413-12242	
$H_0 = Z_{11} \times Z_{25}, H_1 = Z_3^5 \times Z_{11}^4$	
00102-03133-04434-11214-22423	
$H_0 = Z_2^2 \times Z_{25}, H_1 = Z_4 \times Z_{191}$	
00102-03044-11242-13314-22343	
$H_0 = Z_2 \times Z_3 \times Z_{25}, H_1 = 1$	
00102-03044-11214-13233-22434	00102-03044-11412-13233-22434
00102-03113-04334-12232-14424	00102-03304-11343-12232-14424
00102-03113-04334-12144-22324	00102-03113-04434-12214-23324
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5$	
00102-03044-11213-14234-22433	00112-02421-03044-13223-14334
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5^3 \times Z_{11}^2$	
00102-03044-11312-14324-22334	
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5 \times Z_7 \times Z_{11}^2$	
00102-03213-04234-11433-12244	
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5 \times Z_{11}$	
00102-03123-04134-11442-22433	00112-02403-04421-13223-14334
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5 \times Z_{25} \times Z_{71}$	
00102-03044-11213-14324-22334	
$H_0 = Z_2 \times Z_5^2, H_1 = Z_5 \times Z_{281}$	
00102-03044-11312-14234-22433	
$H_0 = \mathbb{Z}$	
00102-03044-11223-13214-24334	00102-03044-11322-12314-24334
00102-03044-11232-13343-14224	00102-03044-11424-12213-23343

00102-03113-04214-12334-22443	00102-03113-04224-12344-14332
00102-03114-04213-12244-23433	00102-03124-04113-14422-23433
00102-03124-04233-11322-14344	00102-03114-04123-13322-24434
00102-03114-04123-13442-22433	00102-03214-04113-12443-22334
00102-03114-04213-12344-22433	00102-03224-04123-11433-13442
00102-03124-04133-11432-22344	00102-03144-04213-11234-22433
00102-03214-04233-11344-12243	00103-02344-04132-11422-12433
00102-03124-04143-11322-23344	00102-03124-04423-11322-14334
00102-03214-04233-11224-13443	00102-03414-04213-11223-24433
00102-03124-04323-11334-14422	00102-03124-04423-11434-13322
00102-03214-04243-11344-12233	00102-03214-04413-11233-22434
00103-02132-04334-11244-14223	00121-02422-03234-04133-11443
00112-02103-04334-13224-14423	00113-02334-03121-04432-14224
00112-02103-04314-13224-23344	00112-02104-03143-13224-23344
00112-02131-03244-04143-22334	00112-02104-03413-14233-22443
00112-02131-03304-14224-23443	00112-02133-03141-04224-23443
00112-02134-03041-14423-22433	00112-02134-03141-04423-22433
00112-02214-03443-04231-13324	00112-02314-03221-04433-13424
00112-02314-03443-04221-13324	00112-02214-03241-04433-13423
00112-02134-03231-04433-14224	00112-02313-03241-04334-14422
00112-02313-03344-04321-14224	00112-02431-03044-13322-14234
00112-02213-03244-04341-14233	00112-02213-03324-04431-14234
00112-02231-03324-04143-13442	00112-02343-03314-04221-13244
00112-02344-03143-04221-13324	00114-02441-03312-04223-13432
00112-02233-03214-04431-13424	00112-02233-03241-04314-13442
00112-02304-03221-13144-24334	00112-02403-04431-13214-22334
00121-02043-03314-11324-22344	00123-02144-03422-04311-13324
00112-02134-03041-14223-24433	
$H_0 = \mathbb{Z}^2$	
00112-02231-03414-04213-24433	00121-02243-03114-04132-23344
00112-02134-03241-04223-14433	00112-02234-03241-04213-14433

00112-02341-03144-04213-22433	00112-02213-03414-04431-23324
00114-02133-03231-04412-22434	00102-03044-11232-13314-22434
$H_0 = \mathbb{Z} \times Z_2$	
00102-03123-04214-11334-22443	00102-03044-11223-13324-14342
$H_0 = \mathbb{Z} \times Z_5$	
00102-03044-11223-13424-14332	00102-03044-11322-12433-14234
00103-02204-11433-12344-13242	00102-03044-11224-13323-14342
00102-03044-11422-12434-13323	00102-03123-04334-11322-14244
00203-01441-04324-11213-22334	00102-03044-11243-13214-22334
00102-03044-11324-12143-22334	00102-03044-11334-12423-14322
00102-03044-11432-12413-22334	00102-03304-11243-13214-22344
00104-02033-11223-13442-14324	00102-03114-04123-13422-24433
00103-02314-04332-11342-12244	00102-03114-04223-12134-24433
00102-03114-04433-12134-22324	00102-03213-04434-11224-14233
00102-03124-04433-11422-13234	00102-03214-04433-11223-13424
00102-03213-04334-11224-14423	00102-03443-04124-11322-14233
00112-02144-03241-04313-22334	00112-02314-03413-04421-22433
00113-02231-03214-04412-24334	00112-02213-03341-04314-23244
00112-02214-03431-04413-23324	00112-02321-03314-04413-22434
00134-02203-04331-11442-12324	00112-02231-03304-13244-14342
00112-02231-03304-13442-14324	00112-02241-03044-13342-14323
00112-02233-03104-13244-14342	00112-02233-03104-13442-14324
00112-02244-03413-04331-14232	00112-02213-03314-04241-23443
00112-02234-03041-13142-24433	00112-02234-03141-04433-13242
00112-02243-03104-13344-14232	00113-02321-03144-04122-24334
$H_0 = \mathbb{Z} \times Z_{25}$	
00102-03044-11224-13342-14323	00102-03044-11224-13432-14233
00102-03044-11422-12343-13324	00103-02044-11433-12324-13422
00102-03114-04433-12234-13242	00102-03114-04433-12342-13224
00102-03224-04433-11342-12314	

TABLE 0.1: Positively Presented Groups

$H_0 = Z_{64}, H_1 = Z_5$	
00102-03484-08679-11874-12289	00102-03484-08679-11874-37764
00102-03484-08679-12289-23669	00102-03484-08679-23669-37764
00102-03484-08769-11892-13779	00102-03484-08769-11892-22864
00102-03484-08769-13779-36674	00102-03484-08769-22864-36674
00102-03484-11874-12289-13542	00102-03484-11874-13542-37764
00102-03484-11892-12354-13779	00102-03484-11892-12354-22864
00102-03484-12289-13542-23669	00102-03484-12354-13779-36674
00102-03484-12354-22864-36674	00102-03484-13542-23669-37764
00102-03674-08489-11234-13779	00102-03674-08489-11234-22864
00102-03674-08489-13779-66987	00102-03674-08489-22864-66987
00102-03674-11234-13779-35439	00102-03674-11234-22864-35439
00102-03674-11379-12234-35484	00102-03674-11379-35484-69877
00102-03674-12234-28664-35484	00102-03674-13779-35439-66987
00102-03674-22864-35439-66987	00102-03674-28664-35484-69877
00102-03764-08489-11874-13422	00102-03764-08489-11874-67798
00102-03764-08489-13422-23669	00102-03764-08489-23669-67798
00102-03764-11342-18774-35484	00102-03764-11342-22369-35484
00102-03764-11874-13422-35439	00102-03764-11874-35439-67798
00102-03764-13422-23669-35439	00102-03764-18774-35484-66798
00102-03764-22369-35484-66798	00102-03764-23669-35439-67798
00102-03934-11289-13542-18774	00102-03934-11289-13542-22369
00102-03934-11379-12354-18922	00102-03934-11379-12354-36774
00102-03934-12354-18922-28664	00102-03934-12354-28664-36774
00102-03934-13542-18774-37664	00102-03934-13542-22369-37664
00102-11234-13779-18592-35439	00102-11234-18592-22864-35439
00102-11342-12859-18774-35484	00102-11342-12859-22369-35484
00102-11374-18542-35989-48776	00102-11379-12234-18592-35484
00102-11379-12354-18922-48598	00102-11379-12354-36774-48598
00102-12234-18592-28664-35484	00102-12354-13779-36674-39859
00102-12354-18922-28664-48598	00102-12354-22864-36674-39859

00102-12354-28664-36774-48598	00102-13542-18774-37664-48598
00102-13542-22369-37664-48598	00102-13542-23669-37764-39859
$H_0 = Z_{32}, H_1 = Z_5 \times Z_{25}$	
00121-02342-03774-08489-11364	00121-02342-03774-08489-18669
00121-02342-03774-08939-11364	00121-02342-03774-08939-18669
00121-02342-03774-11364-35439	00121-02342-03774-11364-35484
00121-02342-03774-18669-35439	00121-02342-03774-18669-35484
00121-02342-08489-11364-22859	00121-02342-08489-18669-22859
00121-02342-08939-11364-22859	00121-02342-08939-18669-22859
00121-02342-11364-22859-35439	00121-02342-11364-22859-35484
00121-02342-18669-22859-35439	00121-02342-18669-22859-35484
00121-03484-08779-11869-37574	00121-03484-08779-13664-37574
00121-03484-11869-22354-37574	00121-03484-13664-22354-37574
00121-03774-08489-11364-57987	00121-03774-08489-18669-57987
00121-03774-11364-35439-57987	00121-03774-11364-35484-57987
00121-03774-18669-35439-57987	00121-03774-18669-35484-57987
00121-03934-11869-22354-37574	00121-03934-13664-22354-37574
00121-11364-22859-35439-57987	00121-11364-22859-35484-57987
00121-13664-22354-37574-39859	00121-13664-22354-37574-48598
$H_0 = Z_{16}, H_1 = Z_{25}$	
00121-02342-03774-08439-11369	00121-02342-03774-08439-11864
00121-02342-03774-08439-13669	00121-02342-03774-08439-18664
00121-02342-03774-11369-35489	00121-02342-03774-11864-35489
00121-02342-03774-13669-35489	00121-02342-03774-18664-35489
00121-02342-08439-11369-22859	00121-02342-08439-11864-22859
00121-02342-08439-13669-22859	00121-02342-08439-18664-22859
00121-02342-11369-22859-35489	00121-02342-11864-22859-35489
00121-02342-13669-22859-35489	00121-02342-18664-22859-35489
00121-03489-08774-11364-37579	00121-03489-08774-11869-37579
00121-03489-08774-13664-37579	00121-03489-08774-18669-37579
00121-03489-11364-22359-37579	00121-03489-11869-22359-37579

00121-03489-13664-22359-37579	00121-03489-18669-22359-37579
00121-03774-11369-35489-57987	00121-03774-11864-35489-57987
00121-03774-13669-35489-57987	00121-03774-18664-35489-57987
00121-11364-22359-37579-39854	00121-11364-22854-35984-48757
00121-13664-22359-37579-39854	00121-13664-22854-35984-48757
$H_0 = Z_{16}, H_1 = Z_{17} \times Z_{25}$	
00121-02342-03774-08489-11369	00121-02342-03774-08489-18664
00121-02342-03774-08939-11864	00121-02342-03774-08939-13669
00121-02342-03774-11369-35439	00121-02342-03774-11864-35484
00121-02342-03774-13669-35484	00121-02342-03774-18664-35439
00121-02342-08489-11369-22859	00121-02342-08489-18664-22859
00121-02342-08939-11864-22859	00121-02342-08939-13669-22859
00121-02342-11369-22859-35439	00121-02342-11864-22859-35484
00121-02342-13669-22859-35484	00121-02342-18664-22859-35439
00121-03484-08779-11369-37574	00121-03484-08779-18664-37574
00121-03484-11369-22354-37574	00121-03484-18664-22354-37574
00121-03774-08489-11369-57987	00121-03774-08489-18664-57987
00121-03774-11369-35439-57987	00121-03774-11864-35484-57987
00121-03774-13669-35484-57987	00121-03774-18664-35439-57987
00121-03934-11864-22354-37574	00121-03934-13669-22354-37574
00121-11364-22359-34854-37579	00121-11364-22854-34359-48757
00121-13664-22854-35989-48757	00121-13669-22354-37574-48598
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00112-03484-08779-13692-37564	00112-03484-08779-18674-37564

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00112-03541-18489-28759-67798	00112-03541-18939-28759-67798
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00121-02034-08669-18939-22374	00121-02034-08669-18939-28779
00121-02034-08669-22374-36439	00121-02034-08669-22374-36484

00121-02034-08669-28779-36439	00121-02034-08669-28779-36484
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00102-03664-08769-28984-48677	00102-03664-08769-34379-48677
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00102-03664-12354-28984-48677	00102-03664-12354-34379-48677
00102-03664-13542-23989-37769	00102-03664-13542-34874-37769
00102-03674-08779-11284-48986	00102-03674-08779-37669-48986
00102-03674-11284-22354-48986	00102-03674-11354-28434-48776
00102-03674-11354-37989-48776	00102-03674-22354-37669-48986
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00102-03679-11289-13934-22359	00102-03679-11359-12234-28939
00102-03679-11359-12234-37484	00102-03679-13934-22359-37664
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00102-03764-08779-18434-48667	00102-03764-08779-36989-48667
00102-03764-11354-18422-48987	00102-03764-11354-36779-48987

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00102-03764-18434-22354-48667	00102-03764-22354-36989-48667
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00102-03774-11842-12354-13989	00102-03774-11842-12354-34864
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00121-02234-11864-28579-35484	00121-02234-11864-28579-35489
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00121-02034-08439-13669-22879	00121-02034-08439-13669-23774
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00121-03489-11869-22379-35759	00121-03489-11869-28774-35759
00121-03489-13664-22379-35759	00121-03489-13664-28774-35759
00121-03489-18669-22379-35759	00121-03489-18669-28774-35759

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00121-11369-22879-35489-57598	00121-11369-23774-35489-57598
00121-13664-22379-35759-39854	00121-13664-28774-35759-39854
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00112-02134-03541-22379-36439	00112-02134-03541-22874-36484
00112-02134-03541-23779-36484	00112-02134-03541-28774-36439
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00112-02134-03641-08939-22874	00112-02134-03641-08939-23779
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00112-02134-08569-23779-36484	00112-02134-08569-28774-36439
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00112-03754-13989-18774-35679	00112-03754-13989-22369-35679
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00121-03484-11874-13579-37754	00121-03484-13579-23669-37754
00121-03542-11864-23489-37759	00121-03542-11864-37759-39874

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00121-03579-18669-28439-59877	00121-03579-18669-37489-59877
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00121-13574-23664-34854-37759	00121-13754-23664-34359-48577
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00102-03484-08669-18779-37674	00102-03484-08669-22364-37674
00102-03484-08779-11374-12189	00102-03484-08779-11374-36764
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00102-03774-23664-35439-67698	00102-03774-23664-35484-67698
00102-03934-11354-12892-18779	00102-03934-11354-12892-22364

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00102-03934-11374-12189-22354	00102-03934-11374-22354-36764
00102-03934-12189-22354-28669	00102-03934-22354-28669-36764
00102-11354-12892-18779-39859	00102-11354-12892-18779-48598
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00102-12134-22859-23664-35439	00102-12134-22859-23664-35484
00102-22354-28669-36764-39859	00102-22354-28669-36764-48598
$H_0 = Z_5 \times Z_8, H_1 = Z_{25}^2 \times Z_{61} \times Z_{121}$	
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00102-03484-08779-12869-36674	00102-03484-08779-13764-36674
00102-03484-11892-12869-22354	00102-03484-11892-13764-22354
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00102-03664-12374-13422-35439	00102-03664-12374-35439-67798
00102-03664-13422-28769-35439	00102-03664-28769-35439-67798
00102-03774-11342-12364-35484	00102-03774-11342-18769-35484
00102-03774-12364-35484-66798	00102-03774-18769-35484-66798
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00102-03934-11354-18922-23764	00102-03934-11354-23764-36774
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00102-11354-12879-18922-48598	00102-11354-12879-36774-48598
00102-11354-18922-23764-48598	00102-11354-23764-36774-48598
00102-12364-22859-35484-66798	00102-13764-22354-36674-39859
$H_0 = Z_5 \times Z_8, H_1 = Z_{25}^2$	
00102-03484-08669-12289-18792	00102-03484-08669-12289-23674
00102-03484-08669-18792-37764	00102-03484-08669-23674-37764

00102-03484-11354-12289-18792	00102-03484-11354-12289-23674
00102-03484-11354-18792-37764	00102-03484-11354-23674-37764
00102-03664-12234-13742-35484	00102-03664-12234-28679-35484
00102-03664-13742-35484-69877	00102-03664-28679-35484-69877
00102-03774-08489-11234-13642	00102-03774-08489-11234-18679
00102-03774-08489-13642-66987	00102-03774-08489-18679-66987
00102-03774-11234-13642-35439	00102-03774-11234-18679-35439
00102-03774-13642-35439-66987	00102-03774-18679-35439-66987
00102-03934-11289-13674-22354	00102-03934-11289-18692-22354
00102-03934-13674-22354-37664	00102-03934-18692-22354-37664
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00102-11354-12289-18792-39859	00102-11354-12289-23674-39859
00102-11354-18792-37764-39859	00102-11354-23674-37764-39859
00102-13642-22859-35439-66987	00102-13674-22354-37664-48598
$H_0 = Z_5 \times Z_8, H_1 = Z_5 \times Z_{25}$	
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00102-03484-08779-11289-13674	00102-03484-08779-11289-18692
00102-03484-08779-13674-37664	00102-03484-08779-18692-37664
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00102-03664-28679-35439-69877	00102-03664-28769-35484-67798
00102-03774-08489-11342-12364	00102-03774-08489-11342-18769
00102-03774-08489-12364-66798	00102-03774-08489-18769-66798

00102-03774-11234-13642-35484	00102-03774-11234-18679-35484
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00102-03774-12364-35439-66798	00102-03774-13642-35484-66987
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00102-03934-11354-12289-18792	00102-03934-11354-12289-23674
00102-03934-11354-18792-37764	00102-03934-11354-23674-37764
00102-03934-11892-12869-22354	00102-03934-11892-13764-22354
00102-03934-12869-22354-36674	00102-03934-13764-22354-36674
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00102-12364-22859-35439-66798	00102-13642-22859-35484-66987
00102-13674-22354-37664-39859	00102-13764-22354-36674-48598
$H_0 = Z_5 \times Z_8, H_1 = Z_5$	
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00102-03664-08769-13922-28434	00102-03664-08769-13922-37989
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00102-03664-12354-13922-37989	00102-03664-12354-28434-48677
00102-03664-12354-37989-48677	00102-03664-13542-37769-48987
00102-03669-08674-12289-23934	00102-03669-08674-23934-37764
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00102-03674-11284-13989-22354	00102-03674-11284-22354-34864
00102-03674-11354-28984-48776	00102-03674-11354-34379-48776
00102-03674-13989-22354-37669	00102-03674-22354-34864-37669
00102-03679-11359-12234-28489	00102-03679-11359-12234-37439

00102-03764-08779-11392-18984	00102-03764-08779-11392-34369
00102-03764-08779-18984-48667	00102-03764-08779-34369-48667
00102-03764-11354-18422-23989	00102-03764-11354-18422-34874
00102-03764-11354-23989-36779	00102-03764-11354-34874-36779
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00102-03779-11234-13592-18939	00102-03779-11234-13592-36484
00102-03779-11892-12359-13934	00102-03779-12359-13934-36674
00102-11234-13592-18939-22854	00102-11234-13592-22854-36484
00102-11342-12854-18489-22359	00102-11342-12854-22359-36439
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00102-12354-22859-36679-48986	00102-12359-13934-22854-36674
00102-13484-18542-22359-37664	00102-13592-22854-36484-66987
$H_0 = Z_4 \times Z_{13}, H_1 = Z_5 \times Z_{51}$	
00121-02034-08779-11374-18489	00121-02034-08779-11374-18939
00121-02034-08779-11374-36439	00121-02034-08779-11374-36484
00121-02034-08779-18489-28669	00121-02034-08779-18939-28669
00121-02034-08779-28669-36439	00121-02034-08779-28669-36484
00121-02034-11374-18489-22354	00121-02034-11374-18939-22354
00121-02034-11374-22354-36439	00121-02034-11374-22354-36484
00121-02034-18489-22354-28669	00121-02034-18939-22354-28669
00121-02034-22354-28669-36439	00121-02034-22354-28669-36484
00121-03774-11879-13484-35754	00121-03774-11879-13934-35754
00121-03774-11879-35754-39869	00121-03774-11879-35754-48698
00121-03774-13484-23664-35754	00121-03774-13934-23664-35754
00121-03774-23664-35754-39869	00121-03774-23664-35754-48698

00121-11374-18489-22354-57598	00121-11374-18939-22354-57598
00121-11374-22354-36439-57598	00121-11374-22354-36484-57598
00121-13484-22859-23664-35754	00121-13934-22859-23664-35754
00121-22354-28669-36439-57598	00121-22354-28669-36484-57598
$H_0 = Z_4 \times Z_{11}, H_1 = Z_5 \times Z_5$	
00121-02342-03664-08489-13774	00121-02342-03664-08489-22869
00121-02342-03664-08939-13774	00121-02342-03664-08939-22869
00121-02342-03664-13774-35439	00121-02342-03664-13774-35484
00121-02342-03664-22869-35439	00121-02342-03664-22869-35484
00121-02342-08489-11859-13774	00121-02342-08489-11859-22869
00121-02342-08939-11859-13774	00121-02342-08939-11859-22869
00121-02342-11859-13774-35439	00121-02342-11859-13774-35484
00121-02342-11859-22869-35439	00121-02342-11859-22869-35484
00121-03484-08669-18779-37574	00121-03484-08669-22364-37574
00121-03484-11354-18779-37574	00121-03484-11354-22364-37574
00121-03664-08489-13774-57987	00121-03664-08489-22869-57987
00121-03664-13774-35439-57987	00121-03664-13774-35484-57987
00121-03664-22869-35439-57987	00121-03664-22869-35484-57987
00121-03934-11354-18779-37574	00121-03934-11354-22364-37574
00121-11354-18779-37574-39859	00121-11354-18779-37574-48598
00121-11354-22364-37574-39859	00121-11354-22364-37574-48598
$H_0 = Z_4 \times Z_{11}, H_1 = Z_5$	
00102-03484-08679-11289-18774	00102-03484-08679-11289-22369
00102-03484-08679-18774-37664	00102-03484-08679-22369-37664
00102-03484-08769-11379-18922	00102-03484-08769-11379-36774
00102-03484-08769-18922-28664	00102-03484-08769-28664-36774
00102-03484-11289-13542-18774	00102-03484-11289-13542-22369
00102-03484-11379-12354-18922	00102-03484-11379-12354-36774
00102-03484-12354-18922-28664	00102-03484-12354-28664-36774
00102-03484-13542-18774-37664	00102-03484-13542-22369-37664
00102-03674-08489-11379-12234	00102-03674-08489-11379-69877

00102-03674-08489-12234-28664	00102-03674-08489-28664-69877
00102-03674-11234-13779-35484	00102-03674-11234-22864-35484
00102-03674-11379-12234-35439	00102-03674-11379-35439-69877
00102-03674-12234-28664-35439	00102-03674-13779-35484-66987
00102-03674-22864-35484-66987	00102-03674-28664-35439-69877
00102-03764-08489-11342-18774	00102-03764-08489-11342-22369
00102-03764-08489-18774-66798	00102-03764-08489-22369-66798
00102-03764-11342-18774-35439	00102-03764-11342-22369-35439
00102-03764-11874-13422-35484	00102-03764-11874-35484-67798
00102-03764-13422-23669-35484	00102-03764-18774-35439-66798
00102-03764-22369-35439-66798	00102-03764-23669-35484-67798
00102-03934-11874-12289-13542	00102-03934-11874-13542-37764
00102-03934-11892-12354-13779	00102-03934-11892-12354-22864
00102-03934-12289-13542-23669	00102-03934-12354-13779-36674
00102-03934-12354-22864-36674	00102-03934-13542-23669-37764
00102-11234-13779-18592-35484	00102-11234-18592-22864-35484
00102-11342-12859-18774-35439	00102-11342-12859-22369-35439
00102-11374-12359-18422-34854	00102-11374-12359-34854-36779
00102-11374-18542-34359-48776	00102-11379-12234-18592-35439
00102-12234-18592-28664-35439	00102-12354-13779-36674-48598
00102-12354-18922-28664-39859	00102-12354-22864-36674-48598
00102-12354-28664-36774-39859	00102-13542-18774-37664-39859
00102-13542-22369-37664-39859	00102-13542-23669-37764-48598
$H_0 = Z_4 \times Z_9, H_1 = Z_5 \times Z_{25}$	
.00102-03484-08779-11364-12892	00102-03484-08779-11364-37674
00102-03484-08779-12892-18669	00102-03484-08779-18669-37674
00102-03484-11364-12892-22354	00102-03484-11364-22354-37674
00102-03484-12892-18669-22354	00102-03484-18669-22354-37674
00102-03664-08489-12134-22879	00102-03664-08489-12134-23774
00102-03664-08489-22879-67698	00102-03664-08489-23774-67698
00102-03664-12134-22879-35439	00102-03664-12134-23774-35439

00102-03664-22879-35439-67698	00102-03664-23774-35439-67698
00102-03774-11869-12342-35484	00102-03774-11869-35484-67987
00102-03774-12342-13664-35484	00102-03774-13664-35484-67987
00102-03934-11354-12189-22374	00102-03934-11354-12189-28779
00102-03934-11354-22374-36764	00102-03934-11354-28779-36764
00102-11354-12189-22374-48598	00102-11354-12189-28779-48598
00102-11354-22374-36764-48598	00102-11354-28779-36764-48598
00102-11364-12892-22354-39859	00102-11364-22354-37674-39859
00102-12342-13664-22859-35484	00102-13664-22859-35484-67987
$H_0 = Z_4 \times Z_9, H_1 = Z_5^3$	
00102-03484-08669-12189-22374	00102-03484-08669-12189-28779
00102-03484-08669-22374-36764	00102-03484-08669-28779-36764
00102-03484-11354-12189-22374	00102-03484-11354-12189-28779
00102-03484-11354-22374-36764	00102-03484-11354-28779-36764
00102-03664-12134-22879-35484	00102-03664-12134-23774-35484
00102-03664-22879-35484-67698	00102-03664-23774-35484-67698
00102-03774-08489-11869-12342	00102-03774-08489-11869-67987
00102-03774-08489-12342-13664	00102-03774-08489-13664-67987
00102-03774-11869-12342-35439	00102-03774-11869-35439-67987
00102-03774-12342-13664-35439	00102-03774-13664-35439-67987
00102-03934-11364-12892-22354	00102-03934-11364-22354-37674
00102-03934-12892-18669-22354	00102-03934-18669-22354-37674
00102-11354-12189-22374-39859	00102-11354-12189-28779-39859
00102-11354-22374-36764-39859	00102-11354-28779-36764-39859
00102-11364-12892-22354-48598	00102-11364-22354-37674-48598
00102-12342-13664-22859-35439	00102-13664-22859-35439-67987
$H_0 = Z_4 \times Z_9, H_1 = Z_2^4 \times Z_5$	
00121-02034-08489-11374-18779	00121-02034-08489-11374-22364
00121-02034-08489-18779-28669	00121-02034-08489-22364-28669
00121-02034-08939-11374-18779	00121-02034-08939-11374-22364
00121-02034-08939-18779-28669	00121-02034-08939-22364-28669

00121-02034-11374-18779-35439	00121-02034-11374-18779-35484
00121-02034-11374-22364-35439	00121-02034-11374-22364-35484
00121-02034-18779-28669-35439	00121-02034-18779-28669-35484
00121-02034-22364-28669-35439	00121-02034-22364-28669-35484
00121-03484-11879-13774-35754	00121-03484-11879-22869-35754
00121-03484-13774-23664-35754	00121-03484-22869-23664-35754
00121-03934-11879-13774-35754	00121-03934-11879-22869-35754
00121-03934-13774-23664-35754	00121-03934-22869-23664-35754
00121-11374-18779-35439-57598	00121-11374-18779-35484-57598
00121-11374-22364-35439-57598	00121-11374-22364-35484-57598
00121-13774-23664-35754-39859	00121-13774-23664-35754-48598
00121-22364-28669-35439-57598	00121-22364-28669-35484-57598
$H_0 = Z_4 \times Z_8, H_1 = \mathbb{Z}^3 \times Z_2^2 \times Z_4$	
00123-02468-07399-09281-11789	00123-02468-07399-09281-26643
00123-02468-07399-11789-37456	00123-02468-07399-26643-37456
00123-02468-09281-11789-25448	00123-02468-09281-25448-26643
00123-02468-11789-25448-37456	00123-02468-25448-26643-37456
00123-02634-07841-11473-37995	00123-02634-07841-29668-37995
00123-02634-11473-25693-37995	00123-02634-25693-29668-37995
00123-02814-04478-07931-11734	00123-02814-04478-07931-26698
00123-02814-04478-11734-25684	00123-02814-11734-25684-29953
00123-03467-04182-15997-17433	00123-03467-15997-17433-36957
00123-03467-15997-26889-36957	00123-04182-06244-17433-19852
00123-04182-15997-17433-19852	00123-04281-07344-11784-14753
00123-04281-11784-14753-25998	00123-04281-14753-25998-26693
00123-04362-15992-17334-24685	00123-04478-07931-26698-37596
00123-04478-11734-25684-37596	00123-06842-14882-18547-26445
00123-07344-11784-14753-37956	00123-14852-15447-17933-36457
00123-15442-17339-18457-29685	00124-02648-08829-23669-25634
$H_0 = Z_4 \times Z_5, H_1 = Z_5$	
00112-02234-03791-08489-13692	00112-02234-03791-08489-18674

00112-02234-03791-08939-13692	00112-02234-03791-08939-18674
00112-02234-03791-13692-35439	00112-02234-03791-13692-35484
00112-02234-03791-18674-35439	00112-02234-03791-18674-35484
00112-02234-08489-13692-28564	00112-02234-08489-18674-28564
00112-02234-08939-13692-28564	00112-02234-08939-18674-28564
00112-02234-13692-28564-35439	00112-02234-13692-28564-35484
00112-02234-18674-28564-35439	00112-02234-18674-28564-35484
00112-02354-03741-13989-18422	00112-02354-03741-13989-36779
00112-02354-03741-18422-34864	00112-02354-03741-18422-48986
00112-02354-03741-34864-36779	00112-02354-03741-36779-48986
00112-02354-13989-18422-28569	00112-02354-13989-28569-36779
00112-02354-18422-28569-34864	00112-02354-18422-28569-48986
00112-02354-28569-34864-36779	00112-02354-28569-36779-48986
00112-02359-03791-13934-18922	00112-02359-03791-13934-36774
00112-02359-13934-18922-28564	00112-02359-13934-28564-36774
00112-03484-08741-13679-37754	00112-03484-08741-18642-37754
00112-03484-13679-23569-37754	00112-03484-18642-23569-37754
00112-03741-08759-13989-18422	00112-03741-08759-13989-36779
00112-03741-08759-18422-34864	00112-03741-08759-18422-48986
00112-03741-08759-34864-36779	00112-03741-08759-36779-48986
00112-03754-08791-13922-18984	00112-03754-08791-18984-48677
00112-03754-13922-18434-23564	00112-03754-13922-18984-23564
00112-03754-13922-23564-34369	00112-03754-13922-23564-36989
00112-03754-18434-23564-48677	00112-03754-18984-23564-48677
00112-03754-23564-34369-48677	00112-03754-23564-36989-48677
00112-03791-08489-13692-59877	00112-03791-08489-18674-59877
00112-03791-13692-35439-59877	00112-03791-13692-35484-59877
00112-03791-18674-35439-59877	00112-03791-18674-35484-59877
00112-03934-13679-23569-37754	00112-03934-18642-23569-37754
00112-13674-23564-34854-37759	00112-13679-23569-37754-48598
00112-13692-28564-35439-59877	00112-13692-28564-35484-59877

00121-02034-08489-11864-22879	00121-02034-08489-11864-23774
00121-02034-08489-13669-22879	00121-02034-08489-13669-23774
00121-02034-08939-11369-22879	00121-02034-08939-11369-23774
00121-02034-08939-18664-22879	00121-02034-08939-18664-23774
00121-02034-11369-22879-35484	00121-02034-11369-23774-35484
00121-02034-11864-22879-35439	00121-02034-11864-23774-35439
00121-02034-13669-22879-35439	00121-02034-13669-23774-35439
00121-02034-18664-22879-35484	00121-02034-18664-23774-35484
00121-03484-11864-22374-35754	00121-03484-11864-28779-35754
00121-03484-13669-22374-35754	00121-03484-13669-28779-35754
00121-03934-11369-22374-35754	00121-03934-11369-28779-35754
00121-03934-18664-22374-35754	00121-03934-18664-28779-35754
00121-11369-22374-35754-48598	00121-11369-22879-35484-57598
00121-11369-23774-35484-57598	00121-11369-28779-35754-48598
00121-13664-22379-34854-35759	00121-13664-28774-34854-35759
00121-13669-22879-35439-57598	00121-13669-23774-35439-57598
$H_0 = Z_4^2, H_1 = \mathbb{Z} \times Z_2 \times Z_4^2$	
00123-02481-07319-11789-37445	00123-02481-07319-26643-37445
00123-02481-11789-25468-37445	00123-02481-25468-26643-37445
00123-02684-04478-07341-37966	00123-02684-04478-25698-37966
00123-02684-07341-29953-37966	00123-02684-25698-29953-37966
00123-02844-04781-07968-11734	00123-02844-04781-11734-14253
00123-02844-04781-14253-26698	00123-02844-07968-11734-29563
00123-02844-11734-14253-29563	00123-02844-14253-26698-29563
00123-03642-06299-14882-26845	00123-03642-14882-15447-26845
00123-03674-04462-06897-17334	00123-03674-04462-15243-17334
00123-03674-04462-15243-26988	00123-03674-15243-17334-19957
00123-03674-15243-19957-26988	00123-04462-06897-17334-18592
00123-04462-06897-18592-26988	00123-04462-15243-17334-18592
00123-04462-15243-18592-26988	00123-04781-07968-11734-37599
00123-04781-11734-14253-37599	00123-04781-14253-26698-37599

00123-07468-11739-24563-37544	00123-14253-26698-29563-37599
00123-14457-15293-17339-18542	00123-14457-15293-18542-26488
$H_0 = Z_4 \times Z_4, H_1 = \mathbb{Z} \times Z_2^2 \times Z_4^2$	
00123-02431-07399-09178-37466	00123-02431-07399-26453-37466
00123-02431-09178-25448-37466	00123-02431-25448-26453-37466
00123-02648-07899-09281-11973	00123-02648-07899-09281-24668
00123-02648-07899-11973-37456	00123-02648-07899-24668-37456
00123-02648-09281-11973-25443	00123-02648-09281-24668-25443
00123-02648-11973-25443-37456	00123-02648-24668-25443-37456
00123-02844-04268-07341-11478	00123-02844-04268-07341-29663
00123-02844-04268-11478-25698	00123-02844-04268-25698-29663
00123-02844-07341-17953-29663	00123-02844-17953-25698-29663
00123-03624-04467-06982-17433	00123-03624-04467-15734-17433
00123-03624-04467-15734-26889	00123-03624-06982-17433-19952
00123-03624-15734-17433-19952	00123-04268-07341-11478-37599
00123-04268-07341-29663-37599	00123-04268-11478-25698-37599
00123-04281-17534-25993-29668	00123-04467-06982-17433-18597
00123-04467-15734-17433-18597	00123-04467-15734-18597-26889
00123-07341-17953-29663-37599	00123-17534-25993-29668-37956
$H_0 = Z_4 \times Z_4, H_1 = \mathbb{Z}^2 \times Z_2^2 \times Z_{13}$	
00123-02431-07819-11739-37445	00123-02431-07819-26648-37445
00123-02431-11739-25463-37445	00123-02431-25463-26648-37445
00123-02468-07899-09281-11739	00123-02468-07899-11739-37456
00123-02468-09281-11739-25443	00123-02468-11739-25443-37456
00123-02684-07341-11478-37995	00123-02684-07341-29663-37995
00123-02684-11478-25698-37995	00123-02684-25698-29663-37995
00123-03142-06299-09367-17339	00123-03142-06299-09367-26488
00123-03142-06299-17339-18452	00123-03142-06299-18452-26488
00123-03142-09367-15447-17339	00123-03142-09367-15447-26488
00123-03142-15447-17339-18452	00123-03142-15447-18452-26488
00123-03624-04467-06892-17334	00123-03624-04467-15743-17334

00123-03624-04467-15743-26988	00123-03624-15743-17334-19952
00123-03624-15743-19952-26988	00123-04281-14753-25993-26698
00123-04367-15997-17334-46857	00123-04367-15997-26988-46857
00123-04467-06892-17334-18597	00123-04467-15743-17334-18597
00123-14452-15793-17339-18547	00123-14753-25993-26698-37956
$H_0 = Z_4, H_1 = Z_5$	
00112-02134-03569-18439-22379	00112-02134-03569-18439-22874
00112-02134-03569-18439-23779	00112-02134-03569-18439-28774
00112-02134-03569-18939-22374	00112-02134-03569-18939-28779
00112-02134-03569-22374-36484	00112-02134-03569-22379-36489
00112-02134-03569-22874-36489	00112-02134-03569-23779-36489
00112-02134-03569-28774-36489	00112-02134-03569-28779-36484
00112-02134-03691-08439-22379	00112-02134-03691-08439-22874
00112-02134-03691-08439-23779	00112-02134-03691-08439-28774
00112-02134-03691-08489-22374	00112-02134-03691-08489-28779
00112-02134-03691-22374-35439	00112-02134-03691-22379-35489
00112-02134-03691-22874-35489	00112-02134-03691-23779-35489
00112-02134-03691-28774-35489	00112-02134-03691-28779-35439
00112-02134-08439-18564-22379	00112-02134-08439-18564-22874
00112-02134-08439-18564-23779	00112-02134-08439-18564-28774
00112-02134-08489-18564-22374	00112-02134-08489-18564-28779
00112-02134-08541-18439-22379	00112-02134-08541-18439-22874
00112-02134-08541-18439-23779	00112-02134-08541-18439-28774
00112-02134-08541-18939-22374	00112-02134-08541-18939-28779
00112-02134-08541-22374-36484	00112-02134-08541-22379-36489
00112-02134-08541-22874-36489	00112-02134-08541-23779-36489
00112-02134-08541-28774-36489	00112-02134-08541-28779-36484
00112-02134-18564-22374-35439	00112-02134-18564-22379-35489
00112-02134-18564-22874-35489	00112-02134-18564-23779-35489
00112-02134-18564-28774-35489	00112-02134-18564-28779-35439
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00121-13664-22359-34854-37579	00121-13664-22854-34359-48757
$H_0 = Z_3 \times Z_{16}, H_1 = Z_5^2$	

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00121-02234-13669-28579-35439	00121-02234-18664-28579-35484
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00121-02374-03422-08939-11369	00121-02374-03422-08939-18664
00121-02374-03422-11369-35484	00121-02374-03422-11864-35439
00121-02374-03422-13669-35439	00121-02374-03422-18664-35484
00121-02374-08489-11864-57798	00121-02374-08489-13669-57798
00121-02374-08939-11369-57798	00121-02374-08939-18664-57798
00121-02374-11369-35484-57798	00121-02374-11864-35439-57798
00121-02374-13669-35439-57798	00121-02374-18664-35484-57798
00121-03422-08489-11864-28759	00121-03422-08489-13669-28759
00121-03422-08939-11369-28759	00121-03422-08939-18664-28759
00121-03422-11369-28759-35484	00121-03422-11864-28759-35439
00121-03422-13669-28759-35439	00121-03422-18664-28759-35484
00121-03484-08792-11864-37754	00121-03484-08792-13669-37754
00121-03484-11864-23574-37754	00121-03484-11864-23754-35774
00121-03484-13669-23574-37754	00121-03484-13669-23754-35774
00121-03742-08489-11864-59877	00121-03742-08489-13669-59877
00121-03742-11369-35484-59877	00121-03742-11864-35439-59877
00121-03742-13669-35439-59877	00121-03742-18664-35484-59877
00121-03934-11369-23574-37754	00121-03934-11369-23754-35774
00121-03934-18664-23574-37754	00121-03934-18664-23754-35774

00121-11364-28754-35989-48577	00121-11369-23574-37754-48598
00121-11369-23754-35774-48598	00121-11369-28579-35484-59877
00121-13664-23579-34854-37759	00121-13664-23759-34854-35779
00121-13664-28754-34359-48577	00121-13669-28579-35439-59877
$H_0 = Z_3 \times Z_8, H_1 = Z_5 \times Z_7 \times Z_{17}^2$	
00121-02034-08669-18489-22879	00121-02034-08669-18489-23774
00121-02034-08669-18939-22879	00121-02034-08669-18939-23774
00121-02034-08669-22879-36439	00121-02034-08669-22879-36484
00121-02034-08669-23774-36439	00121-02034-08669-23774-36484
00121-02034-11354-18489-22879	00121-02034-11354-18489-23774
00121-02034-11354-18939-22879	00121-02034-11354-18939-23774
00121-02034-11354-22879-36439	00121-02034-11354-22879-36484
00121-02034-11354-23774-36439	00121-02034-11354-23774-36484
00121-03664-13484-22374-35754	00121-03664-13484-28779-35754
00121-03664-13934-22374-35754	00121-03664-13934-28779-35754
00121-03664-22374-35754-39869	00121-03664-22374-35754-48698
00121-03664-28779-35754-39869	00121-03664-28779-35754-48698
00121-11354-18489-22879-57598	00121-11354-18489-23774-57598
00121-11354-18939-22879-57598	00121-11354-18939-23774-57598
00121-11354-22879-36439-57598	00121-11354-22879-36484-57598
00121-11354-23774-36439-57598	00121-11354-23774-36484-57598
$H_0 = Z_3 \times Z_8, H_1 = Z_5$	
00112-02234-03641-08939-13792	00112-02234-03641-08939-28674
00112-02234-03641-13792-35484	00112-02234-03641-28674-35484
00112-02234-03741-08489-13679	00112-02234-03741-08489-18642
00112-02234-03741-13679-35439	00112-02234-03741-18642-35439
00112-02234-08489-13679-28569	00112-02234-08489-18642-28569
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00112-02234-13679-28569-35439	00112-02234-13792-18569-35484
00112-02234-18569-28674-35484	00112-02234-18642-28569-35439
00112-02354-03791-13922-18434	00112-02354-03791-13922-36989

00112-02354-03791-18434-48677	00112-02354-03791-36989-48677
00112-02354-13922-18434-28564	00112-02354-13922-28564-36989
00112-02354-18434-28564-48677	00112-02354-28564-36989-48677
00112-02374-03569-18422-48986	00112-02374-03569-36779-48986
00112-02374-08541-18422-48986	00112-02374-08541-36779-48986
00112-02379-03564-13934-18922	00112-02379-03564-13934-36774
00112-02379-08591-13934-18922	00112-02379-08591-13934-36774
00112-03484-08691-18742-37754	00112-03484-08691-23679-37754
00112-03484-13564-18742-37754	00112-03484-13564-23679-37754
00112-03541-13422-18489-23759	00112-03541-13422-23759-36439
00112-03541-18489-23759-67798	00112-03541-23759-36439-67798
00112-03564-13934-18922-28754	00112-03564-13934-28754-36774
00112-03564-18922-28754-48698	00112-03564-28754-36774-48698
00112-03641-13792-35484-59877	00112-03641-28674-35484-59877
00112-03741-08489-13679-59877	00112-03741-08489-18642-59877
00112-03741-08754-13422-18939	00112-03741-08754-13422-36484
00112-03741-08754-18939-67798	00112-03741-08754-36484-67798
00112-03741-13679-35439-59877	00112-03741-18642-35439-59877
00112-03754-13989-18422-23569	00112-03754-13989-23569-36779
00112-03754-18422-23569-34864	00112-03754-23569-34864-36779
00112-03934-13692-23564-37754	00112-03934-18674-23564-37754
00112-13564-18742-37754-39859	00112-13564-23679-37754-39859
00112-13679-28569-35439-59877	00112-13692-23564-37754-48598
$H_0 = Z_3 \times Z_4, H_1 = Z_5 \times Z_{13}$	
00121-02034-08489-11369-22879	00121-02034-08489-11369-23774
00121-02034-08489-18664-22879	00121-02034-08489-18664-23774
00121-02034-08939-11864-22879	00121-02034-08939-11864-23774
00121-02034-08939-13669-22879	00121-02034-08939-13669-23774
00121-02034-11369-22879-35439	00121-02034-11369-23774-35439
00121-02034-11864-22879-35484	00121-02034-11864-23774-35484
00121-02034-13669-22879-35484	00121-02034-13669-23774-35484

00121-02034-18664-22879-35439	00121-02034-18664-23774-35439
00121-03484-11369-22374-35754	00121-03484-11369-28779-35754
00121-03484-18664-22374-35754	00121-03484-18664-28779-35754
00121-03934-11864-22374-35754	00121-03934-11864-28779-35754
00121-03934-13669-22374-35754	00121-03934-13669-28779-35754
00121-11364-22379-34854-35759	00121-11364-28774-34854-35759
00121-11369-22879-35439-57598	00121-11369-23774-35439-57598
00121-13669-22374-35754-48598	00121-13669-22879-35484-57598
00121-13669-23774-35484-57598	00121-13669-28779-35754-48598
$H_0 = Z_3 \times Z_4, H_1 = Z_5^2$	
00112-02234-03569-13792-18939	00112-02234-03569-13792-36484
00112-02234-03569-18939-28674	00112-02234-03569-28674-36484
00112-02234-08541-13792-18939	00112-02234-08541-13792-36484
00112-02234-08541-18939-28674	00112-02234-08541-28674-36484
00112-02374-08691-18422-48985	00112-02374-08691-36779-48985
00112-02374-13564-18422-48985	00112-02374-13564-36779-48985
00112-02379-03934-08641-18922	00112-02379-03934-08641-36774
00112-02379-03934-13569-18922	00112-02379-03934-13569-36774
00112-03541-13989-18792-37759	00112-03541-13989-23674-37759
00112-03541-18792-34864-37759	00112-03541-23674-34864-37759
00112-03569-13792-18939-59877	00112-03569-13792-36484-59877
00112-03569-18939-28674-59877	00112-03569-28674-36484-59877
00112-03641-08984-13922-23754	00112-03641-08984-23754-48677
00112-03641-13922-23754-34359	00112-03641-23754-34359-48677
00112-03934-13569-18922-28754	00112-03934-13569-28754-36774
00112-13422-18564-23759-35439	00112-13569-28754-36774-48598
$H_0 = Z_3 \times Z_4, H_1 = Z_5$	
00112-02134-03569-18939-22879	00112-02134-03569-18939-23774
00112-02134-03569-22879-36484	00112-02134-03569-23774-36484
00112-02134-03691-08489-22879	00112-02134-03691-08489-23774
00112-02134-03691-22879-35439	00112-02134-03691-23774-35439

00112-02134-08489-18564-22879	00112-02134-08489-18564-23774
00112-02134-08541-18939-22879	00112-02134-08541-18939-23774
00112-02134-08541-22879-36484	00112-02134-08541-23774-36484
00112-02134-18564-22879-35439	00112-02134-18564-23774-35439
00112-02234-03569-13792-18489	00112-02234-03569-13792-36439
00112-02234-03569-18489-28674	00112-02234-03569-28674-36439
00112-02234-03791-08439-13674	00112-02234-03791-08439-18692
00112-02234-03791-13674-35489	00112-02234-03791-18692-35489
00112-02234-08439-13674-28564	00112-02234-08439-18692-28564
00112-02234-08541-13792-18489	00112-02234-08541-13792-36439
00112-02234-08541-18489-28674	00112-02234-08541-28674-36439
00112-02234-13674-28564-35489	00112-02234-18692-28564-35489
00112-02354-03791-13984-18922	00112-02354-03791-13984-36774
00112-02354-03791-18922-34869	00112-02354-03791-34869-36774
00112-02354-13984-18922-28564	00112-02354-13984-28564-36774
00112-02354-18922-28564-34869	00112-02354-28564-34869-36774
00112-02374-03989-08691-18422	00112-02374-03989-08691-36779
00112-02374-03989-13564-18422	00112-02374-03989-13564-36779
00112-02374-08691-18422-34854	00112-02374-08691-34854-36779
00112-02374-13564-18422-34854	00112-02374-13564-34854-36779
00112-03484-08641-18922-28754	00112-03484-08641-28754-36774
00112-03484-13569-18922-28754	00112-03484-13569-28754-36774
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00112-03489-13692-23564-37759	00112-03489-18674-23564-37759
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00112-03541-18792-37759-48986	00112-03541-22379-34864-36759
00112-03541-23674-37759-48986	00112-03541-28774-34864-36759
00112-03569-13792-18489-59877	00112-03569-13792-36439-59877
00112-03569-18489-28674-59877	00112-03569-18939-22879-59867
00112-03569-18939-23774-59867	00112-03569-22879-36484-59867
00112-03569-23774-36484-59867	00112-03569-28674-36439-59877

00112-03591-13934-18742-37754	00112-03591-13934-23679-37754
00112-03641-13922-23754-35989	00112-03641-23754-35989-48677
00112-03691-08489-22879-59867	00112-03691-08489-23774-59867
00112-03691-22879-35439-59867	00112-03691-23774-35439-59867
00112-03741-08754-13489-18422	00112-03741-08754-13489-36779
00112-03741-08754-18422-39864	00112-03741-08754-36779-39864
00112-03754-13422-18439-23569	00112-03754-13422-23569-36489
00112-03754-18439-23569-67798	00112-03754-23569-36489-67798
00112-03791-13674-35489-59877	00112-03791-18692-35489-59877
00112-03934-13569-22374-36754	00112-03934-13569-28779-36754
00112-13422-18564-23759-35484	00112-13564-28759-34854-36779
00112-13569-22374-36754-48598	00112-13569-28779-36754-48598
00112-13642-23569-34859-37754	00112-13674-28564-35489-59877
00121-02034-08489-11364-22879	00121-02034-08489-11364-23774
00121-02034-08489-11879-13774	00121-02034-08489-11879-22869
00121-02034-08489-13774-23664	00121-02034-08489-18669-22879
00121-02034-08489-18669-23774	00121-02034-08489-22869-23664
00121-02034-08779-11369-28439	00121-02034-08779-11369-37489
00121-02034-08779-11864-28439	00121-02034-08779-11864-37489
00121-02034-08779-13669-28439	00121-02034-08779-13669-37489
00121-02034-08779-18664-28439	00121-02034-08779-18664-37489
00121-02034-08939-11364-22879	00121-02034-08939-11364-23774
00121-02034-08939-11879-13774	00121-02034-08939-11879-22869
00121-02034-08939-13774-23664	00121-02034-08939-18669-22879
00121-02034-08939-18669-23774	00121-02034-08939-22869-23664
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00121-02034-11364-23774-35439	00121-02034-11364-23774-35484
00121-02034-11369-22354-28439	00121-02034-11369-22354-37489
00121-02034-11864-22354-28439	00121-02034-11864-22354-37489
00121-02034-11879-13774-35439	00121-02034-11879-13774-35484
00121-02034-11879-22869-35439	00121-02034-11879-22869-35484

00121-02034-13669-22354-28439	00121-02034-13669-22354-37489
00121-02034-13774-23664-35439	00121-02034-13774-23664-35484
00121-02034-18664-22354-28439	00121-02034-18664-22354-37489
00121-02034-18669-22879-35439	00121-02034-18669-22879-35484
00121-02034-18669-23774-35439	00121-02034-18669-23774-35484
00121-02034-22869-23664-35439	00121-02034-22869-23664-35484
00121-03484-11374-18779-35754	00121-03484-11374-22364-35754
00121-03484-11869-22374-35754	00121-03484-11869-28779-35754
00121-03484-13664-22374-35754	00121-03484-13664-28779-35754
00121-03484-18779-28669-35754	00121-03484-22364-28669-35754
00121-03774-11369-23984-35754	00121-03774-11369-34879-35754
00121-03774-11864-23984-35754	00121-03774-11864-34879-35754
00121-03774-13669-23984-35754	00121-03774-13669-34879-35754
00121-03774-18664-23984-35754	00121-03774-18664-34879-35754
00121-03934-11374-18779-35754	00121-03934-11374-22364-35754
00121-03934-11869-22374-35754	00121-03934-11869-28779-35754
00121-03934-13664-22374-35754	00121-03934-13664-28779-35754
00121-03934-18779-28669-35754	00121-03934-22364-28669-35754
00121-11364-22854-23489-35759	00121-11364-22854-35759-39874
00121-11364-22879-35439-57598	00121-11364-22879-35484-57598
00121-11364-23774-35439-57598	00121-11364-23774-35484-57598
00121-11369-22354-28439-57598	00121-11369-22354-37489-57598
00121-11374-18779-35754-39859	00121-11374-18779-35754-48598
00121-11374-22364-35754-39859	00121-11374-22364-35754-48598
00121-13664-22374-35754-39859	00121-13664-22374-35754-48598
00121-13664-22854-23489-35759	00121-13664-22854-35759-39874
00121-13664-28779-35754-39859	00121-13664-28779-35754-48598
00121-13669-22354-28439-57598	00121-13669-22354-37489-57598
00121-13774-23664-35439-57598	00121-13774-23664-35484-57598
00121-22364-28669-35754-39859	00121-22364-28669-35754-48598
$H_0 = Z_3 \times Z_4, H_1 = Z_2^2 \times Z_5$	

00121-02034-08489-11864-22374	00121-02034-08489-11864-28779
00121-02034-08489-13669-22374	00121-02034-08489-13669-28779
00121-02034-08939-11369-22374	00121-02034-08939-11369-28779
00121-02034-08939-18664-22374	00121-02034-08939-18664-28779
00121-02034-11369-22374-35484	00121-02034-11369-28779-35484
00121-02034-11864-22374-35439	00121-02034-11864-28779-35439
00121-02034-13669-22374-35439	00121-02034-13669-28779-35439
00121-02034-18664-22374-35484	00121-02034-18664-28779-35484
00121-03484-11864-22879-35754	00121-03484-11864-23774-35754
00121-03484-13669-22879-35754	00121-03484-13669-23774-35754
00121-03934-11369-22879-35754	00121-03934-11369-23774-35754
00121-03934-18664-22879-35754	00121-03934-18664-23774-35754
00121-11369-22374-35484-57598	00121-11369-22879-35754-48598
00121-11369-23774-35754-48598	00121-11369-28779-35484-57598
00121-13664-22874-34854-35759	00121-13664-23779-34854-35759
00121-13669-22374-35439-57598	00121-13669-28779-35439-57598
$H_0 = Z_3 \times Z_4, H_1 = Z_2^4 \times Z_5$	
00121-02034-08489-11364-22374	00121-02034-08489-11364-28779
00121-02034-08489-18669-22374	00121-02034-08489-18669-28779
00121-02034-08939-11364-22374	00121-02034-08939-11364-28779
00121-02034-08939-18669-22374	00121-02034-08939-18669-28779
00121-02034-11364-22374-35439	00121-02034-11364-22374-35484
00121-02034-11364-28779-35439	00121-02034-11364-28779-35484
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00121-02034-18669-28779-35439	00121-02034-18669-28779-35484
00121-03484-11869-22879-35754	00121-03484-11869-23774-35754
00121-03484-13664-22879-35754	00121-03484-13664-23774-35754
00121-03934-11869-22879-35754	00121-03934-11869-23774-35754
00121-03934-13664-22879-35754	00121-03934-13664-23774-35754
00121-11364-22374-35439-57598	00121-11364-22374-35484-57598
00121-11364-28779-35439-57598	00121-11364-28779-35484-57598

00121-13664-22879-35754-39859	00121-13664-22879-35754-48598
00121-13664-23774-35754-39859	00121-13664-23774-35754-48598
$H_0 = Z_2 \times Z_{32}, H_1 = \mathbb{Z}$	
00121-02342-03774-08669-18489	00121-02342-03774-08669-18939
00121-02342-03774-08669-36439	00121-02342-03774-08669-36484
00121-02342-03774-11354-18489	00121-02342-03774-11354-18939
00121-02342-03774-11354-36439	00121-02342-03774-11354-36484
00121-02342-08669-18489-22859	00121-02342-08669-18939-22859
00121-02342-08669-22859-36439	00121-02342-08669-22859-36484
00121-02342-11354-18489-22859	00121-02342-11354-18939-22859
00121-02342-11354-22859-36439	00121-02342-11354-22859-36484
00121-03664-08779-13484-37574	00121-03664-08779-13934-37574
00121-03664-08779-37574-39869	00121-03664-08779-37574-48698
00121-03664-13484-22354-37574	00121-03664-13934-22354-37574
00121-03664-22354-37574-39869	00121-03664-22354-37574-48698
00121-03774-11354-18489-57987	00121-03774-11354-18939-57987
00121-03774-11354-36439-57987	00121-03774-11354-36484-57987
00121-11354-18489-22859-57987	00121-11354-18939-22859-57987
00121-11354-22859-36439-57987	00121-11354-22859-36484-57987
$H_0 = Z_2 \times Z_{27}, H_1 = Z_2^2 \times Z_5$	
00121-02034-08489-11874-13779	00121-02034-08489-11874-22864
00121-02034-08489-13779-23669	00121-02034-08489-22864-23669
00121-02034-08939-11379-18774	00121-02034-08939-11379-22369
00121-02034-08939-18774-28664	00121-02034-08939-22369-28664
00121-02034-11379-18774-35484	00121-02034-11379-22369-35484
00121-02034-11874-13779-35439	00121-02034-11874-22864-35439
00121-02034-13779-23669-35439	00121-02034-18774-28664-35484
00121-02034-22369-28664-35484	00121-02034-22864-23669-35439
00121-03484-11874-13779-35754	00121-03484-11874-22864-35754
00121-03484-13779-23669-35754	00121-03484-22864-23669-35754
00121-03934-11379-18774-35754	00121-03934-11379-22369-35754

00121-03934-18774-28664-35754	00121-03934-22369-28664-35754
00121-11379-18774-35484-57598	00121-11379-18774-35754-48598
00121-11379-22369-35484-57598	00121-11379-22369-35754-48598
00121-13774-23664-34854-35759	00121-13779-23669-35439-57598
00121-22369-28664-35484-57598	00121-22369-28664-35754-48598
$H_0 = Z_2 \times Z_{19}, H_1 = Z_{25}$	
00102-03484-08669-12289-18742	00102-03484-08669-12289-23679
00102-03484-08669-18742-37764	00102-03484-08669-23679-37764
00102-03484-08779-11892-12864	00102-03484-08779-11892-13769
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00102-03484-11354-12289-18742	00102-03484-11354-12289-23679
00102-03484-11354-18742-37764	00102-03484-11354-23679-37764
00102-03484-11892-12864-22354	00102-03484-11892-13769-22354
00102-03484-12864-22354-36674	00102-03484-13769-22354-36674
00102-03664-08489-12874-13422	00102-03664-08489-12874-67798
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00102-03664-13422-23769-35439	00102-03664-13792-35484-69877
00102-03664-23769-35439-67798	00102-03664-28674-35484-69877
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00102-03774-08489-13679-66987	00102-03774-08489-18642-66987
00102-03774-11234-13679-35439	00102-03774-11234-18642-35439
00102-03774-11342-12369-35484	00102-03774-11342-18764-35484
00102-03774-12369-35484-66798	00102-03774-13679-35439-66987
00102-03774-18642-35439-66987	00102-03774-18764-35484-66798
00102-03934-11289-13692-22354	00102-03934-11289-18674-22354
00102-03934-11354-12379-18922	00102-03934-11354-12379-36774
00102-03934-11354-18922-28764	00102-03934-11354-28764-36774
00102-03934-13692-22354-37664	00102-03934-18674-22354-37664
00102-11234-13679-22859-35439	00102-11234-18642-22859-35439

00102-11342-12369-22859-35484	00102-11342-18764-22859-35484
00102-11354-12289-18742-39859	00102-11354-12289-23679-39859
00102-11354-12379-18922-48598	00102-11354-12379-36774-48598
00102-11354-18742-37764-39859	00102-11354-18922-28764-48598
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00102-12364-22854-35989-48667	00102-13679-22859-35439-66987
00102-13692-22354-37664-48598	00102-13764-22359-34854-36679
$H_0 = Z_2 \times Z_{19}, H_1 = Z_5$	
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00121-02034-08669-18779-37439	00121-02034-08669-18779-37484
00121-02034-08669-22364-28489	00121-02034-08669-22364-28939
00121-02034-08669-22364-37439	00121-02034-08669-22364-37484
00121-02034-11354-18779-28489	00121-02034-11354-18779-28939
00121-02034-11354-18779-37439	00121-02034-11354-18779-37484
00121-02034-11354-22364-28489	00121-02034-11354-22364-28939
00121-02034-11354-22364-37439	00121-02034-11354-22364-37484
00121-03664-13774-23484-35754	00121-03664-13774-23934-35754
00121-03664-13774-35754-39879	00121-03664-13774-35754-48798
00121-03664-22869-23484-35754	00121-03664-22869-23934-35754
00121-03664-22869-35754-39879	00121-03664-22869-35754-48798
00121-11354-18779-28489-57598	00121-11354-18779-28939-57598
00121-11354-18779-37439-57598	00121-11354-18779-37484-57598
00121-11354-22364-28489-57598	00121-11354-22364-28939-57598
00121-11354-22364-37439-57598	00121-11354-22364-37484-57598
$H_0 = Z_2 \times Z_{16}, H_1 = \mathbb{Z} \times Z_2^2 \times Z_4$	
00123-02668-04281-07844-14734	00123-02668-04281-07844-29698
00123-02668-04281-14734-25993	00123-02668-04281-25993-29698
00123-02668-07844-14734-37956	00123-02668-07844-29698-37956
00123-02668-14734-25993-37956	00123-02668-24648-25443-37456
00123-02804-07341-11478-26844	00123-02804-07341-17993-29663
00123-02804-07341-26844-29663	00123-02804-11478-25698-26844

00123-02804-17993-25698-29663	00123-02804-25698-26844-29663
00123-03624-04467-06882-17434	00123-03624-04467-06882-26989
00123-03624-04467-15733-17434	00123-03624-04467-15733-26989
00123-03624-06882-17434-19952	00123-03624-15733-17434-19952
00123-04062-18892-19973-26985	00123-04134-07718-15293-37446
00123-04281-07844-11753-29698	00123-04281-11753-14734-25993
00123-04467-06882-17434-18597	00123-04467-06882-18597-26989
00123-04467-15733-18597-26989	00123-06377-14253-24436-45486
00123-06882-14452-17939-18547	00123-07341-17993-29663-37595
00123-07844-11753-29698-37956	00123-11753-14734-25993-37956
$H_0 = Z_2 \times Z_{16}, H_1 = \mathbb{Z}^2 \times Z_2$	
00123-02568-04734-11784-37996	00123-02568-04734-26693-37996
00123-02568-11784-29598-37996	00123-02568-24548-26643-37446
00123-02811-04078-14473-17984	00123-02811-04078-14473-26934
00123-02811-04078-26934-29968	00123-02811-04478-07934-26968
00123-02811-04478-25984-26968	00123-02811-24453-25489-26468
00123-03157-04174-19882-24436	00123-03157-14882-26454-29936
00123-03362-04067-17443-19824	00123-03362-04067-17443-34697
00123-03362-04067-19824-26899	00123-03362-04067-26899-34697
00123-03362-06744-24695-26898	00123-03362-14829-15452-26844
00123-03362-15452-17993-39647	00123-03362-15452-26844-39647
00123-04067-17443-18857-19824	00123-04067-17443-18857-34697
00123-04067-18857-19824-26899	00123-04067-18857-26899-34697
00123-04078-14473-26934-37566	00123-04078-26934-29968-37566
00123-04478-07934-14173-37566	00123-04478-14173-25984-37566
00123-07439-17319-24453-37566	00123-14173-25984-29953-37566
00123-14473-25953-26934-37566	00123-24468-25453-26439-37566
$H_0 = Z_2 \times Z_{16}, H_1 = \mathbb{Z}$	
00112-02341-03674-08939-13779	00112-02341-03674-08939-22864
00112-02341-03674-13779-35484	00112-02341-03674-22864-35484
00112-02341-08939-13779-18592	00112-02341-08939-18592-22864

00112-02341-13779-18592-35484	00112-02341-18592-22864-35484
00112-02364-03779-08921-13934	00112-02364-03779-08921-48698
00112-02364-03779-13934-35674	00112-02364-03779-35674-48698
00112-02364-08921-13934-22854	00112-02364-08921-22854-48698
00112-02364-13934-22854-35674	00112-02364-22854-35674-48698
00112-03421-08774-13754-18489	00112-03421-08774-13754-36439
00112-03421-13754-18489-22359	00112-03421-13754-22359-36439
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00112-03484-13542-18774-37564	00112-03484-13542-22369-37564
00112-03674-13779-35484-56987	00112-03674-22864-35484-56987
00112-03774-18754-35679-48986	00112-03779-13934-18759-35674
00112-13542-18774-37564-39859	00112-13542-22369-37564-39859
00112-13754-18489-22359-56798	00112-13754-22359-36439-56798
00121-02234-03742-08669-18489	00121-02234-03742-08669-18939
00121-02234-03742-08669-36439	00121-02234-03742-08669-36484
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00121-02234-08669-18489-28579	00121-02234-08669-18939-28579
00121-02234-08669-28579-36439	00121-02234-08669-28579-36484
00121-02234-11354-18489-28579	00121-02234-11354-18939-28579
00121-02234-11354-28579-36439	00121-02234-11354-28579-36484
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00121-02374-11354-36439-57798	00121-02374-11354-36484-57798
00121-03422-08669-18489-28759	00121-03422-08669-18939-28759
00121-03422-08669-28759-36439	00121-03422-08669-28759-36484

00121-03422-11354-18489-28759	00121-03422-11354-18939-28759
00121-03422-11354-28759-36439	00121-03422-11354-28759-36484
00121-03664-08792-13484-37754	00121-03664-08792-13934-37754
00121-03664-08792-37754-39869	00121-03664-08792-37754-48698
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00121-03664-13934-23574-37754	00121-03664-13934-23754-35774
00121-03664-23574-37754-39869	00121-03664-23574-37754-48698
00121-03664-23754-35774-39869	00121-03664-23754-35774-48698
00121-03742-11354-18489-59877	00121-03742-11354-18939-59877
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00121-11354-18489-28579-59877	00121-11354-18489-28759-57798
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00121-11354-28579-36439-59877	00121-11354-28579-36484-59877
00121-11354-28759-36439-57798	00121-11354-28759-36484-57798
$H_0 = Z_2 \times Z_{11}, H_1 = Z_5$	
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00102-03484-08669-22874-36764	00102-03484-08669-23779-36764
00102-03484-08779-11864-12892	00102-03484-08779-11864-37674
00102-03484-08779-12892-13669	00102-03484-08779-13669-37674
00102-03484-11354-12189-22874	00102-03484-11354-12189-23779
00102-03484-11354-22874-36764	00102-03484-11354-23779-36764
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00102-03664-08769-28934-48677	00102-03664-08769-37984-48677
00102-03664-12134-22379-35484	00102-03664-12134-22874-35439
00102-03664-12134-23779-35439	00102-03664-12134-28774-35484

00102-03664-12284-13542-23489	00102-03664-12284-13542-39874
00102-03664-12354-13922-28934	00102-03664-12354-13922-37984
00102-03664-12354-28934-48677	00102-03664-12354-37984-48677
00102-03664-13542-23489-37769	00102-03664-13542-37769-39874
00102-03664-22379-35484-67698	00102-03664-22874-35439-67698
00102-03664-23779-35439-67698	00102-03664-28774-35484-67698
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00102-03774-08489-11864-12342	00102-03774-08489-11864-67987
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00102-03774-13669-35439-67987	00102-03774-18664-35484-67987
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00102-03934-11354-12189-22379	00102-03934-11354-12189-28774
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00102-12354-13489-22859-36679	00102-12354-22859-36679-39864
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00112-02354-13922-18564-28984	00112-02354-13922-18564-34379

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00112-03541-18642-28939-59877	00112-03541-18642-37484-59877
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00112-03641-08754-28489-67798	00112-03641-08754-37439-67798
00112-03741-08754-13989-18422	00112-03741-08754-13989-36779
00112-03741-08754-18422-34864	00112-03741-08754-34864-36779
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00112-03759-13564-18922-23934	00112-03759-13564-23934-36774
00112-03791-08489-13674-59877	00112-03791-08489-18692-59877
00112-03791-13674-35439-59877	00112-03791-18692-35439-59877
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00121-02034-11354-22379-36439	00121-02034-11354-22874-36484
00121-02034-11354-23779-36484	00121-02034-11354-28774-36439
00121-02034-11369-22354-28489	00121-02034-11369-22354-37439

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00121-02034-13669-22354-28939	00121-02034-13669-22354-37484
00121-02034-18664-22354-28489	00121-02034-18664-22354-37439
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00121-02234-08939-11374-18579	00121-02234-08939-18579-28669
00121-02234-11374-18579-35439	00121-02234-11374-18579-35484
00121-02234-18579-28669-35439	00121-02234-18579-28669-35484
00121-02354-03922-11369-28984	00121-02354-03922-11369-34379
00121-02354-03922-18664-28984	00121-02354-03922-18664-34379
00121-02354-11369-28984-48577	00121-02354-11369-34379-48577
00121-02354-18664-28984-48577	00121-02354-18664-34379-48577
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00121-02364-03422-28669-35439	00121-02364-03422-28669-35484
00121-02364-08489-11374-57798	00121-02364-08489-28669-57798
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00121-03422-08754-11364-28489	00121-03422-08754-11364-37439
00121-03422-08754-18669-28489	00121-03422-08754-18669-37439
00121-03422-08939-11374-18759	00121-03422-08939-18759-28669

00121-03422-11374-18759-35439	00121-03422-11374-18759-35484
00121-03422-18759-28669-35439	00121-03422-18759-28669-35484
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00121-03484-11879-13574-37754	00121-03484-11879-13754-35774
00121-03484-13574-23664-37754	00121-03484-13754-23664-35774
00121-03542-11864-23989-37759	00121-03542-11864-34874-37759
00121-03542-13669-23989-37759	00121-03542-13669-34874-37759
00121-03579-11364-28939-59877	00121-03579-11364-37484-59877
00121-03579-18669-28939-59877	00121-03579-18669-37484-59877
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00121-03664-13934-22874-35754	00121-03664-13934-23779-35754
00121-03664-22379-35754-39869	00121-03664-22874-35754-48698
00121-03664-23779-35754-48698	00121-03664-28774-35754-39869
00121-03754-11864-35779-48987	00121-03754-13669-35779-48987
00121-03759-11869-23934-35774	00121-03759-13664-23934-35774
00121-03774-11369-23484-35754	00121-03774-11369-35754-39879
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00121-11354-18939-22874-57598	00121-11354-18939-23779-57598
00121-11354-22379-36439-57598	00121-11354-22874-36484-57598
00121-11354-23779-36484-57598	00121-11354-28774-36439-57598
00121-11364-22854-23989-35759	00121-11364-22854-34874-35759
00121-11369-22354-28489-57598	00121-11369-22354-37439-57598
00121-11374-18579-35439-59877	00121-11374-18579-35484-59877

00121-11374-18759-35439-57798	00121-11374-18759-35484-57798
00121-13574-23664-37754-39859	00121-13574-23664-37754-48598
00121-13664-22854-35759-48987	00121-13669-22354-28939-57598
00121-13669-22354-37484-57598	00121-13669-22859-23934-35754
00121-13754-23664-35774-39859	00121-13754-23664-35774-48598
$H_0 = Z_2 \times Z_9, H_1 = Z_{25}$	
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00121-02234-03792-11869-35439	00121-02234-03792-13664-35439
00121-02234-08489-11869-28574	00121-02234-08489-13664-28574
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00121-02374-03989-11369-35779	00121-02374-03989-18664-35779
00121-02374-08422-11369-34854	00121-02374-08422-18664-34854
00121-02374-11369-34854-35779	00121-02374-18664-34854-35779
00121-03422-08939-11869-23759	00121-03422-08939-13664-23759
00121-03422-11869-23759-35484	00121-03422-13664-23759-35484
00121-03484-11364-28754-35774	00121-03484-18669-28754-35774
00121-03792-08489-11869-59877	00121-03792-08489-13664-59877
00121-03792-11869-35439-59877	00121-03792-13664-35439-59877
00121-03934-11364-23579-37754	00121-03934-18669-23579-37754
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00121-13664-23759-35484-57798	00121-13664-28574-35439-59877
$H_0 = Z_2 \times Z_9, H_1 = Z_5 \times Z_{37}$	
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00102-03664-08679-28489-69877	00102-03664-08679-37439-69877
00102-03664-12234-13542-28489	00102-03664-12234-13542-37439
00102-03664-13542-28489-69877	00102-03664-13542-37439-69877
00102-03674-08779-11289-13484	00102-03674-08779-11289-39869
00102-03674-08779-13484-37664	00102-03674-08779-37664-39869
00102-03674-11289-13484-22354	00102-03674-11289-22354-39869
00102-03674-11354-12289-23934	00102-03674-11354-12289-48798

00102-03674-11354-23934-37764	00102-03674-11354-37764-48798
00102-03674-13484-22354-37664	00102-03674-22354-37664-39869
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00102-11234-13542-18939-22859	00102-11234-13542-22859-36484
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00102-13484-18592-22354-37664	00102-13542-22859-36484-66987
$H_0 = Z_2 \times Z_9, H_1 = Z_5 \times Z_7$	
00121-02034-08669-18489-22874	00121-02034-08669-18489-23779
00121-02034-08669-18939-22379	00121-02034-08669-18939-28774
00121-02034-08669-22379-36484	00121-02034-08669-22874-36439
00121-02034-08669-23779-36439	00121-02034-08669-28774-36484
00121-02034-11354-18489-22874	00121-02034-11354-18489-23779
00121-02034-11354-18939-22379	00121-02034-11354-18939-28774
00121-02034-11354-22379-36484	00121-02034-11354-22874-36439
00121-02034-11354-23779-36439	00121-02034-11354-28774-36484
00121-03664-13484-22874-35754	00121-03664-13484-23779-35754
00121-03664-13934-22379-35754	00121-03664-13934-28774-35754
00121-03664-22379-35754-48698	00121-03664-22874-35754-39869
00121-03664-23779-35754-39869	00121-03664-28774-35754-48698
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00121-11354-18939-22379-57598	00121-11354-18939-28774-57598
00121-11354-22379-36484-57598	00121-11354-22874-36439-57598
00121-11354-23779-36439-57598	00121-11354-28774-36484-57598
$H_0 = Z_2 \times Z_9, H_1 = Z_5$	
00102-03664-08679-12234-28939	00102-03664-08679-12234-37484
00102-03664-08679-28939-69877	00102-03664-08679-37484-69877
00102-03664-08769-13422-28489	00102-03664-08769-13422-28939
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00102-03664-08769-37439-67798	00102-03664-08769-37484-67798
00102-03664-12234-13542-28939	00102-03664-12234-13542-37484
00102-03664-12354-13422-28489	00102-03664-12354-13422-28939
00102-03664-12354-13422-37439	00102-03664-12354-13422-37484
00102-03664-12354-28489-67798	00102-03664-12354-28939-67798
00102-03664-12354-37439-67798	00102-03664-12354-37484-67798
00102-03664-13542-28939-69877	00102-03664-13542-37484-69877
00102-03674-08779-11289-13934	00102-03674-08779-11289-48698
00102-03674-08779-13934-37664	00102-03674-08779-37664-48698
00102-03674-11289-13934-22354	00102-03674-11289-22354-48698
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00102-03764-08779-36674-39869	00102-03764-08779-36674-48698
00102-03764-11354-18922-23484	00102-03764-11354-18922-23934
00102-03764-11354-18922-39879	00102-03764-11354-18922-48798
00102-03764-11354-23484-36774	00102-03764-11354-23934-36774
00102-03764-11354-36774-39879	00102-03764-11354-36774-48798
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00102-03774-11342-12354-36439	00102-03774-11342-12354-36484
00102-03774-12354-18489-66798	00102-03774-12354-18939-66798
00102-03774-12354-36439-66798	00102-03774-12354-36484-66798
00102-03774-13542-18489-66987	00102-03774-13542-36439-66987

00102-11234-13542-18489-22859	00102-11234-13542-22859-36439
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00102-11342-12354-22859-36439	00102-11342-12354-22859-36484
00102-11354-12289-18592-23484	00102-11354-12289-18592-39879
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00102-13542-18489-22859-66987	00102-13542-22859-36439-66987
00112-02234-03541-13792-18489	00112-02234-03541-13792-36439
00112-02234-03541-18489-28674	00112-02234-03541-28674-36439
00112-02234-03569-13742-18939	00112-02234-03569-13742-36484
00112-02234-03569-18939-28679	00112-02234-03569-28679-36484
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00112-02234-08569-18489-28674	00112-02234-08569-28674-36439
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00112-02374-03691-13422-35439	00112-02374-03691-35439-67798
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00112-02374-08489-13422-18564	00112-02374-08489-18564-67798
00112-02374-08641-18422-34854	00112-02374-08641-34854-36779
00112-02374-13422-18564-35439	00112-02374-13569-18422-34854
00112-02374-13569-34854-36779	00112-02374-18564-35439-67798
00112-03484-08691-18922-28754	00112-03484-08691-28754-36774
00112-03484-13564-18922-28754	00112-03484-13564-28754-36774
00112-03541-13792-18489-59877	00112-03541-13792-36439-59877

00112-03541-13989-18742-37759	00112-03541-13989-23679-37759
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00112-03541-23679-34864-37759	00112-03541-28674-36439-59877
00112-03564-13934-18742-37754	00112-03564-13934-23679-37754
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00112-03569-18939-28679-59877	00112-03569-28679-36484-59877
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00112-03641-13422-23759-35484	00112-03641-13922-28754-34359
00112-03641-23759-35484-67798	00112-03641-28754-34359-48677
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00121-02354-13664-28984-48577	00121-02354-13664-34379-48577
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00121-03579-11369-28939-59877	00121-03579-11369-37484-59877
$H_0 = Z_2 \times Z_9, H_1 = Z_2^2 \times Z_5$	
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00121-02034-08439-11874-13779	00121-02034-08439-11874-22864
00121-02034-08439-13779-23669	00121-02034-08439-18774-28664
00121-02034-08439-22369-28664	00121-02034-08439-22864-23669

00121-02034-08489-11864-22874	00121-02034-08489-11864-23779
00121-02034-08489-13669-22874	00121-02034-08489-13669-23779
00121-02034-08939-11369-22379	00121-02034-08939-11369-28774
00121-02034-08939-18664-22379	00121-02034-08939-18664-28774
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00121-02034-18664-28774-35484	00121-02034-18774-28664-35489
00121-02034-22369-28664-35489	00121-02034-22864-23669-35489
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00121-13669-22874-35439-57598	00121-13669-23779-35439-57598
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$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z} \times Z_2 \times Z_5^3$	
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00123-02811-04178-25968-29344	00123-02811-04178-25968-29844

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00123-02811-24899-25468-26453	00123-02811-25468-26453-39744
00123-02814-04178-07311-29344	00123-02814-04178-07311-29984
00123-02814-04178-25668-29344	00123-02814-04178-25668-29984
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00123-03362-06734-24469-26895	00123-03362-06734-26895-46997
00123-04178-07314-29344-37566	00123-04178-07314-29844-37566
00123-04178-07314-34799-37566	00123-04178-07314-37566-47998
00123-04178-25668-29344-37596	00123-04178-25668-29984-37596
00123-04178-25668-34479-37596	00123-04178-25668-37596-47998
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00123-07311-24489-26453-37546	00123-07311-26453-37546-39974
00123-07314-26953-29344-37566	00123-07314-26953-29844-37566
00123-07314-26953-34799-37566	00123-07314-26953-37566-47998
00123-24899-25468-26453-37566	00123-25468-26453-37566-39744
00123-25468-26453-37566-44897	00123-25968-26953-29344-37566
00134-04463-06847-07418-22876	00134-04463-15293-22876-25369
00152-03624-04673-12344-17433	00152-03624-12344-17433-19582
00152-03674-12433-17344-19587	00152-12344-17433-18597-19582
00153-02184-04682-13244-22634	00153-02184-04682-17998-69778
00153-02184-17998-19573-69778	00153-02684-19778-36957-67998
00153-13244-19573-22634-36759	00153-14778-17543-36457-44867
$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z} \times Z_2 \times Z_4$	

00112-02134-03779-08741-18439	00112-02134-03779-08741-36489
00112-02134-03779-18439-23569	00112-02134-03779-23569-36489
00112-02134-03791-08439-18774	00112-02134-03791-08439-22369
00112-02134-03791-18774-35489	00112-02134-03791-22369-35489
00112-02134-08439-18774-28564	00112-02134-08439-22369-28564
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00112-03489-13774-23564-36759	00112-03489-22869-23564-36759
00112-03741-08779-13489-36759	00112-03741-08779-36759-39864
00112-03741-13489-22354-36759	00112-03741-22354-36759-39864
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00112-03791-18774-35489-59867	00112-03791-22369-35489-59867
00112-13489-22354-28569-36759	00112-13774-23564-36759-39854
00112-22354-28569-36759-39864	00112-22369-28564-35489-59867
$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z} \times Z_2 \times Z_3^4 \times Z_5$	
00123-02804-07311-14178-29344	00123-02804-07311-14178-29984
00123-02804-07311-26963-29344	00123-02804-07311-26963-29984
00123-02804-07311-26963-34479	00123-02804-07311-26963-47998
00123-02804-14178-25668-29344	00123-02804-14178-25668-29984
00123-02804-14178-25668-34479	00123-02804-14178-25668-47998
00123-02804-25668-26963-29344	00123-02804-25668-26963-29984
00123-02804-25668-26963-34479	00123-02804-25668-26963-47998
00123-04062-19244-26885-34367	00123-04062-19744-26885-34367
00123-04062-24699-26885-34367	00123-04062-26885-34367-46997
00123-07311-24489-26463-37545	00123-07311-26463-37545-39974
00123-14178-25668-29344-37595	00123-14178-25668-29984-37595
00123-14178-25668-34479-37595	00123-14178-25668-37595-47998
00152-03623-04674-12433-17344	00152-03623-12433-17344-19592
00152-03673-12344-17433-19597	00152-12344-17433-18582-19597

00153-02182-04684-17998-69778	00153-02182-17998-19593-69778
00153-02682-14778-36454-44867	00153-14778-17573-36454-44867
$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z} \times Z_2$	
00112-02341-03779-08674-18439	00112-02341-03779-08674-36489
00112-02341-03779-13592-18439	00112-02341-03779-13592-36489
00112-02341-08674-18439-22854	00112-02341-08674-22854-36489
00112-02341-13592-18439-22854	00112-02341-13592-22854-36489
00112-02364-03489-08421-13774	00112-02364-03489-08421-22869
00112-02364-03489-13774-35679	00112-02364-03489-22869-35679
00112-02364-08421-13774-39854	00112-02364-08421-22869-39854
00112-02364-13774-35679-39854	00112-02364-22869-35679-39854
00112-03421-08439-13759-18774	00112-03421-08439-13759-22369
00112-03421-13759-18774-35489	00112-03421-13759-22369-35489
00112-03489-13774-18759-35679	00112-03489-18759-22869-35679
00112-03674-08779-13489-37569	00112-03674-08779-37569-39864
00112-03674-13489-22354-37569	00112-03674-22354-37569-39864
00112-03774-13542-18934-48756	00112-03774-13542-36984-48756
00112-13489-18592-22354-37569	00112-13542-22859-36984-48756
00112-13754-18779-35984-48567	00112-13754-22364-35984-48567
00123-02489-07311-09178-37446	00123-02489-07311-26453-37446
00123-02489-09178-25668-37446	00123-02489-25668-26453-37446
00123-02534-04281-11784-14473	00123-02534-04281-11784-29968
00123-02534-04281-14473-26693	00123-02534-04281-26693-29968
00123-02534-11784-14473-37956	00123-02534-11784-29968-37956
00123-02534-14473-26693-37956	00123-02534-26693-29968-37956
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00123-02814-17984-25668-29953	00123-03624-04152-17443-19882
00123-03624-04152-19882-26899	00123-03624-06957-17443-19882
00123-03624-06957-19882-26899	00123-04152-17443-18597-19882
00123-04152-17443-18597-33467	00123-04152-18597-19882-26899

00123-04152-18597-26899-33467	00123-04281-07598-11784-14473
00123-04281-07598-14473-26693	00123-04362-15992-26885-34697
00123-04478-07311-26934-37596	00123-04478-25668-26934-37596
00123-06457-14882-18547-26844	00123-07548-11789-19973-37456
$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z}^2 \times Z_2^2 \times Z_4$	
00123-02534-04731-11784-37996	00123-02534-04731-26693-37996
00123-02534-11784-29568-37996	00123-02534-26693-29568-37996
00123-02811-04178-07934-14473	00123-02811-04178-07934-29968
00123-02811-04178-14473-25984	00123-02811-04478-17984-25968
00123-02811-04478-25968-26934	00123-02811-07439-24468-26453
00123-03174-04152-19882-24436	00123-03174-06957-19882-24436
00123-03362-06734-17443-24695	00123-03362-06734-24695-26899
00123-03362-06744-26895-34697	00123-03362-15442-26845-39647
00123-04178-07934-29968-37566	00123-04478-07314-17984-37566
00123-04478-07314-26934-37566	00123-04478-17984-25968-37566
00123-04478-25968-26934-37566	00123-06457-14882-26854-29936
00123-06734-17443-18857-24695	00123-07314-17984-29953-37566
00123-07314-26934-29953-37566	00123-07439-19973-26453-37566
00123-07439-24468-26453-37566	00123-24453-25468-26439-37566
00124-02548-08741-11798-18829	00124-07539-11798-18829-23569
00132-02184-04153-17998-19773	00132-06458-14773-17448-36754
$H_0 = Z_2 \times Z_8, H_1 = \mathbb{Z}$	
00112-02341-03674-08489-13779	00112-02341-03674-08489-22864
00112-02341-03674-13779-35439	00112-02341-03674-22864-35439
00112-02341-08489-13779-18592	00112-02341-08489-18592-22864
00112-02341-13779-18592-35439	00112-02341-18592-22864-35439
00112-02364-03779-08921-13484	00112-02364-03779-08921-39869
00112-02364-03779-13484-35674	00112-02364-03779-35674-39869
00112-02364-08921-13484-22854	00112-02364-08921-22854-39869
00112-02364-13484-22854-35674	00112-02364-22854-35674-39869
00112-03421-08774-13754-18939	00112-03421-08774-13754-36484

00112-03421-13754-18939-22359	00112-03421-13754-22359-36484
00112-03674-08489-13779-56987	00112-03674-08489-22864-56987
00112-03674-13779-35439-56987	00112-03674-22864-35439-56987
00112-03774-13989-18754-35679	00112-03774-18754-34864-35679
00112-03934-13542-18774-37564	00112-03934-13542-22369-37564
00112-13484-18759-22854-35674	00112-13542-18774-37564-48598
00112-13542-22369-37564-48598	00112-13754-22359-36484-56798
00123-02648-07899-09731-37466	00123-02648-07899-24568-37466
00123-02648-09731-25443-37466	00123-02648-24568-25443-37466
00123-02668-04281-07344-14784	00123-02668-04281-07344-29693
00123-02668-04281-14784-25998	00123-02668-04281-25998-29693
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00123-02668-04284-14478-25698	00123-02668-04284-25698-29963
00123-02668-07341-14478-37959	00123-02668-07341-29963-37959
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00123-02804-07311-14784-17998	00123-02804-07311-14784-26344
00123-02804-07311-17998-29693	00123-02804-07311-26344-29693
00123-02804-07341-11793-14478	00123-02804-07341-14478-26684
00123-02804-07341-26684-29963	00123-02804-07841-11473-26344
00123-02804-07841-17998-29668	00123-02804-07841-26344-29668
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00123-02804-14478-25698-26684	00123-02804-14784-17998-25668
00123-02804-14784-25668-26344	00123-02804-17998-25668-29693
00123-02804-17998-25693-29668	00123-02804-25668-26344-29693
00123-02804-25693-26344-29668	00123-02804-25698-26684-29963
00123-02814-04478-07341-11793	00123-02814-04478-07341-26684
00123-02814-04478-11793-25698	00123-02814-04478-25698-26684
00123-02814-07341-11793-29953	00123-02814-07341-26684-29953
00123-02814-11793-25698-29953	00123-02814-25698-26684-29953

00123-02841-04268-07344-11478	00123-02841-04268-07344-29663
00123-02841-04268-11478-25998	00123-02841-04268-25998-29663
00123-02841-07344-11478-17953	00123-02841-07344-17953-29663
00123-02841-17953-25998-29663	00123-02844-04178-07981-29668
00123-02844-04178-25634-29668	00123-02844-07981-11473-26953
00123-02844-07981-26953-29668	00123-02844-11473-25634-26953
00123-02844-25634-26953-29668	00123-03174-04467-06982-24336
00123-03174-04467-15734-24336	00123-03174-06982-19952-24336
00123-03174-15734-19952-24336	00123-03467-04062-17433-18244
00123-03467-04062-17433-36997	00123-03467-04062-26889-36997
00123-03467-15957-17433-18244	00123-03467-15957-17433-36997
00123-03467-15957-26889-36997	00123-03624-06992-19882-26895
00123-03624-15744-19882-26895	00123-03647-09962-15482-17933
00123-04062-17433-18244-19852	00123-04062-17433-19852-36997
00123-04062-18244-19892-26885	00123-04062-18244-26885-34674
00123-04062-18992-19733-26985	00123-04062-18992-24688-26985
00123-04062-19733-26985-36744	00123-04062-19852-26889-36997
00123-04062-19892-26885-36997	00123-04062-26885-34674-36997
00123-04178-07981-29668-37599	00123-04178-25634-29668-37599
00123-04268-07344-29663-37569	00123-04268-11478-25998-37569
00123-04281-07314-11784-34475	00123-04281-07314-26693-34475
00123-04281-07344-11753-29693	00123-04281-11753-14784-25998
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00123-04284-07311-26963-34475	00123-04284-07341-11753-14478
00123-04284-07341-11753-29963	00123-04284-11753-25698-29963
00123-04284-14178-25668-34475	00123-04362-06744-24688-26985
00123-04362-15992-19733-26985	00123-04362-15992-24688-26985
00123-04462-15982-17433-18524	00123-04478-07341-11793-37596
00123-04478-07341-26684-37596	00123-04478-11793-25698-37596
00123-04478-25698-26684-37596	00123-04624-06882-18992-26985
00123-04624-06992-26885-34367	00123-04624-15733-18992-26985

00123-04624-15744-26885-34367	00123-04634-06847-07718-28699
00123-04634-07718-15293-28699	00123-04634-15253-22936-28699
00123-06344-07718-19293-28695	00123-06442-14547-26885-36739
00123-06734-17433-18524-19957	00123-06744-18957-19733-26985
00123-06744-18957-24688-26985	00123-06807-13744-19598-22936
00123-06882-14547-26485-36799	00123-07311-17448-24643-37545
00123-07311-24643-26399-37545	00123-07314-11784-34475-37956
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00123-07341-11793-29953-37596	00123-07341-14478-26684-37595
00123-07344-11753-29693-37956	00123-07344-17953-29663-37569
00123-07481-24668-26453-37544	00123-07718-13744-15293-19598
00123-07841-26344-29668-37595	00123-11743-24453-25648-37546
00123-11753-14478-25698-37959	00123-13744-15253-19598-22936
00123-14457-15482-17933-18529	00123-14547-15799-26885-36739
00123-14852-15457-17933-36447	00123-15457-26885-36447-39679
00123-24668-25639-26453-37544	00123-24668-25643-26399-37545
00124-02889-03291-07413-11793	00124-02889-07413-11793-47856
00124-07148-08819-15229-69878	00124-08819-13234-15229-25396
00132-04624-06708-12844-17488	00132-04624-12844-15352-17488
00132-06708-12844-17488-19597	00132-12844-15352-17488-19597
00134-04637-06223-07418-12993	00134-04637-07418-12993-15877
00134-04718-06307-19223-37699	00134-04718-07463-12844-15223
00134-04718-07463-15223-37699	00134-04718-07637-15844-19223
00173-02068-04184-19778-67998	00173-02068-14778-36454-44867
00173-03312-04674-06997-23436	00173-04184-15753-19778-67998
$H_0 = Z_2 \times Z_7, H_1 = Z_{25}$	
00121-02234-03792-08939-11369	00121-02234-03792-08939-18664
00121-02234-03792-11369-35484	00121-02234-03792-18664-35484
00121-02234-08939-11369-28574	00121-02234-08939-18664-28574
00121-02234-11369-28574-35484	00121-02234-18664-28574-35484
00121-02374-08422-11364-48985	00121-02374-08422-18669-48985

00121-02374-11364-35779-48985	00121-02374-18669-35779-48985
00121-02379-03934-08922-11369	00121-02379-03934-08922-18664
00121-02379-03934-11369-35774	00121-02379-03934-18664-35774
00121-03422-08489-11864-23759	00121-03422-08489-13669-23759
00121-03422-11864-23759-35439	00121-03422-13669-23759-35439
00121-03484-08742-11864-37754	00121-03484-08742-13669-37754
00121-03484-11864-23579-37754	00121-03484-13669-23579-37754
00121-03792-11369-35484-59877	00121-03792-18664-35484-59877
00121-03934-11369-28754-35774	00121-03934-18664-28754-35774
00121-11369-28574-35484-59877	00121-11369-28754-35774-48598
00121-13664-23574-34854-37759	00121-13664-23754-34359-48577
$H_0 = Z_2 \times Z_7, H_1 = Z_5$	
00112-02234-03691-08489-13742	00112-02234-03691-08489-28679
00112-02234-03691-08939-13792	00112-02234-03691-08939-28674
00112-02234-03691-13742-35439	00112-02234-03691-13792-35484
00112-02234-03691-28674-35484	00112-02234-03691-28679-35439
00112-02234-03741-08439-13679	00112-02234-03741-08439-18642
00112-02234-03741-13679-35489	00112-02234-03741-18642-35489
00112-02234-08439-13679-28569	00112-02234-08439-18642-28569
00112-02234-08489-13742-18564	00112-02234-08489-18564-28679
00112-02234-08939-13792-18564	00112-02234-08939-18564-28674
00112-02234-13679-28569-35489	00112-02234-13742-18564-35439
00112-02234-13792-18564-35484	00112-02234-18564-28674-35484
00112-02234-18564-28679-35439	00112-02234-18642-28569-35489
00112-02354-03791-13922-18934	00112-02354-03791-13922-36984
00112-02354-03791-18934-48677	00112-02354-03791-36984-48677
00112-02354-13922-18934-28564	00112-02354-13922-28564-36984
00112-02354-18934-28564-48677	00112-02354-28564-36984-48677
00112-02374-03541-18422-48986	00112-02374-03541-36779-48986
00112-02374-03569-13422-18939	00112-02374-03569-13422-36484
00112-02374-03569-18939-67798	00112-02374-03569-36484-67798

00112-02374-08541-13422-18939	00112-02374-08541-13422-36484
00112-02374-08541-18939-67798	00112-02374-08541-36484-67798
00112-02374-08569-18422-48986	00112-02374-08569-36779-48986
00112-02379-03591-13934-18922	00112-02379-03591-13934-36774
00112-02379-08564-13934-18922	00112-02379-08564-13934-36774
00112-03484-08641-18742-37754	00112-03484-08641-23679-37754
00112-03484-13569-18742-37754	00112-03484-13569-23679-37754
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00112-03541-13989-18422-23759	00112-03541-13989-23759-36779
00112-03541-18422-23759-34864	00112-03541-18422-28759-48986
00112-03541-23759-34864-36779	00112-03541-28759-36779-48986
00112-03564-13922-18434-28754	00112-03564-13922-18984-23754
00112-03564-13922-23754-34369	00112-03564-13922-28754-36989
00112-03564-18434-28754-48677	00112-03564-18984-23754-48677
00112-03564-23754-34369-48677	00112-03564-28754-36989-48677
00112-03591-13934-18922-28754	00112-03591-13934-28754-36774
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00112-03691-13742-35439-59877	00112-03691-13792-35484-59877
00112-03691-28674-35484-59877	00112-03691-28679-35439-59877
00112-03741-08754-13422-18439	00112-03741-08754-13422-36489
00112-03741-08754-18439-67798	00112-03741-08754-36489-67798
00112-03741-13679-35489-59877	00112-03741-18642-35489-59877
00112-03754-13489-18422-23569	00112-03754-13489-23569-36779
00112-03754-18422-23569-39864	00112-03754-23569-36779-39864
00112-03934-13569-18792-37754	00112-03934-13569-23674-37754
00112-13564-18792-34854-37759	00112-13564-23674-34854-37759
00112-13569-18792-37754-48598	00112-13569-23674-37754-48598
00112-13642-23569-37759-39854	00112-13679-28569-35489-59877
$H_0 = Z_2 \times Z_7, H_1 = Z_2^3 \times Z_{25}$	
00121-02234-03792-08489-11364	00121-02234-03792-08489-18669

00121-02234-03792-11364-35439	00121-02234-03792-18669-35439
00121-02234-08489-11364-28574	00121-02234-08489-18669-28574
00121-02234-11364-28574-35439	00121-02234-18669-28574-35439
00121-02374-03989-08422-11864	00121-02374-03989-08422-13669
00121-02374-03989-11864-35779	00121-02374-03989-13669-35779
00121-02374-08422-11864-34854	00121-02374-08422-13669-34854
00121-02374-11864-34854-35779	00121-02374-13669-34854-35779
00121-03422-08939-11364-23759	00121-03422-08939-18669-23759
00121-03422-11364-23759-35484	00121-03422-18669-23759-35484
00121-03484-11869-28754-35774	00121-03484-13664-28754-35774
00121-03792-08489-11364-59877	00121-03792-08489-18669-59877
00121-03792-11364-35439-59877	00121-03792-18669-35439-59877
00121-03934-11869-23579-37754	00121-03934-13664-23579-37754
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00121-13664-23579-37754-48598	00121-13664-28754-35774-39859
$H_0 = Z_2 \times Z_7, H_1 = Z_2^3 \times Z_5$	
00121-02034-08489-11864-22379	00121-02034-08489-11864-28774
00121-02034-08489-13669-22379	00121-02034-08489-13669-28774
00121-02034-08939-11369-22874	00121-02034-08939-11369-23779
00121-02034-08939-18664-22874	00121-02034-08939-18664-23779
00121-02034-11369-22874-35484	00121-02034-11369-23779-35484
00121-02034-11864-22379-35439	00121-02034-11864-28774-35439
00121-02034-13669-22379-35439	00121-02034-13669-28774-35439
00121-02034-18664-22874-35484	00121-02034-18664-23779-35484
00121-02234-03692-08439-11379	00121-02234-03692-08439-28664
00121-02234-03692-11379-35489	00121-02234-03692-28664-35489
00121-02234-08439-11379-18574	00121-02234-08439-18574-28664
00121-02234-11379-18574-35489	00121-02234-18574-28664-35489
00121-02364-03489-08422-11374	00121-02364-03489-08422-28669
00121-02364-03489-11374-35779	00121-02364-03489-28669-35779
00121-02364-08422-11374-39854	00121-02364-08422-28669-39854

00121-02364-11374-35779-39854	00121-02364-28669-35779-39854
00121-03422-08439-11874-13759	00121-03422-08439-13759-23669
00121-03422-11874-13759-35489	00121-03422-13759-23669-35489
00121-03484-11864-22379-35754	00121-03484-11864-28774-35754
00121-03484-13669-22379-35754	00121-03484-13669-28774-35754
00121-03489-08692-11879-37759	00121-03489-08692-23664-37759
00121-03489-11374-18759-35779	00121-03489-11879-13574-37759
00121-03489-13574-23664-37759	00121-03489-18759-28669-35779
00121-03692-11379-35489-59877	00121-03692-28664-35489-59877
00121-03934-11369-22874-35754	00121-03934-11369-23779-35754
00121-03934-18664-22874-35754	00121-03934-18664-23779-35754
00121-11369-22874-35484-57598	00121-11369-22874-35754-48598
00121-11369-23779-35484-57598	00121-11369-23779-35754-48598
00121-11374-18759-35779-39854	00121-11379-18574-35489-59877
00121-13574-23664-37759-39854	00121-13664-22374-34854-35759
00121-13664-28779-34854-35759	00121-13669-22379-35439-57598
00121-13669-28774-35439-57598	00121-13754-23664-35984-48577
$H_0 = Z_2 \times Z_5, H_1 = Z_{125}$	
02269-04091-15297-28668-33589	03089-11568-17199-28795-39775
03608-07713-09984-11979-26573	07559-11585-28436-29633-46797
07559-18264-23924-33565-34766	07956-08778-14674-18433-26455
08863-09762-15965-22564-78998	09644-15685-17532-22365-29339
11567-25754-29885-36446-37895	17665-25754-29885-37895-68699
$H_0 = Z_2 \times Z_5, H_1 = Z_{25}$	
00657-17624-18743-19882-58599	00679-18873-26576-29645-44858
00768-17378-39754-44587-46656	00819-06414-23325-29776-34865
00902-15822-17439-29963-36865	00903-15262-18473-48876-57996
00957-12689-15335-29374-66978	01597-07769-14719-28558-33684
01597-12254-14719-28558-33684	02964-07121-08448-17955-18233
02964-07121-08448-17955-36887	02992-15868-22678-36455-48965
06519-08841-13958-26775-37997	06558-26863-36774-39647-44575

06578-09899-13379-14767-26355	06578-09899-14767-26355-28864
06579-08898-13767-26455-29963	06597-07769-14719-28558-33684
06597-12254-14719-28558-33684	06696-09748-23673-25586-37544
06719-11858-14755-24259-28433	06813-17532-19844-36577-55979
06912-07959-11828-39885-45677	06958-07677-18455-23989-28664
06988-19679-26559-35486-37577	07159-11858-14755-24679-37884
07469-09971-12675-28863-48558	07469-09971-12682-18755-33435
07556-17629-18793-33967-35995	07559-12689-29374-56588-66978
07562-08873-09967-11343-15974	07596-26763-28644-29556-58898
07629-15593-18969-22465-28858	07659-11784-24289-47556-58688
07659-15529-19624-22858-33684	07664-08422-09589-15674-68788
07667-15968-19355-22473-48985	07667-15968-19355-29778-48985
07762-15865-33569-39546-44787	07767-11598-14685-24393-35547
07767-11598-14685-35547-48978	07873-11959-13755-15367-29344
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07993-08532-09824-18665-22646	08636-12984-22856-44687-45575
08763-11825-19889-26575-45997	08778-09526-14692-25564-33684
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09557-19678-24374-29336-35665	09656-15288-17759-29899-35867
09657-12178-15547-28644-33534	09756-14719-34886-55878-57769
09756-29646-34886-55878-57769	13755-19844-23576-36856-45477
14557-19242-28435-29533-36656	15479-19952-25753-28566-33634
15597-26765-35399-37886-46957	15765-18853-19547-22569-34437
15922-17843-23364-46965-55758	15954-17529-18778-24566-33985
15974-17657-18733-19552-58998	17558-25993-28768-34795-56696
17968-25565-28466-39895-45877	
$H_0 = Z_2 \times Z_5, H_1 = Z_5 \times Z_{11}$	
06557-17673-18597-46987-58899	06984-17458-23775-29966-35685
07656-09714-15789-33586-77998	07956-12962-17589-37886-55998

08647-09576-11553-17974-37889	09558-19893-29678-39756-57766
09658-13189-15748-17732-44755	09658-13189-15748-22678-44755
09658-15748-22678-36864-44755	17788-19665-23579-25436-45958
$H_0 = Z_2 \times Z_5, H_1 = Z_5^2$	
01984-06758-26368-55799-69778	02899-07658-17463-39787-45566
07569-17648-23359-29798-36655	07587-08862-15692-34597-66899
07598-18239-26979-33556-47665	07658-17378-39754-44556-46687
07659-17864-24289-47588-55668	07659-18269-23924-33475-35566
07956-17464-28855-34586-39677	07956-17533-18767-29648-35599
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08951-09762-14684-33647-37755	09586-11557-17369-29343-39775
09911-18467-23573-28655-29854	15765-19854-22956-25368-28899
$H_0 = Z_2 \times Z_5, H_1 = Z_5$	
00711-09528-22639-34689-58796	00759-15885-24296-36789-37466
00767-09158-11395-22369-37984	00791-02684-03789-29769-58866
00791-02684-03789-47697-58866	00993-02819-17885-24869-25676
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02679-06414-18743-46588-55778	02698-07659-11879-24829-33556
02856-07633-13262-29964-55989	02899-06748-07873-11455-13697
02968-07159-13355-23974-34667	02992-08556-13184-28776-34546
03989-08411-13647-22655-25978	04371-08822-09368-12464-14755
06218-07881-11989-28575-44795	06298-07659-14869-22463-23355
06417-09778-23366-39856-47595	06418-09713-11775-34784-39557
06557-09889-13537-17678-44796	06569-17975-18533-19952-22343
06647-09576-18558-24269-33987	06687-09844-17537-22969-35856
06697-17547-22868-35884-45956	06699-08576-14263-28455-34787
06699-09842-17355-23763-29685	06711-08239-25795-44758-46886
06719-07598-11473-13355-24874	06748-09143-13268-36557-44775
06751-09268-14859-22993-23365	06768-07781-35857-39544-46647
06779-08692-11233-25843-45956	06781-07537-18857-29544-34664
06782-08539-11258-46477-56899	06792-07664-09548-36377-56988

06792-07669-18228-39885-45956	06792-08659-22648-33755-34696
06792-08659-26488-34696-37755	06792-14698-17359-33775-48655
06799-08651-19588-22848-26975	06879-11455-12698-28573-29935
06897-08539-11958-17799-23756	06937-08664-09543-22688-24756
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06984-11753-22996-23585-37456	07121-17995-28963-47586-55988
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07524-09882-12658-19235-36644	07556-12178-28586-47996-59889
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07569-19785-26376-44867-45588	07576-26995-28534-47865-66889
07596-12678-13799-29856-55889	07657-08264-09243-18875-34466
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07658-26873-37446-39754-45566	07659-15584-19643-22885-24736
07659-17869-24289-47558-56688	07659-17869-37974-47558-56688
07659-26693-28974-47586-55688	07664-09542-15874-35684-67788
07669-15843-23564-45957-67788	07671-17335-18754-19743-34455
07679-11574-18228-33485-45956	07691-08874-17348-29754-36655
07769-11882-15748-28534-45956	07793-08789-09592-15664-67688
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07823-17568-37445-39764-46655	07857-11567-33795-34754-36446
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07952-15687-29358-44886-46675	07954-14587-18935-22633-46657
07956-17533-18767-35599-39647	07958-22665-23746-39896-45568
07959-15692-36637-39885-45776	07964-08871-12675-29368-39955
07969-11295-18448-23358-26575	08209-11263-14155-28785-29344
08209-14155-17668-28785-29344	08647-09576-15533-26693-28974
08656-09647-15822-17598-33744	08657-12179-15447-33455-37896
08668-09242-12955-15269-28433	08739-15667-25844-29575-46886
08739-17598-25569-29764-33665	08739-17698-25979-33655-47566

08752-09733-12599-17465-34366	08756-12899-14863-18577-55979
08757-09733-12665-18199-25989	08759-18422-28569-39864-55766
08767-09984-11375-19229-36585	08779-15517-19668-37484-57598
08791-18674-34854-37759-55766	08822-09536-12843-24696-47556
08822-09536-19647-37684-55697	08891-09576-29736-37755-46968
08963-09597-19375-33677-47665	09189-15868-23776-24425-39655
09556-14764-22846-24368-33575	09576-11529-18558-24269-33987
09576-11558-17924-18829-23985	09587-14843-22634-25566-37465
09651-15337-18599-25768-39779	09658-13189-15732-17448-47755
09658-13689-15782-17748-44755	09658-15748-18673-26443-47755
09658-15782-17748-18643-44755	09668-24773-34639-55767-56589
09748-12643-25878-37556-44665	09748-12643-25878-37566-44655
09778-13657-19825-26644-35859	09853-11593-17528-22996-23569
09853-18675-22359-28465-44766	09867-14885-17428-19569-22558
09867-18563-19935-22554-26973	09974-15788-18562-25375-39669
12598-17564-23924-33665-35547	12992-15853-25778-35466-39564
15597-17674-18573-23465-58899	15779-18592-26843-46965-55887
15792-17854-19643-36559-58877	15865-25776-33596-34564-78799
15964-18743-26554-46778-57588	17359-18875-25765-34466-45897
17458-19653-22566-23984-28955	17799-18245-25866-35785-46598
17865-25975-37645-44668-48857	17935-18554-19863-22445-25678
19675-22958-24365-33766-35459	
$H_0 = Z_2 \times Z_4 \times Z_{11}, H_1 = \mathbb{Z} \times Z_2 \times Z_4$	
00123-02811-04078-14734-17993	00123-02811-04078-14734-26844
00123-02811-04078-17993-29698	00123-02811-04078-26844-29698
00123-02811-04784-07998-26968	00123-02811-04784-25344-26968
00123-02811-07448-24543-26468	00123-02811-24543-25399-26468
00123-03362-04067-17434-19973	00123-03362-04067-17434-24468
00123-03362-04067-19973-26989	00123-03362-04067-24468-26989
00123-03362-04674-06997-26898	00123-03362-04674-15244-26898
00123-03362-06447-14542-26848	00123-03362-14542-15299-26848

00123-04067-17434-18857-19973	00123-04067-17434-18857-24468
00123-04067-18857-19973-26989	00123-04067-18857-24468-26989
00123-04078-14734-17993-37566	00123-04078-14734-26844-37566
00123-04078-17993-29698-37566	00123-04078-26844-29698-37566
00123-04674-06997-17343-18857	00123-04674-15244-17343-18857
00123-04784-07998-14173-37566	00123-04784-14173-25344-37566
00123-06447-14542-17393-18857	00123-07448-17319-24543-37566
00123-14173-25344-29593-37566	00123-14542-15299-17393-18857
$H_0 = Z_2 \times Z_4 \times Z_5, H_1 = \mathbb{Z} \times Z_4 \times Z_{11}$	
00123-02634-04478-07311-14284	00123-02634-04478-07311-37969
00123-02634-04478-14284-25668	00123-02634-04478-25668-37969
00123-02634-07311-14284-29953	00123-02634-07311-29953-37969
00123-02634-14284-25668-29953	00123-02634-25668-29953-37969
00123-02648-07311-09789-37446	00123-02648-07311-24543-37446
00123-02648-09789-25668-37446	00123-02648-24543-25668-37446
00123-02804-07981-11784-14473	00123-02804-07981-14473-26693
00123-02804-11784-14473-25634	00123-02804-11784-25634-29968
00123-03647-06209-14882-17993	00123-03647-06209-14882-26844
00123-03647-14882-15457-17993	00123-03647-14882-15457-26844
00123-04062-17443-18524-19882	00123-04062-17443-18524-33467
00123-04062-18524-19882-26899	00123-04062-18524-26899-33467
00123-04478-07311-17598-37969	00123-04478-17598-25668-37969
00123-07481-11789-19973-37545	00123-07481-19973-26643-37545
00123-11784-14473-25634-37595	00123-11784-25634-29968-37595
00123-14882-15457-17993-18529	00123-14882-15457-18529-26844
$H_0 = Z_2 \times Z_4 \times Z_5, H_1 = \mathbb{Z} \times Z_4^2$	
00112-02234-03679-08641-28939	00112-02234-03679-08641-37484
00112-02234-03679-13569-28939	00112-02234-03679-13569-37484
00112-02234-08641-18542-28939	00112-02234-08641-18542-37484
00112-02234-13569-18542-28939	00112-02234-13569-18542-37484
00112-02364-03541-13922-28984	00112-02364-03541-13922-34379

00112-02364-03541-28984-48677	00112-02364-03541-34379-48677
00112-02364-08569-13922-28984	00112-02364-08569-13922-34379
00112-02364-08569-28984-48677	00112-02364-08569-34379-48677
00112-03541-13922-18759-28984	00112-03541-13922-18759-34379
00112-03541-18759-28984-48677	00112-03541-18759-34379-48677
00112-03564-13754-18422-48987	00112-03564-13754-36779-48987
00112-03569-13759-18922-23934	00112-03569-13759-23934-36774
00112-03641-08679-23989-37759	00112-03641-08679-34874-37759
00112-03641-13542-23989-37759	00112-03641-13542-34874-37759
00112-03679-13569-28939-59877	00112-03679-13569-37484-59877
00112-13542-18569-23989-37759	00112-13542-18569-34874-37759
$H_0 = Z_2 \times Z_4 \times Z_5, H_1 = \mathbb{Z} \times Z_2^2 \times Z_{11}$	
00123-02804-07931-11478-17344	00123-02804-07931-11478-26998
00123-02804-07931-17344-29663	00123-02804-07931-26998-29663
00123-02804-11478-17344-25684	00123-02804-11478-25684-26998
00123-02804-17344-25684-29663	00123-02804-25684-26998-29663
00123-02811-04268-07844-29698	00123-02811-04268-14734-25993
00123-02811-04268-25993-29698	00123-02811-04784-07968-26998
00123-02811-07468-17399-24543	00123-02811-07468-24543-26448
00123-03362-04467-06824-17434	00123-03362-04467-06824-26989
00123-03362-04467-15973-17434	00123-03362-04467-15973-26989
00123-03362-04674-06897-26998	00123-03362-04674-15243-26998
00123-04062-17344-18892-24685	00123-04062-24685-26998-33674
00123-04268-07844-29698-37566	00123-04268-14734-25993-37566
00123-04467-06824-17434-18857	00123-04467-06824-18857-26989
00123-04467-15973-18857-26989	00123-04674-15243-17344-18857
00123-04674-15243-18857-26998	00123-06824-17434-18857-19952
00123-07431-17399-24663-37545	00123-14542-15293-17399-18857
$H_0 = Z_2 \times Z_4 \times Z_5, H_1 = \mathbb{Z} \times Z_2$	
00121-02234-03669-08642-28489	00121-02234-03669-08642-37439
00121-02234-03669-13579-28489	00121-02234-03669-13579-37439

00121-02234-08642-11854-28489	00121-02234-08642-11854-37439
00121-02234-11854-13579-28489	00121-02234-11854-13579-37439
00121-02364-03922-08669-28434	00121-02364-03922-08669-37989
00121-02364-03922-11354-28434	00121-02364-03922-11354-37989
00121-02364-08669-28434-48577	00121-02364-08669-37989-48577
00121-02364-11354-28434-48577	00121-02364-11354-37989-48577
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00121-03422-11359-18754-28939	00121-03422-11359-18754-37484
00121-03642-08669-37759-48987	00121-03642-11354-37759-48987
00121-03664-13754-23989-35779	00121-03664-13754-34874-35779
00121-03669-08642-28489-59877	00121-03669-13579-28489-59877
00121-03669-13579-37439-59877	00121-03692-11359-23934-37754
00121-11354-18579-37759-48987	00121-11354-18759-28434-48577
00121-11354-18759-37989-48577	00121-11359-18574-23934-37754
$H_0 = Z_2 \times Z_4, H_1 = \mathbb{Z} \times Z_2^2$	
00112-02134-03741-08489-18779	00112-02134-03741-08489-22364
00112-02134-03741-08779-18489	00112-02134-03741-08779-18939
00112-02134-03741-08779-36439	00112-02134-03741-08779-36484
00112-02134-03741-08939-18779	00112-02134-03741-08939-22364
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00112-02134-03741-18779-35484	00112-02134-03741-18939-22354
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00112-02134-03741-22364-35439	00112-02134-03741-22364-35484
00112-02134-03779-08741-18489	00112-02134-03779-08741-36439
00112-02134-03779-18489-23569	00112-02134-03779-23569-36439
00112-02134-03791-08939-18774	00112-02134-03791-08939-22369
00112-02134-03791-18774-35484	00112-02134-03791-22369-35484
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00112-02134-08779-28569-36439	00112-02134-08779-28569-36484

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00112-03484-08791-13774-36754	00112-03484-08791-22869-36754
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00123-03624-06952-17443-19882	00123-03624-06952-19882-26899
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00123-06744-18957-19734-26885	00123-07534-11784-14473-37956
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00112-02234-08691-18542-28439	00112-02234-08691-18542-37489
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00112-03564-18754-28439-67798	00112-03564-18754-37489-67798
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00123-02531-04284-14478-26698	00123-02531-04284-26698-29963
00123-02531-04734-17844-37966	00123-02531-04734-26993-37966
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00123-02844-04178-14798-25668	00123-02844-04178-25668-29634
00123-02844-07311-14798-26953	00123-02844-07311-26953-29634
00123-02844-07311-26963-34795	00123-02844-14178-25668-34795

00123-02844-14798-25668-26953	00123-02844-25668-26953-29634
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00123-03152-04624-18992-26988	00123-03152-14547-17339-18442
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00123-04624-06857-18992-26988	00123-04692-15997-26885-34367
00123-06429-14457-26885-36739	00123-06452-14482-17933-18547
00123-06734-18924-19957-26885	00123-06857-14547-17339-36799
00123-06857-14547-18442-26488	00123-06857-24336-26959-34467
00123-07311-14798-17844-37595	00123-07311-14798-26953-37599
00123-07311-14798-26993-37595	00123-07311-24639-26443-37545
00123-07311-24639-26453-37544	00123-07344-14293-26953-37566
00123-07534-17844-29668-37956	00123-07568-11734-14478-37959
00123-14178-25668-34795-37599	00123-14457-15482-18429-26885
00123-14798-25668-26953-37599	00123-24639-25668-26453-37544

00124-02541-08748-11829-26334	00124-02541-11829-23539-26334
00124-03289-13179-25669-47588	00124-07548-08741-26334-36647
00124-07548-23569-26334-36647	00124-07569-08748-26334-36647
00124-07569-23539-26334-36647	00124-25669-26864-37854-47588
00132-04184-06758-22634-24468	00132-06453-22639-29968-36754
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00123-02811-04078-26968-29344	00123-02811-04078-26968-29844
00123-02811-04078-26968-34799	00123-02811-04078-26968-47998
00123-02811-24899-25453-26468	00123-02811-25453-26468-39744
00123-03362-04067-17343-19244	00123-03362-04067-17343-19974
00123-03362-04067-19244-26898	00123-03362-04067-19974-26898
00123-03362-04067-24469-26898	00123-03362-04067-26898-46997
00123-03362-14479-15452-26848	00123-03362-15452-26848-29964
00123-04067-17343-18857-19244	00123-04067-17343-18857-19974
00123-04067-17343-18857-24469	00123-04067-17343-18857-46997
00123-04067-18857-19244-26898	00123-04067-18857-19974-26898
00123-04067-18857-24469-26898	00123-04067-18857-26898-46997
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00123-14173-25953-29344-37566	00123-14173-25953-29844-37566
00123-14173-25953-34799-37566	00123-14173-25953-37566-47998
$H_0 = Z_2 \times Z_3 \times Z_7, H_1 = Z_5$	
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00121-02034-08779-13669-28489	00121-02034-08779-13669-37439
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00121-02034-11864-22354-28489	00121-02034-11864-22354-37439
00121-02034-13669-22354-28489	00121-02034-13669-22354-37439
00121-02034-18664-22354-28939	00121-02034-18664-22354-37484

00121-03774-11369-23934-35754	00121-03774-11369-35754-48798
00121-03774-11864-23484-35754	00121-03774-11864-35754-39879
00121-03774-13669-23484-35754	00121-03774-13669-35754-39879
00121-03774-18664-23934-35754	00121-03774-18664-35754-48798
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00121-13669-22354-28489-57598	00121-13669-22354-37439-57598
$H_0 = Z_2 \times Z_3 \times Z_5, H_1 = Z_5 \times Z_7$	
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00121-02034-08489-18774-28664	00121-02034-08489-22369-28664
00121-02034-08939-11874-13779	00121-02034-08939-11874-22864
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00121-02034-11874-13779-35484	00121-02034-11874-22864-35484
00121-02034-13779-23669-35484	00121-02034-18774-28664-35439
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00121-22364-28669-34854-35759	00121-22369-28664-35439-57598
$H_0 = Z_2 \times Z_3 \times Z_5, H_1 = Z_5$	
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00102-03484-08669-22379-36764	00102-03484-08669-28774-36764
00102-03484-08779-11369-12892	00102-03484-08779-11369-37674
00102-03484-08779-12892-18664	00102-03484-08779-18664-37674
00102-03484-11354-12189-22379	00102-03484-11354-12189-28774

00102-03484-11354-22379-36764	00102-03484-11354-28774-36764
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00102-03664-22379-35439-67698	00102-03664-22874-35484-67698
00102-03664-23779-35484-67698	00102-03664-28774-35439-67698
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00121-02034-08779-11364-37439	00121-02034-08779-11364-37484
00121-02034-08779-18669-28489	00121-02034-08779-18669-28939
00121-02034-08779-18669-37439	00121-02034-08779-18669-37484

00121-02034-11364-22354-28489	00121-02034-11364-22354-28939
00121-02034-11364-22354-37439	00121-02034-11364-22354-37484
00121-02034-18669-22354-28489	00121-02034-18669-22354-28939
00121-02034-18669-22354-37439	00121-02034-18669-22354-37484
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00121-03774-13664-35754-39879	00121-03774-13664-35754-48798
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00121-11364-22354-37439-57598	00121-11364-22354-37484-57598
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00121-13664-22859-35754-39879	00121-13664-22859-35754-48798
$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_9^2$	
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00123-02804-07811-26968-29844	00123-02804-07811-26968-29984

00123-02804-07811-26968-34479	00123-02804-07811-26968-34799
00123-02804-14173-25663-29844	00123-02804-14173-25663-29984
00123-02804-14173-25663-34479	00123-02804-14173-25663-34799
00123-02804-25663-26968-29844	00123-02804-25663-26968-29984
00123-02804-25663-26968-34479	00123-02804-25663-26968-34799
00123-03367-04062-17343-19744	00123-03367-04062-17343-19974
00123-03367-04062-19744-26898	00123-03367-04062-19974-26898
00123-03367-04062-24469-26898	00123-03367-04062-24699-26898
00123-03367-14479-15457-26848	00123-03367-14799-15457-26848
00123-04062-17343-18852-19744	00123-04062-17343-18852-19974
00123-04062-17343-18852-24469	00123-04062-17343-18852-24699
00123-07811-24489-26468-37545	00123-07811-24899-26468-37545
00123-14173-25663-29844-37595	00123-14173-25663-29984-37595
00123-14173-25663-34479-37595	00123-14173-25663-34799-37595
$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_4^2 \times Z_5 \times Z_{13}$	
00112-02234-03641-08679-28489	00112-02234-03641-08679-37439
00112-02234-03641-13542-28489	00112-02234-03641-13542-37439
00112-02234-08679-18569-28489	00112-02234-08679-18569-37439
00112-02234-13542-18569-28489	00112-02234-13542-18569-37439
00112-02364-03541-13422-28939	00112-02364-03541-13422-37484
00112-02364-03541-28939-67798	00112-02364-03541-37484-67798
00112-02364-08569-13422-28939	00112-02364-08569-13422-37484
00112-02364-08569-28939-67798	00112-02364-08569-37484-67798
00112-03541-13422-18759-28939	00112-03541-13422-18759-37484
00112-03541-18759-28939-67798	00112-03541-18759-37484-67798
00112-03564-13754-18922-23484	00112-03564-13754-18922-39879
00112-03564-13754-23484-36774	00112-03564-13754-36774-39879
00112-03641-08679-28489-59877	00112-03641-08679-37439-59877
00112-03641-13542-28489-59877	00112-03641-13542-37439-59877
00112-03674-13564-23934-37754	00112-03674-13564-37754-48798
00112-13542-18569-28489-59877	00112-13542-18569-37439-59877

$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_2^2 \times Z_{13} \times Z_{97}$	
00123-02431-07809-11739-37446	00123-02431-07809-26648-37446
00123-02431-11739-25453-37446	00123-02431-25453-26648-37446
00123-02648-07811-09289-19973	00123-02648-07811-19973-37454
00123-02648-09289-19973-25663	00123-02648-19973-25663-37454
00123-02684-07811-14734-37995	00123-02684-07811-29698-37995
00123-02684-14734-25663-37995	00123-02684-25663-29698-37995
00123-03142-06709-17339-29936	00123-03142-06709-26488-29936
00123-03142-15452-17339-29936	00123-03142-15452-26488-29936
00123-03367-04624-06982-17443	00123-03367-04624-06982-26899
00123-03367-04624-15734-17443	00123-03367-04624-15734-26899
00123-03367-04682-06244-26989	00123-03367-04682-15997-26989
00123-03367-06244-19573-26989	00123-03367-06482-14547-26844
00123-04284-17534-25663-29968	00123-04624-06982-18852-26899
00123-04624-15734-17443-18852	00123-04624-15734-18852-26899
00123-06244-17434-18852-19573	00123-06482-14547-18852-26844
00123-14547-15739-17993-18852	00123-14547-15739-18852-26844
$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_2^2 \times Z_3$	
00123-02804-07811-14734-17993	00123-02804-07811-14734-26844
00123-02804-07811-17993-29698	00123-02804-07811-26844-29698
00123-02804-14734-17993-25663	00123-02804-14734-25663-26844
00123-02804-17993-25663-29698	00123-02804-25663-26844-29698
00123-03367-04062-17434-19973	00123-03367-04062-17434-24468
00123-03367-04062-19973-26989	00123-03367-04062-24468-26989
00123-03367-04624-06992-26898	00123-03367-04624-15744-26898
00123-03367-06442-14547-26848	00123-03367-14547-15799-26848
00123-04062-17434-18852-19973	00123-04062-17434-18852-24468
00123-04062-18852-19973-26989	00123-04062-18852-24468-26989
00123-04284-07811-26968-34475	00123-04284-14173-25663-34475
00123-04624-06992-17343-18852	00123-04624-15744-17343-18852
00123-06442-14547-17393-18852	00123-07811-14734-17993-37595

00123-07811-17443-24648-37545	00123-07811-24648-26899-37545
00123-14173-25663-34475-37959	00123-14547-15799-17393-18852
00123-15457-17939-18852-29968	00123-15457-18852-26484-29968
$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_2^2$	
00123-02431-07809-17399-37466	00123-02431-07809-26448-37466
00123-02431-17399-25453-37466	00123-02431-25453-26448-37466
00123-02468-07811-09289-17399	00123-02468-07811-09289-26448
00123-02468-07811-17399-37454	00123-02468-07811-26448-37454
00123-02468-09289-17399-25663	00123-02468-09289-25663-26448
00123-02468-17399-25663-37454	00123-02468-25663-26448-37454
00123-02844-04268-07811-14734	00123-02844-04268-07811-29698
00123-02844-04268-14734-25663	00123-02844-04268-25663-29698
00123-02844-14734-17953-25663	00123-02844-17953-25663-29698
00123-03142-06709-17399-29336	00123-03142-15452-17399-29336
00123-03367-04462-15973-17434	00123-03367-04462-15973-26989
00123-03367-04624-15743-26998	00123-03367-06824-19957-26989
00123-04067-24336-26998-46857	00123-04268-07811-14734-37599
00123-04268-07811-29698-37599	00123-04268-14734-25663-37599
00123-04268-25663-29698-37599	00123-04284-14753-25663-26998
00123-04624-15743-17344-18852	00123-14547-15793-17399-18852
$H_0 = Z_2 \times Z_3 \times Z_4, H_1 = \mathbb{Z} \times Z_2$	
00112-02234-03641-08679-28939	00112-02234-03641-08679-37484
00112-02234-03641-13542-28939	00112-02234-03641-13542-37484
00112-02234-03691-08679-28489	00112-02234-03691-08679-37439
00112-02234-03691-13542-28489	00112-02234-03691-13542-37439
00112-02234-08679-18564-28489	00112-02234-08679-18564-37439
00112-02234-08679-18569-28939	00112-02234-08679-18569-37484
00112-02234-13542-18564-28489	00112-02234-13542-18564-37439
00112-02234-13542-18569-28939	00112-02234-13542-18569-37484
00112-02341-03779-08674-18489	00112-02341-03779-08674-36439
00112-02341-03779-13592-18489	00112-02341-03779-13592-36439

00112-02341-08674-18489-22854	00112-02341-08674-22854-36439
00112-02341-13592-18489-22854	00112-02341-13592-22854-36439
00112-02364-03541-13422-28489	00112-02364-03541-13422-37439
00112-02364-03541-28489-67798	00112-02364-03541-37439-67798
00112-02364-03569-13422-28939	00112-02364-03569-13422-37484
00112-02364-03569-28939-67798	00112-02364-03569-37484-67798
00112-02364-03989-08421-13774	00112-02364-03989-08421-22869
00112-02364-03989-13774-35679	00112-02364-03989-22869-35679
00112-02364-08421-13774-34854	00112-02364-08421-22869-34854
00112-02364-08541-13422-28939	00112-02364-08541-13422-37484
00112-02364-08541-28939-67798	00112-02364-08541-37484-67798
00112-02364-08569-13422-28489	00112-02364-08569-13422-37439
00112-02364-08569-28489-67798	00112-02364-08569-37439-67798
00112-02364-13774-34854-35679	00112-02364-22869-34854-35679
00112-03421-08939-13759-18774	00112-03421-08939-13759-22369
00112-03421-13759-18774-35484	00112-03421-13759-22369-35484
00112-03484-13779-18754-35674	00112-03484-18754-22864-35674
00112-03541-13422-18759-28489	00112-03541-13422-18759-37439
00112-03541-13759-18422-23989	00112-03541-13759-18422-34874
00112-03541-13759-23989-36779	00112-03541-13759-34874-36779
00112-03541-18759-28489-67798	00112-03541-18759-37439-67798
00112-03564-13754-18922-23934	00112-03564-13754-18922-48798
00112-03564-13754-23934-36774	00112-03564-13754-36774-48798
00112-03564-13922-18754-28434	00112-03564-13922-18754-37989
00112-03564-18754-28434-48677	00112-03564-18754-37989-48677
00112-03641-08679-28939-59877	00112-03641-08679-37484-59877
00112-03641-13542-28939-59877	00112-03641-13542-37484-59877
00112-03674-08641-23934-37754	00112-03674-08641-37754-48798
00112-03674-08779-37569-48986	00112-03674-13564-23484-37754
00112-03674-13564-37754-39879	00112-03674-13569-23934-37754
00112-03674-13569-37754-48798	00112-03674-22354-37569-48986

00112-03679-08774-13934-37564	00112-03679-13934-22359-37564
00112-03691-13542-28489-59877	00112-03691-13542-37439-59877
00112-03774-13542-18984-48756	00112-03774-13542-34369-48756
00112-13542-18564-28489-59877	00112-13542-18564-37439-59877
00112-13542-18569-28939-59877	00112-13542-18569-37484-59877
00112-13542-18984-22859-48756	00112-13542-22859-34369-48756
00112-13754-18779-35989-48567	00112-13754-22364-35989-48567
$H_0 = Z_2 \times Z_3 \times Z_3, H_1 = Z_2^2 \times Z_3 \times Z_5$	
00121-02034-08489-11364-22874	00121-02034-08489-11364-23779
00121-02034-08489-18669-22874	00121-02034-08489-18669-23779
00121-02034-08939-11364-22379	00121-02034-08939-11364-28774
00121-02034-08939-18669-22379	00121-02034-08939-18669-28774
00121-02034-11364-22379-35484	00121-02034-11364-22874-35439
00121-02034-11364-23779-35439	00121-02034-11364-28774-35484
00121-02034-18669-22379-35484	00121-02034-18669-22874-35439
00121-02034-18669-23779-35439	00121-02034-18669-28774-35484
00121-03484-11869-22874-35754	00121-03484-11869-23779-35754
00121-03484-13664-22874-35754	00121-03484-13664-23779-35754
00121-03934-11869-22379-35754	00121-03934-11869-28774-35754
00121-03934-13664-22379-35754	00121-03934-13664-28774-35754
00121-11364-22379-35484-57598	00121-11364-22874-35439-57598
00121-11364-23779-35439-57598	00121-11364-28774-35484-57598
00121-13664-22379-35754-48598	00121-13664-22874-35754-39859
00121-13664-23779-35754-39859	00121-13664-28774-35754-48598
$H_0 = Z_2 \times Z_3, H_1 = Z_{25}$	
00191-08232-11862-28445-47985	00756-12697-18892-19873-35445
00758-11595-13782-18429-23446	00956-17893-18874-19642-22535
00978-04357-13315-17664-29379	00978-07543-13662-14415-28739
01771-09528-11963-25584-34874	02823-07631-26653-29844-55969
03082-07668-09844-15678-69779	06569-18533-19775-23443-26795
06571-07914-08633-12445-22343	06571-18825-19544-22989-37685

06571-18825-19544-34774-37685	06711-07579-29885-36446-37895
06913-08454-17337-29775-56689	06959-11878-17529-22456-33985
07469-09971-12175-18873-34355	07559-15885-19628-24789-36679
07559-17929-18824-34876-35665	07559-18874-26348-35665-47976
07578-17685-28665-29544-69889	07596-08448-12179-29556-36887
07598-13667-15199-23284-29558	07659-24269-35366-39887-47556
07668-17865-28575-29544-69889	07954-14665-22686-28539-33457
07958-12215-13664-23989-28455	07958-12215-18664-23489-28455
07959-08432-09233-14665-17718	07991-08873-15752-19547-48668
08199-18685-23776-45698-47557	08668-09576-15529-26979-28893
08743-09332-14665-22636-25954	08774-09589-14665-17188-25784
09556-28476-33575-36977-46896	09557-11585-12474-18879-26398
09788-14667-28935-36556-47957	09984-15853-17528-22356-29669
15697-22868-26645-33584-47595	17695-25754-29665-35887-36399
$H_0 = Z_2 \times Z_3, H_1 = Z_5 \times Z_7$	
00771-09528-17468-23934-58966	01958-15578-26798-36869-59977
02978-04681-09893-39677-55766	06697-08671-14433-25758-45987
06791-07482-18854-34595-37766	06919-08134-26574-33967-37755
06974-07567-18537-33966-44578	07567-09624-15823-33574-66998
07567-09624-15823-35744-66988	07568-26373-39764-44587-46655
07568-26373-39764-44665-45587	07579-08473-17695-23365-39966
07579-15299-18562-33466-37895	07598-14268-29373-55699-58766
07598-17364-33556-47665-48797	07642-09569-11882-15348-22859
07858-15768-35477-39564-44667	07958-12684-29878-37566-55996
07974-17684-28543-47556-58866	08568-15732-19548-22589-44766
08568-15732-19548-25899-47766	08691-09589-15977-26688-29375
08739-15679-19933-25866-29575	08757-09734-15867-25669-68899
08774-09569-11332-12579-15843	08774-09569-12579-15843-66788
08874-09569-12579-15843-66778	08891-09576-14624-18293-37755
09518-11577-26973-34864-47558	09684-15229-17565-36785-44887
09859-15364-25679-33957-37766	15679-25443-28536-29575-33466

15965-17529-36785-44568-48877	18965-24735-33776-45958-46675
$H_0 = Z_2 \times Z_3, H_1 = Z_5$	
00653-17932-18244-34686-57759	00657-26433-28676-29634-35445
00658-07637-09779-18687-39644	00678-01363-22968-26439-44575
00756-09213-17624-28463-44885	00756-19873-26976-33545-36744
00759-17869-24289-47658-56688	00759-18269-23924-33476-35665
00759-18269-33476-35665-48797	00767-09586-11539-18774-37989
00771-09528-17468-34879-58966	00789-09748-11763-28758-44656
00889-06457-17967-28653-34476	00956-08778-14179-19252-36884
00956-17784-19679-25335-36874	00956-17884-18742-22535-46896
00957-18462-33796-35665-47897	01069-04762-19925-35886-48778
01598-08819-13914-23255-29776	01598-13914-23255-29776-33546
01899-06758-17863-39647-45577	01958-13684-15578-26798-59977
01959-09667-12975-18228-33584	02123-03537-09844-13665-46477
02529-04682-08793-11562-44886	02669-04091-15247-18778-33985
02669-04091-15247-22868-35889	02957-07869-12665-14433-37985
02964-07121-08448-17955-23368	02992-06863-17782-36455-48965
02992-08556-18454-23776-34686	02992-08556-18684-22876-34546
03709-08782-13667-29344-46556	03974-06446-26635-37687-55789
04756-09622-12464-39886-55878	04768-09242-11355-15264-33789
06219-07424-11855-14758-28893	06219-07424-11855-14758-33784
06219-07974-11855-14758-33784	06219-07974-11858-14755-33789
06433-08784-09541-11312-22574	06477-09541-26866-33584-37597
06512-19547-25863-35699-48877	06557-08679-12637-14789-33445
06557-08899-14532-26376-47986	06557-09889-13537-14799-26763
06557-09889-13537-26763-29644	06557-12629-36879-39967-45885
06558-13639-14573-17432-44775	06559-08822-13748-14264-34675
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06559-14642-17784-36874-57588	06559-17784-36874-46796-57588
06559-18589-26774-46968-57887	06564-08633-09762-14425-77898
06571-12954-19985-25368-33774	06587-12863-19984-22559-29536

06597-07719-12914-28558-33684	06597-07719-14764-28558-33684
06597-07719-28558-33684-47696	06597-12254-19629-28558-33684
06597-12914-22546-28558-33684	06597-22546-28558-33684-47696
06677-09558-12874-13425-36489	06696-08557-09829-26844-28763
06708-26576-28863-39559-44697	06719-07924-11855-14758-33784
06719-07974-11858-14755-28893	06719-11855-14758-25979-37889
06719-11858-14755-24259-28893	06751-18533-26995-34654-77879
06756-09264-22965-36885-44878	06759-07488-11355-14687-24734
06759-07488-11355-14687-29798	06792-07669-18228-33985-45956
06798-07559-11335-14823-24629	06798-07822-14593-35856-66997
06799-18537-25663-29575-33464	06879-08552-11445-12698-28478
06887-17532-18565-22939-44596	06911-07879-09592-12213-33589
06911-08792-09593-12213-25433	06913-08454-26628-29775-56889
06924-07562-08673-11443-23345	06959-09711-22868-26475-33584
06974-11452-18448-25756-33785	06977-07659-14719-28558-36884
06978-07654-19647-22355-33986	06982-07567-11433-23586-24459
06987-08429-12663-14455-28573	06989-07651-19957-22829-33685
07151-08763-09644-57986-77889	07441-09757-15962-28853-36639
07528-09784-17685-44657-48866	07556-08719-12692-18243-33445
07556-08769-17467-33445-36897	07556-08899-12453-19267-23698
07556-12682-23536-33959-44796	07556-12859-13267-29634-58899
07559-14715-18588-24379-46678	07559-14715-18858-24379-46678
07559-15885-18432-24746-37966	07559-18764-24748-26334-35665
07559-24764-26569-34887-35366	07562-15992-24845-36696-37885
07582-17665-23599-24645-33436	07587-17635-33657-39669-44795
07596-12682-23364-29956-35539	07596-15588-24629-36679-37854
07598-14268-28473-55699-58766	07598-15519-18662-23284-29958
07598-15519-18662-28478-58799	07598-15519-18662-28784-29958
07598-15519-18662-29373-58799	07598-17364-24879-33566-47655
07598-18269-23974-33566-47655	07622-09656-15989-23244-33586
07629-08863-15744-19565-48778	07629-15524-19659-22858-36889

07652-09744-17885-37539-46866	07656-09714-15789-22344-35886
07658-17323-37446-39754-45566	07658-17828-39754-44556-46687
07659-11824-17929-33556-34875	07659-11824-26474-33556-34875
07659-17479-35566-36975-39887	07659-18269-23979-33475-35566
07659-18269-24874-33475-35566	07659-26429-35566-36975-39887
07667-15968-19355-29773-34854	07668-08581-15732-39544-46477
07669-15742-18228-33485-45956	07677-15985-19663-35547-39784
07692-09564-11822-15398-28854	07741-09526-14642-28558-34886
07741-09526-19679-28558-34886	07768-09844-15678-35857-66979
07797-08609-17368-19844-55678	07797-08609-17368-34469-55678
07858-15768-35447-39564-46677	07862-09984-11779-19735-36585
07922-08719-09514-11788-36589	07924-08739-17564-33655-34766
07928-14668-22656-23955-45898	07929-08734-17664-33655-39756
07929-11962-15975-18558-28433	07929-14667-15518-28933-58597
07934-08578-09773-13665-26446	07956-14582-17464-22855-39886
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09558-19848-23779-25665-26896	09558-24678-34756-39684-57766
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09569-11878-15917-24775-33985	09576-14647-34886-55878-56977
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09658-15782-17748-18689-44755	09658-15782-18689-22639-44755
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09978-13585-22646-25798-36659	11567-25443-28534-29575-33646
15295-17669-18858-23974-34557	15629-17754-24595-28668-35884
15685-25736-33779-39765-44596	15759-17422-35537-39886-46965
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15795-17664-18588-23455-24739	15859-19674-26554-36889-57877
15952-17628-24699-33539-55786	15954-25679-34885-36377-45766
15958-18673-19344-26553-57797	15965-18537-22568-24884-44576
17525-37865-45997-46488-57668	17569-24259-34887-35366-47655

17669-25979-34887-35536-47565	17795-25739-28866-34685-45965
18519-24266-25778-34599-35865	18955-19733-29376-35775-45696
19562-29655-39887-45797-58668	19667-28974-29565-33536-45578
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01559-18584-19643-25288-29776	01809-15863-24255-28776-48996
01863-06807-19984-23776-29559	01964-06907-24776-28558-33684
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06557-08628-09889-14479-17632	06571-12925-18853-34377-44695
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07562-09974-15218-37885-39669	07592-17665-24845-37885-44686
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07791-09526-14674-28558-34886	08752-17665-18258-19889-24599
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09556-28476-33697-35775-46896	09557-12474-15885-23664-26398
15517-19668-23774-35984-48575	15954-17529-18778-24566-33485
15964-25528-29776-33689-46585	19695-29756-34886-45576-58778
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00123-02668-04781-14284-25998	00123-02668-04781-25998-37969
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00123-02841-04078-26344-29668	00123-02841-04078-26634-29968
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00123-02841-25953-26344-29668	00123-02841-25953-26634-29968
00123-03462-04067-17433-18244	00123-03462-04067-17433-36997
00123-03462-04067-17443-18824	00123-03462-04067-17443-33697
00123-03462-04067-18824-26899	00123-03462-04067-26889-36997
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00123-04781-11753-14284-25998	00123-06377-07184-13474-19953
00123-06844-07718-19528-29869	00123-07184-13474-15228-19953
00123-07344-11753-29563-37969	00123-07718-13744-15298-19593
00123-14857-15452-17933-36447	00123-24668-25453-26399-37564
$H_0 = Z_2 \times Z_2 \times Z_{11}, H_1 = \mathbb{Z}$	
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00123-02531-04284-17344-29663	00123-02531-04284-26998-29663
00123-02531-04734-11784-37996	00123-02531-04734-26693-37996
00123-02531-11478-17344-37959	00123-02531-11478-26998-37959
00123-02531-11784-29598-37996	00123-02531-17344-29663-37959
00123-02531-24548-26643-37446	00123-02531-24663-26448-37454
00123-02811-04078-14473-17934	00123-02811-04078-14473-26984
00123-02811-04078-14793-26998	00123-02811-04078-17344-29684
00123-02811-04078-17934-29968	00123-02811-04078-26998-29684

00123-02811-04478-07984-26968	00123-02811-04478-25934-26968
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00123-02811-07844-26968-29534	00123-02811-24539-25443-26468
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00123-03152-14547-17399-18842	00123-03152-14547-17399-33679
00123-03152-14547-26448-33679	00123-03152-14882-26454-29936
00123-03362-04067-17344-24689	00123-03362-04067-17443-19734
00123-03362-04067-17443-24698	00123-03362-04067-19734-26899
00123-03362-04067-19743-26998	00123-03362-04067-24698-26899
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$H_0 = Z_2 \times Z_2 \times Z_9, H_1 = \mathbb{Z}$	
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00112-02234-03679-08691-28939	00112-02234-03679-08691-37484
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00112-02234-03741-08679-36439	00112-02234-03741-08679-36484
00112-02234-03741-13542-18489	00112-02234-03741-13542-18939

00112-02234-03741-13542-36439	00112-02234-03741-13542-36484
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00112-02234-08691-18542-28939	00112-02234-08691-18542-37484
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00112-02234-13569-18542-28489	00112-02234-13569-18542-37439
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00112-02364-03541-28434-48677	00112-02364-03541-37989-48677
00112-02364-03569-13922-28984	00112-02364-03569-13922-34379
00112-02364-03569-28984-48677	00112-02364-03569-34379-48677
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00112-02364-08569-28434-48677	00112-02364-08569-37989-48677
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00112-03541-13759-18922-23934	00112-03541-13759-18922-48798
00112-03541-13759-23934-36774	00112-03541-13759-36774-48798
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00112-03564-18754-28489-67798	00112-03564-18754-37439-67798
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00112-03674-08791-13484-37754	00112-03674-08791-13934-37754
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00112-03674-13484-23564-37754	00112-03674-13934-23564-37754
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00112-03679-13569-37439-59877	00112-03691-13592-23934-37754
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00112-03741-13542-18489-59877	00112-03741-13542-18939-59877
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00121-02234-08669-18939-28574	00121-02234-08669-28574-36484
00121-02234-11354-18939-28574	00121-02234-11354-28574-36484
00121-02374-03669-08422-48986	00121-02374-03669-35779-48986

00121-02374-08422-11854-48986	00121-02374-11854-35779-48986
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00121-02379-08922-11859-13934	00121-02379-11859-13934-35774
00121-03422-08669-18489-23759	00121-03422-08669-23759-36439
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00121-03664-13484-23579-37754	00121-03664-13934-28754-35774
00121-03664-23579-37754-39869	00121-03664-28754-35774-48698
00121-03792-11354-18939-59877	00121-03792-11354-36484-59877
00121-11354-18489-23759-57798	00121-11354-18939-28574-59877
00121-11354-23759-36439-57798	00121-11354-28574-36484-59877
00123-02568-04784-17344-37966	00123-02568-04784-26998-37966
00123-02568-17344-29593-37966	00123-02568-24543-26448-37466
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00123-02804-07811-17344-47968	00123-02804-07811-26998-47968
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00123-02844-04798-14173-25663	00123-02844-04798-25663-26968
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00123-03157-04674-24336-26998	00123-03157-14542-17399-29336
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00123-03367-04462-15924-26898	00123-03367-14457-15429-26848
00123-04062-17344-18852-19243	00123-04062-17344-18852-46897
00123-04462-15924-17343-18852	00123-04798-07811-26968-37599
00123-04798-14173-25663-37599	00123-07811-24539-26468-37544
00123-14173-25663-29534-37599	00123-14293-17344-25663-37595
$H_0 = Z_2 \times Z_2 \times Z_7, H_1 = \mathbb{Z}$	
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00123-02814-04731-11784-25344	00123-02814-04731-25344-26693
00123-02814-07998-11784-29568	00123-02814-07998-26693-29568

00123-02814-11784-25344-29568	00123-02814-25344-26693-29568
00123-02841-04478-07314-11798	00123-02841-04478-07314-26634
00123-02841-04478-11798-25968	00123-02841-04478-25968-26634
00123-02841-07314-11798-29953	00123-02841-07314-26634-29953
00123-02841-11798-25968-29953	00123-02841-25968-26634-29953
00123-03174-04362-06997-19882	00123-03174-04362-15244-19882
00123-03174-06997-18957-19882	00123-03174-06997-18957-33467
00123-03174-15244-18957-19882	00123-03174-15244-18957-33467
00123-04362-06997-19882-26859	00123-04362-15244-19882-26859
00123-04468-06347-07184-22869	00123-04468-06347-13774-25936
00123-04468-13774-15298-25936	00123-04478-11798-25968-37569
00123-04478-25968-26634-37569	00123-04731-07998-11784-37596
00123-07448-11789-24568-37546	00123-14882-15299-18457-26854
$H_0 = Z_2 \times Z_2 \times Z_5, H_1 = \mathbb{Z} \times Z_{11}$	
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00123-02534-04281-17844-29668	00123-02534-04281-26993-29668
00123-02534-11473-17844-37956	00123-02534-11473-26993-37956
00123-02534-17844-29668-37956	00123-02534-26993-29668-37956
00123-02811-04178-07344-29684	00123-02811-04178-14793-25998
00123-02811-04178-25998-29684	00123-02811-04798-25968-26993
00123-02811-07344-26953-29684	00123-02811-24539-25468-26443
00123-03362-06479-14482-26845	00123-03362-06479-26845-39967
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00123-03624-04152-17433-19982	00123-03624-04152-17433-34467
00123-03624-04152-26889-34467	00123-03624-06957-17433-19982
00123-03624-06957-17433-34467	00123-03624-06957-26889-34467
00123-04152-17433-18597-19982	00123-04152-18597-26889-34467
00123-04178-07344-29684-37566	00123-04178-14793-25998-37566
00123-04281-07598-17844-29668	00123-04798-07314-26993-37566
00123-07344-26953-29684-37566	00123-07548-17899-24668-37456
$H_0 = Z_2 \times Z_2 \times Z_5, H_1 = \mathbb{Z}$	

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00112-02134-03791-18774-35439	00112-02134-03791-22369-35439
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00112-03674-08779-37564-39869	00112-03674-08779-37564-48698

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00121-11354-18759-37484-57798	00121-11354-18759-37984-48577
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00123-02804-07841-26634-29968	00123-02804-11798-14473-25693
00123-02804-14473-25693-26634	00123-02804-25668-26993-34796
00123-02804-25693-26634-29968	00123-02814-04798-07311-17844
00123-02814-04798-07311-26993	00123-02814-04798-25668-26993
00123-02814-07311-17844-29534	00123-02814-07311-26993-29534
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00123-02844-04178-25668-34796	00123-02844-04798-07311-14178
00123-02844-04798-07311-26963	00123-02844-04798-14178-25668
00123-02844-04798-25668-26963	00123-02844-07311-26953-34796
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00123-02844-25668-26953-34796	00123-02844-25668-26963-29534
00123-03157-04174-19982-24336	00123-03157-04174-24336-34467
00123-03157-24336-26959-34467	00123-03174-04152-19982-24336
00123-03174-04152-24336-34467	00123-03174-06957-19982-24336
00123-03174-06957-24336-34467	00123-03467-04062-17443-18824
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00123-03467-15957-17443-33697	00123-03467-15957-18824-26899
00123-03467-15957-26899-33697	00123-04062-17443-18824-19852
00123-04062-17443-19852-33697	00123-04062-18824-19852-26899

00123-04062-18974-26885-34467	00123-04062-19852-26899-33697
00123-04152-24336-26859-34467	00123-04174-06852-19982-24336
00123-04178-25668-34796-37599	00123-04462-15924-18982-26885
00123-04468-06377-25986-29369	00123-04468-15228-25986-29369
00123-04798-07311-14178-37599	00123-04798-07311-17844-37596
00123-04798-07311-26963-37599	00123-04798-07311-26993-37596
00123-04798-14178-25668-37599	00123-06377-07134-18474-19953
00123-06377-14453-18979-25486	00123-06457-26854-29336-39967
00123-06734-19957-24369-26885	00123-07134-15228-18474-19953
00123-07311-24539-26443-37546	00123-07311-24539-26463-37544
00123-07841-11798-14473-37595	00123-07841-14473-26634-37595
00123-11748-19973-25643-37545	00123-14178-25668-29534-37599
00123-14457-15429-18482-26885	00123-14457-15429-26885-36739
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00124-02548-08741-11829-26334	00124-02548-11829-23569-26334
00124-03179-13289-25669-47588	00124-07539-08741-26334-36647
00124-07539-23569-26334-36647	00124-07541-08748-26334-36647
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$H_0 = Z_2 \times Z_2 \times Z_3 \times Z_5, H_1 = \mathbb{Z}$	
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00121-02234-03669-13579-28939	00121-02234-03669-13579-37484
00121-02234-08642-11854-28939	00121-02234-08642-11854-37484
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00121-02364-11354-28984-48577	00121-02364-11354-34379-48577
00121-03422-08664-18754-28489	00121-03422-08664-18754-37439
00121-03422-11359-18754-28489	00121-03422-11359-18754-37439

00121-03642-08669-23989-37759	00121-03642-08669-34874-37759
00121-03642-11354-23989-37759	00121-03642-11354-34874-37759
00121-03664-13754-35779-48987	00121-03669-13579-28939-59877
00121-03669-13579-37484-59877	00121-03669-13759-23934-35774
00121-11354-18579-23989-37759	00121-11354-18579-34874-37759
00121-11354-18759-28984-48577	00121-11354-18759-34379-48577
$H_0 = Z_2 \times Z_2 \times Z_3 \times Z_3, H_1 = \mathbb{Z} \times Z_3$	
00112-02234-03691-08679-28939	00112-02234-03691-08679-37484
00112-02234-03691-13542-28939	00112-02234-03691-13542-37484
00112-02234-08679-18564-28939	00112-02234-08679-18564-37484
00112-02234-13542-18564-28939	00112-02234-13542-18564-37484
00112-02364-03569-13422-28489	00112-02364-03569-13422-37439
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00112-02364-08541-28489-67798	00112-02364-08541-37439-67798
00112-03541-13759-18422-48987	00112-03541-13759-36779-48987
00112-03564-13922-18754-28984	00112-03564-13922-18754-34379
00112-03564-18754-28984-48677	00112-03564-18754-34379-48677
00112-03591-13754-18922-23934	00112-03591-13754-23934-36774
00112-03674-08641-23484-37754	00112-03674-08641-37754-39879
00112-03674-13569-23484-37754	00112-03674-13569-37754-39879
00112-03691-13542-28939-59877	00112-03691-13542-37484-59877
00112-13542-18564-28939-59877	00112-13542-18564-37484-59877
$H_0 = Z_2 \times Z_2 \times Z_3, H_1 = \mathbb{Z} \times Z_{19}$	
00112-02234-03691-08679-28439	00112-02234-03691-08679-37489
00112-02234-03691-13542-28439	00112-02234-03691-13542-37489
00112-02234-08679-18564-28439	00112-02234-08679-18564-37489
00112-02234-13542-18564-28439	00112-02234-13542-18564-37489
00112-02364-03569-13422-28439	00112-02364-03569-13422-37489
00112-02364-03569-28439-67798	00112-02364-03569-37489-67798
00112-02364-08541-13422-28439	00112-02364-08541-13422-37489

00112-02364-08541-28439-67798	00112-02364-08541-37489-67798
00112-03541-13759-18422-23489	00112-03541-13759-18422-39874
00112-03541-13759-23489-36779	00112-03541-13759-36779-39874
00112-03564-13922-18754-28934	00112-03564-13922-18754-37984
00112-03564-18754-28934-48677	00112-03564-18754-37984-48677
00112-03674-08641-23984-37754	00112-03674-08641-34879-37754
00112-03674-13569-23984-37754	00112-03674-13569-34879-37754
00112-03691-13542-28439-59877	00112-03691-13542-37489-59877
00112-13542-18564-28439-59877	00112-13542-18564-37489-59877
$H_0 = Z_2 \times Z_2 \times Z_3, H_1 = \mathbb{Z} \times Z_{13}$	
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00123-02531-17344-29593-37966	00123-02531-24543-26448-37466
00123-02804-07811-14793-17344	00123-02804-07811-14793-26998
00123-02804-07811-17344-29684	00123-02804-07811-26998-29684
00123-02804-14793-25663-26998	00123-02804-17344-25663-29684
00123-02804-25663-26998-29684	00123-02844-07811-26968-34795
00123-02844-14173-25663-34795	00123-02844-25663-26968-34795
00123-03152-04674-17344-24336	00123-03152-04674-24336-26998
00123-03152-14542-17399-29336	00123-03367-04062-17344-24689
00123-03367-04062-19743-26998	00123-03367-04462-15974-26898
00123-03367-06429-14457-26848	00123-04062-17344-18852-19743
00123-04062-17344-18852-24689	00123-04062-18852-24689-26998
00123-04462-15974-17343-18852	00123-06429-14457-17393-18852
00123-07811-14793-17344-37595	00123-07811-14793-26998-37595
00123-07811-24689-26448-37545	00123-14173-25663-34795-37599
00123-15457-17399-18852-29684	00123-15457-18852-26448-29684
$H_0 = Z_2 \times Z_2 \times Z_3, H_1 = \mathbb{Z} \times Z_7$	
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00112-02134-03569-22364-28939	00112-02134-03569-22364-37484
00112-02134-03691-08779-28489	00112-02134-03691-08779-37439
00112-02134-03691-22354-28489	00112-02134-03691-22354-37439

00112-02134-08541-18779-28939	00112-02134-08541-18779-37484
00112-02134-08541-22364-28939	00112-02134-08541-22364-37484
00112-02134-08779-18564-28489	00112-02134-08779-18564-37439
00112-02134-18564-22354-28489	00112-02134-18564-22354-37439
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00112-03774-13569-23934-36754	00112-03774-13569-36754-48798
00112-13564-22854-36759-48987	00112-13569-22859-23934-36754
$H_0 = Z_2 \times Z_2 \times Z_3, H_1 = \mathbb{Z}$	
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00112-02234-03679-13569-28439	00112-02234-03679-13569-37489
00112-02234-08641-18542-28439	00112-02234-08641-18542-37489
00112-02234-13569-18542-28439	00112-02234-13569-18542-37489
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00112-02364-03541-28934-48677	00112-02364-03541-37984-48677
00112-02364-08569-13922-28934	00112-02364-08569-13922-37984
00112-02364-08569-28934-48677	00112-02364-08569-37984-48677
00112-03541-13922-18759-28934	00112-03541-13922-18759-37984
00112-03541-18759-28934-48677	00112-03541-18759-37984-48677
00112-03564-13754-18422-23489	00112-03564-13754-18422-39874
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00112-13542-18569-23489-37759	00112-13542-18569-37759-39874
00121-02234-03792-08669-18489	00121-02234-03792-08669-36439
00121-02234-03792-11354-18489	00121-02234-03792-11354-36439

00121-02234-08669-18489-28574	00121-02234-08669-28574-36439
00121-02234-11354-18489-28574	00121-02234-11354-28574-36439
00121-02374-03669-08422-13989	00121-02374-03669-08422-34864
00121-02374-03669-13989-35779	00121-02374-03669-34864-35779
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TABLE 0.2: Non-Positively Presented Groups