

## Broken Circles, Broken Squares

### LEARNING TO COOPERATE

The most basic lesson that students must learn when working in groups is to be sensitive and responsive to the needs of other members of the group. They must also learn that they are part of an interdependent group. What happens in the group is important for them. There are two specific norms that express these ideas simply:

PAY ATTENTION TO WHAT OTHER GROUP MEMBERS NEED

NO ONE IS DONE UNTIL EVERYONE IS DONE

This is so different from conventional classroom behavior and so necessary for successful cooperative learning that we recommend that each class start out with one such activity. We present two activities that can develop these norms: Advanced Broken Circles and Broken Squares.

The instructions to the participants and suggested discussion given below are those of the developers of Broken Circles, Nancy and Ted Graves (Graves & Graves, 1985). Broken Circles is based on the Broken Squares game invented by Dr. Alex Bavelas (1973).

The class is divided into groups of 3-6 persons. Each person is given an envelope with different pieces of the circle. The goal is for each person to put together a complete circle. In order for this goal to be reached, there must be some exchange of pieces. Group members are not allowed to talk or to take pieces from someone else's envelope. They are allowed only to give away their pieces (one at a time)..

#### **Instructions to the participants:**

Each of you will be given an envelope containing two or three pieces of a puzzle, but don't open it until I say so. The object of this exercise is to put these pieces together in such a way that each member of your group ends up with a complete circle. There are a few rules to make the exercise more fun.

1. This exercise must be played in complete silence. No talking.
2. You may not point or signal to other players with your hands in any way.
3. Each player must put together his or her own circle. No one else may show a player how to do it or do it for him or her.
4. This is an exercise in giving. You may not take a piece from another player, but you may give your pieces, one at a time, to any other members of your group, and other group members may give pieces to you. You may not place a piece in another person's puzzle; players must complete only their own puzzles. Instead, hand the piece to the other player, or place it beside the other pieces in front of him or her.

Now you may take the pieces out of your envelope and place them in front of you, colored side up. This is a group task, and you will have 10 minutes to make your circles.

Remember, the task is not finished until each of you at your table has a completed circle in front of you. When all of you have finished, raise your hands. (If one group finishes before the others, suggest that they try to discover if there are any other ways they could put the pieces together to form different circles.

## Discussion

When all groups have completed the task or the allotted time has ended, the teacher should help the participants to identify some of the important things that happened, analyze why they happened, and generalize to other group learning situations. The following questions can serve as a guide to the discussion:

What do you think this exercise was all about?

How do you feel about what happened in your group today?

What things did you do in your group that helped you to be successful in solving the problem?

What things did you do that made it harder?

What could the groups do better in the future?

Help participants to be concrete about what they did, abstract about the general implications of what they did, and the lessons they learned for the future. In Advanced Broken Circles, one player may block the task for the rest of the group by completing his or her circle satisfactorily, but refusing to share some pieces with the others. This is analogous to a member of a cooperative learning group who tries to work alone and does not help other members.

In the discussion be sure to come back to the two key behaviors that make a group successful: **PAY ATTENTION TO WHAT OTHER GROUP MEMBERS NEED, NO ONE IS DONE TILL EVERYONE IS DONE.** Point out when groups report these kind of behaviors or when they decide these behaviors would help them do better in the future.

Directions for three levels of difficulty are presented. You may wish to use the intermediate and advanced versions, going on to the advanced version later in the year if you feel that this particular lesson needs to be reviewed.

## Instructions for Making a Set of Broken Circles

Below are the patterns for the Broken Circles activities. Using Advanced Broken Circles as an example, a single set consists of fifteen pieces that will make six circles, as shown in the summary figure. Make one set of six circles for each small group using heavy cardboard. The circles can be any size. However, all the circles within the set should be the same size.

Each **set** of six circles should be a different color. This way, each small group will be able to work with pieces that are all of the same color, and different from any other group's color. This will enable you to easily sort the pieces when you are preparing the materials for the activity.

After making a set of circles, cut it into pieces and mark each piece with the letters and numbers shown in the diagram. In Figure 1, the numbers indicate the group size. The letters indicate how to sort the pieces for the individuals within the group. You will sort differently depending on group size.

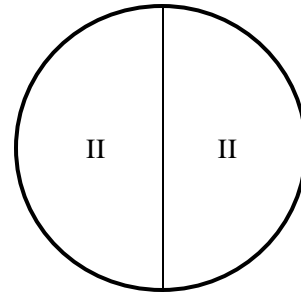
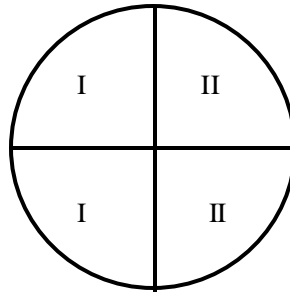
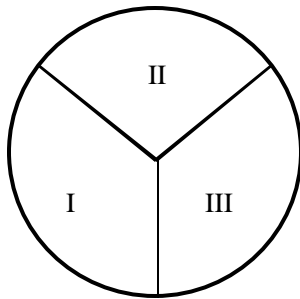
Prepare a set of envelopes marked with the letters (A, B, C, etc.; use as many envelopes as there will be members in the group). Take all the pieces with only letters on them and put them in the corresponding envelopes. These never change. The placement of the other four pieces varies with the size of the group. For example, if you are working with six-person groups, the piece marked 6=F goes into the F envelope, the 6=E piece goes into the E envelope, the 6=C piece into the C envelope and the 6=D piece into the D envelope. Repeat this pattern for each six-person group.

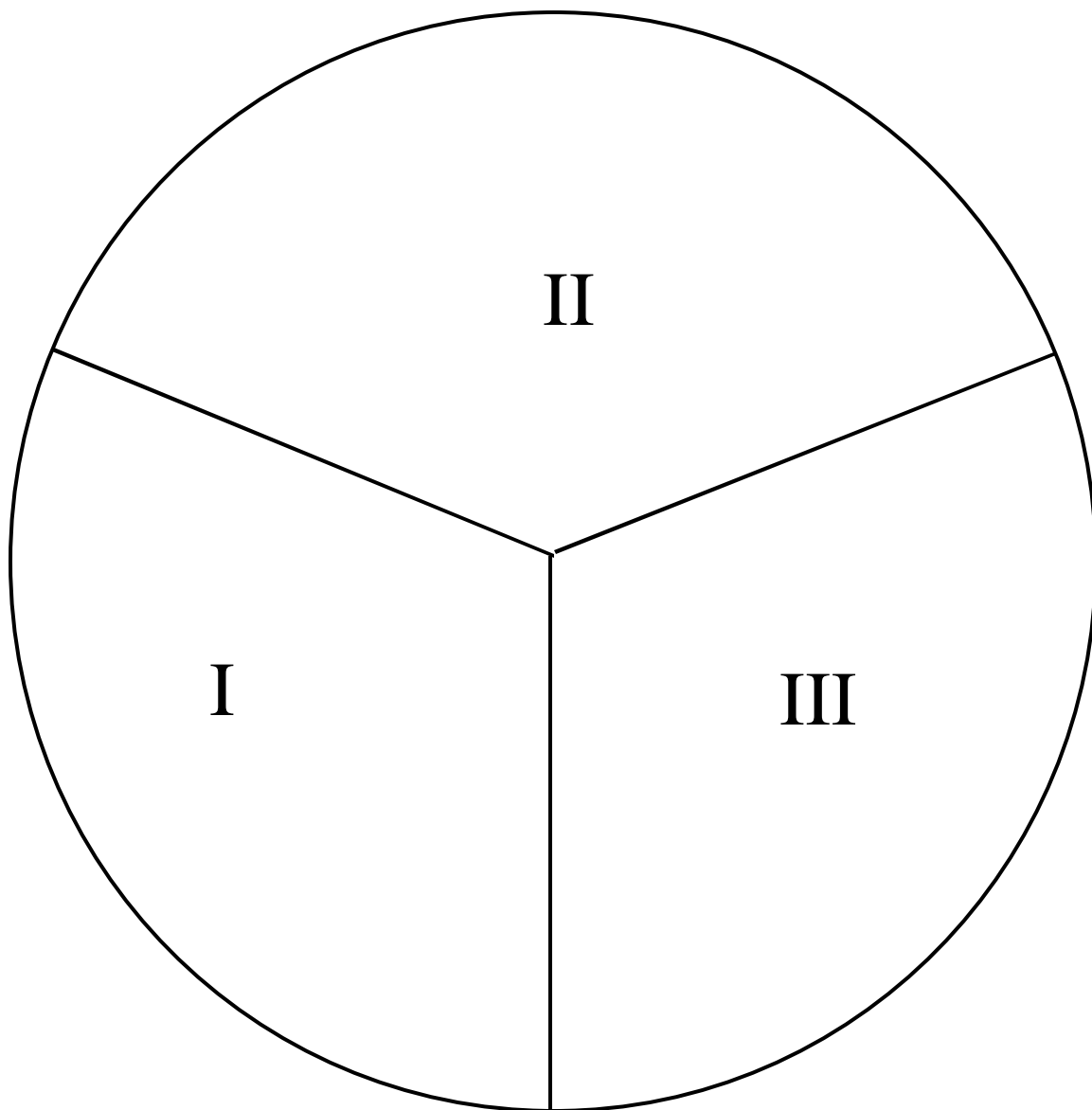
Once you have sorted a group set into the lettered envelopes, put these envelopes into a larger one. You are now ready to hand out the materials to the small group.

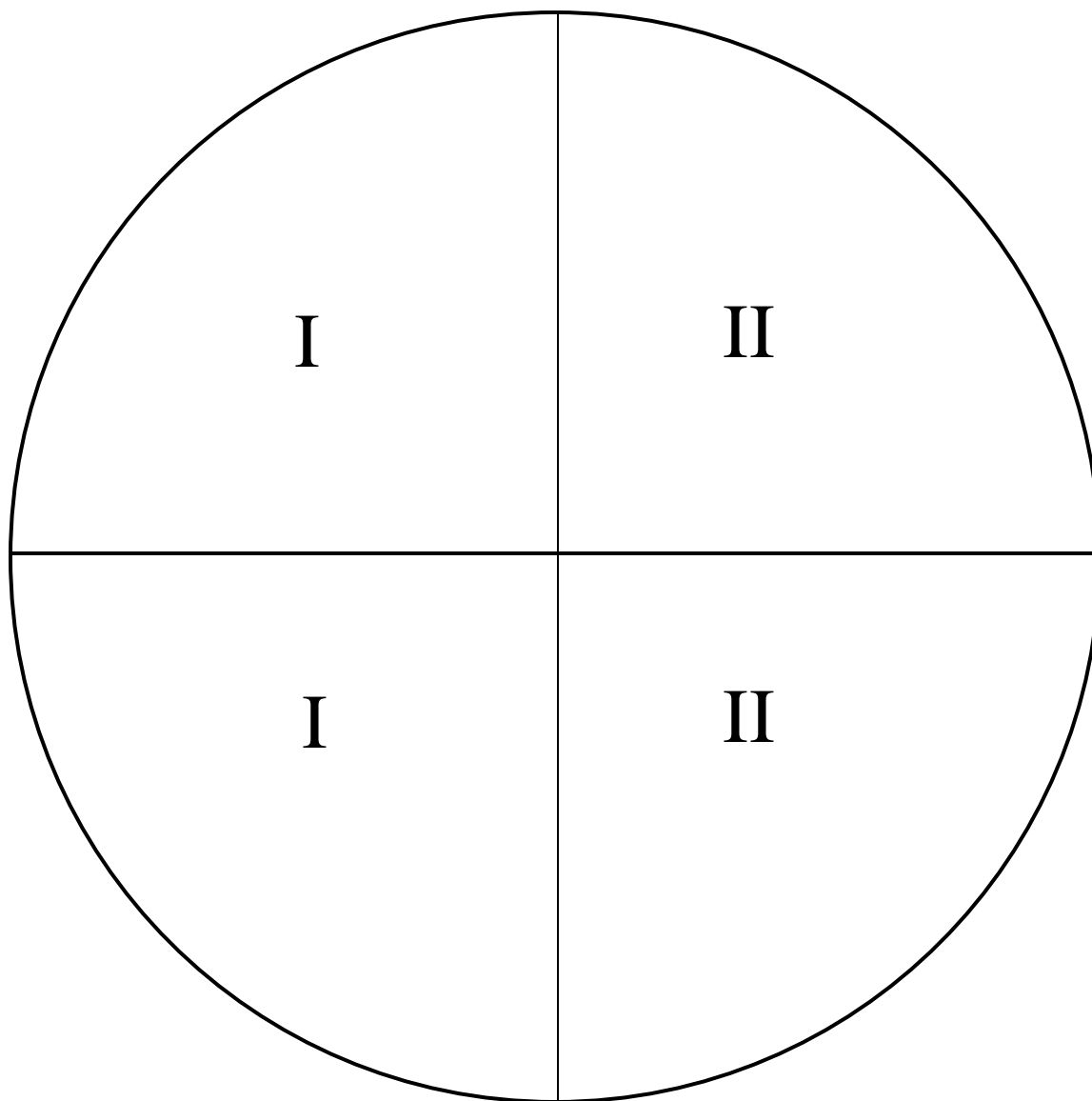
Although it is fairly easy on the spot to modify a set of six circles for groups of five or less, once you are familiar with the exercise, it is easier to make up and label sets of varying sizes in advance. Then these can be quickly substituted when required.

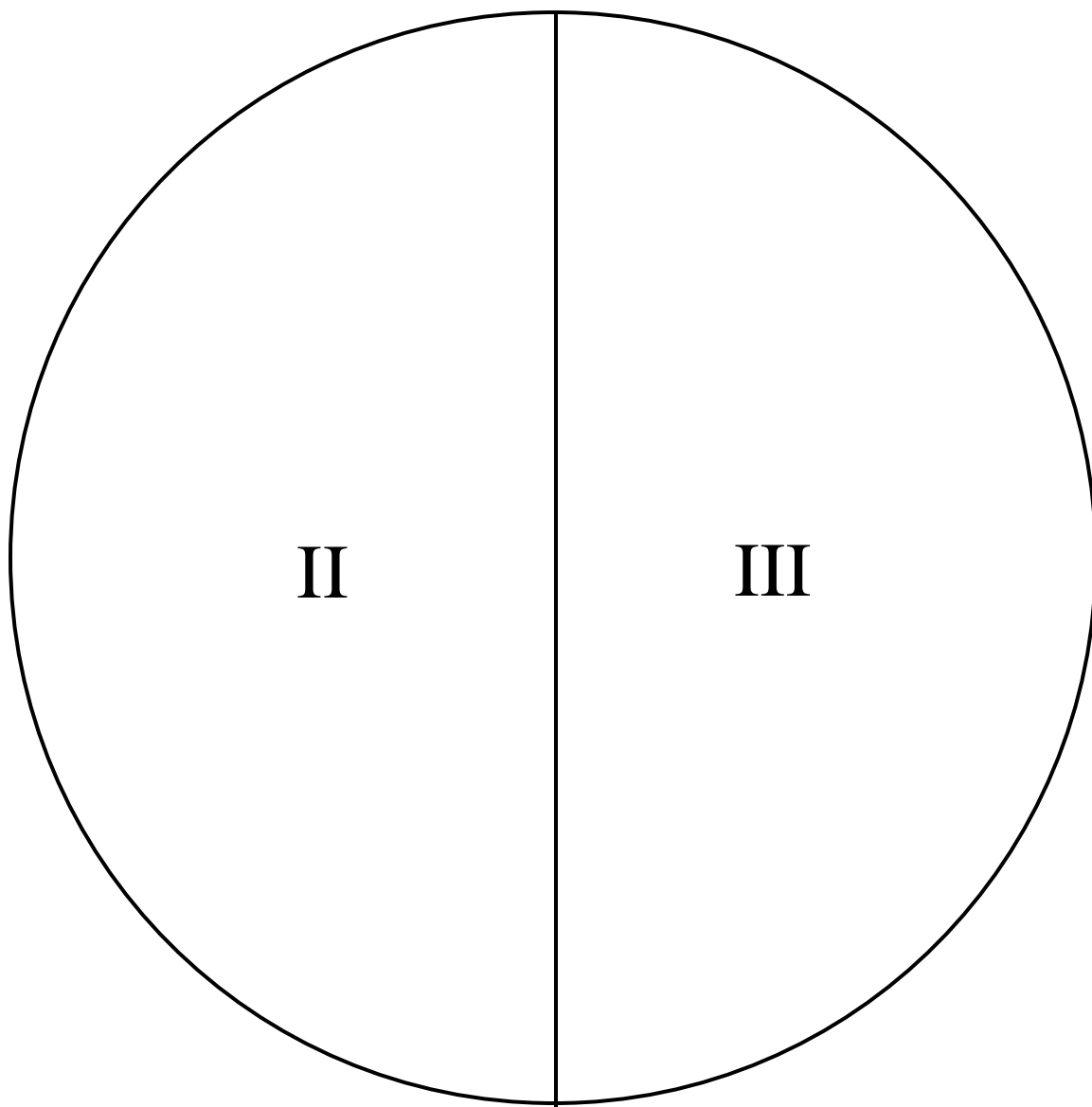
### **SIMPLEST BROKEN CIRCLES**

This pattern is suitable for children 5-7 years old in groups of three. Sort the pieces into three envelopes (I, II, and III, as marked below) and give one envelope to each student. The summary figure given below indicates one solution; in this solution each player must give up some of his or her pieces to other players. The diagram shows how pieces held by players I, II, and III can be rearranged to form three circles. Two circles composed of a half and two quarters represents an alternative solution.



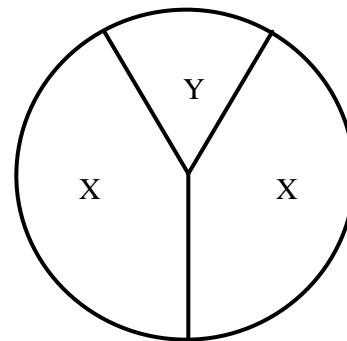
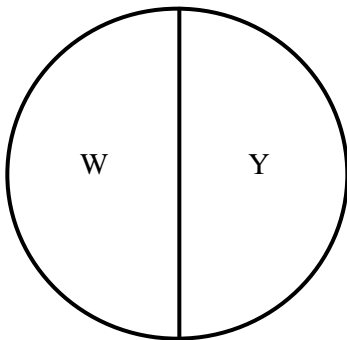
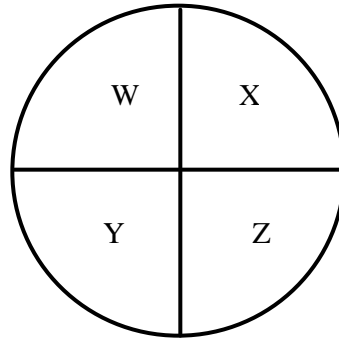
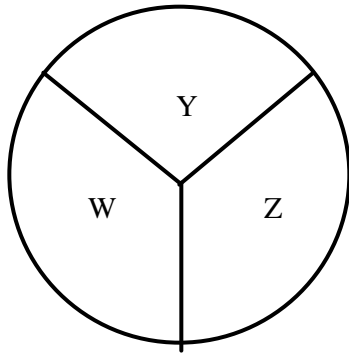


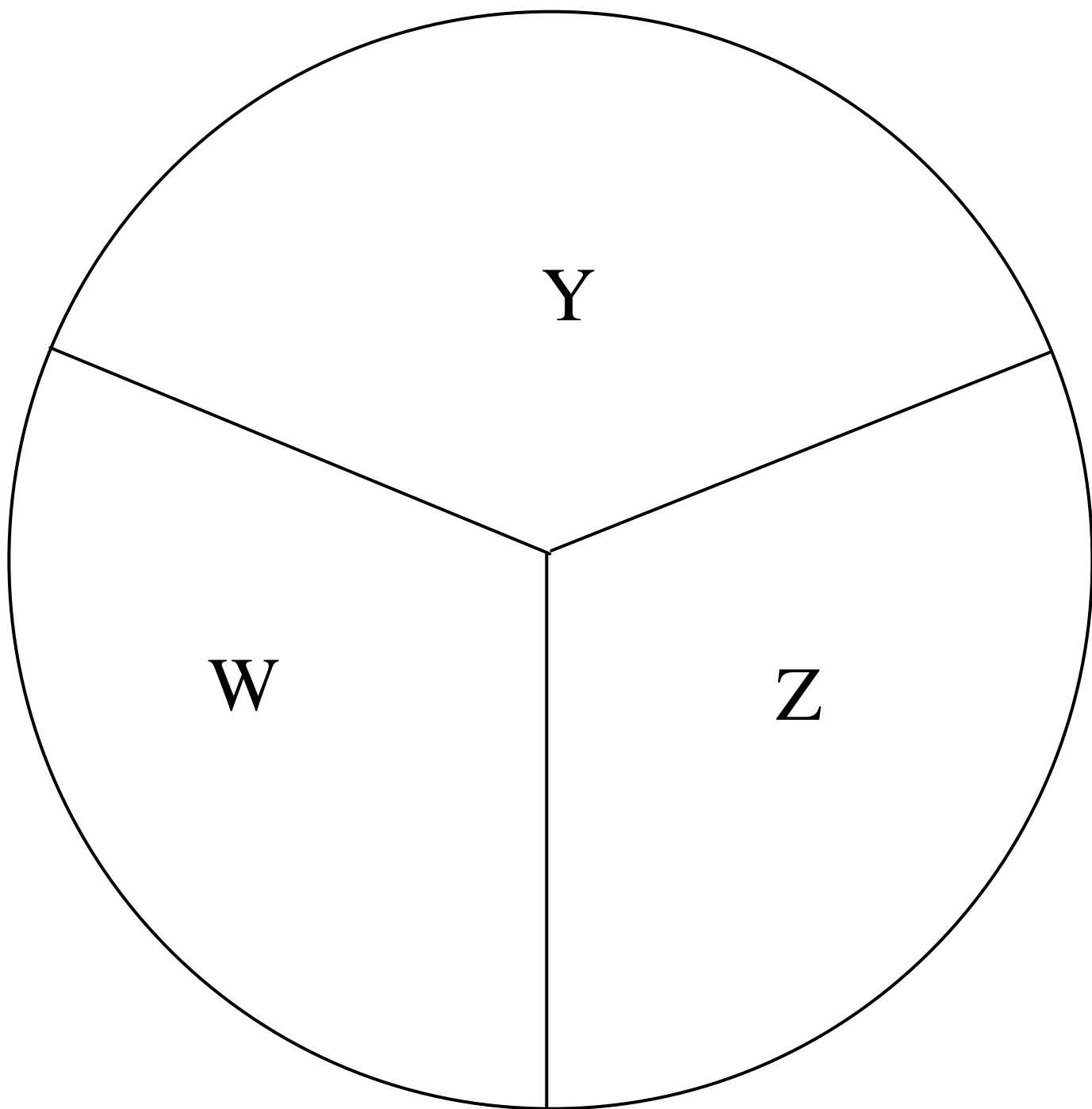




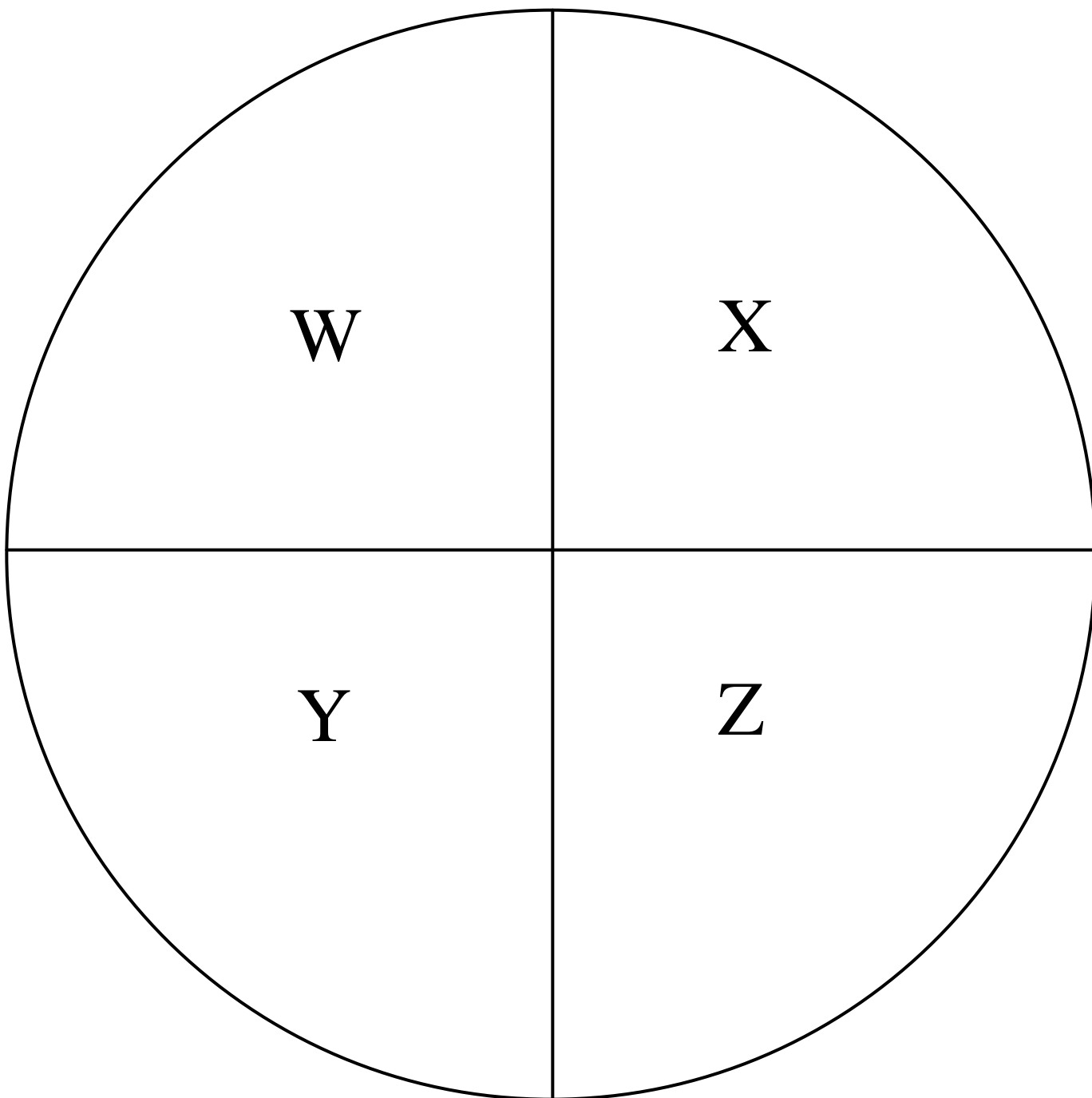
## SIMPLE BROKEN CIRCLES

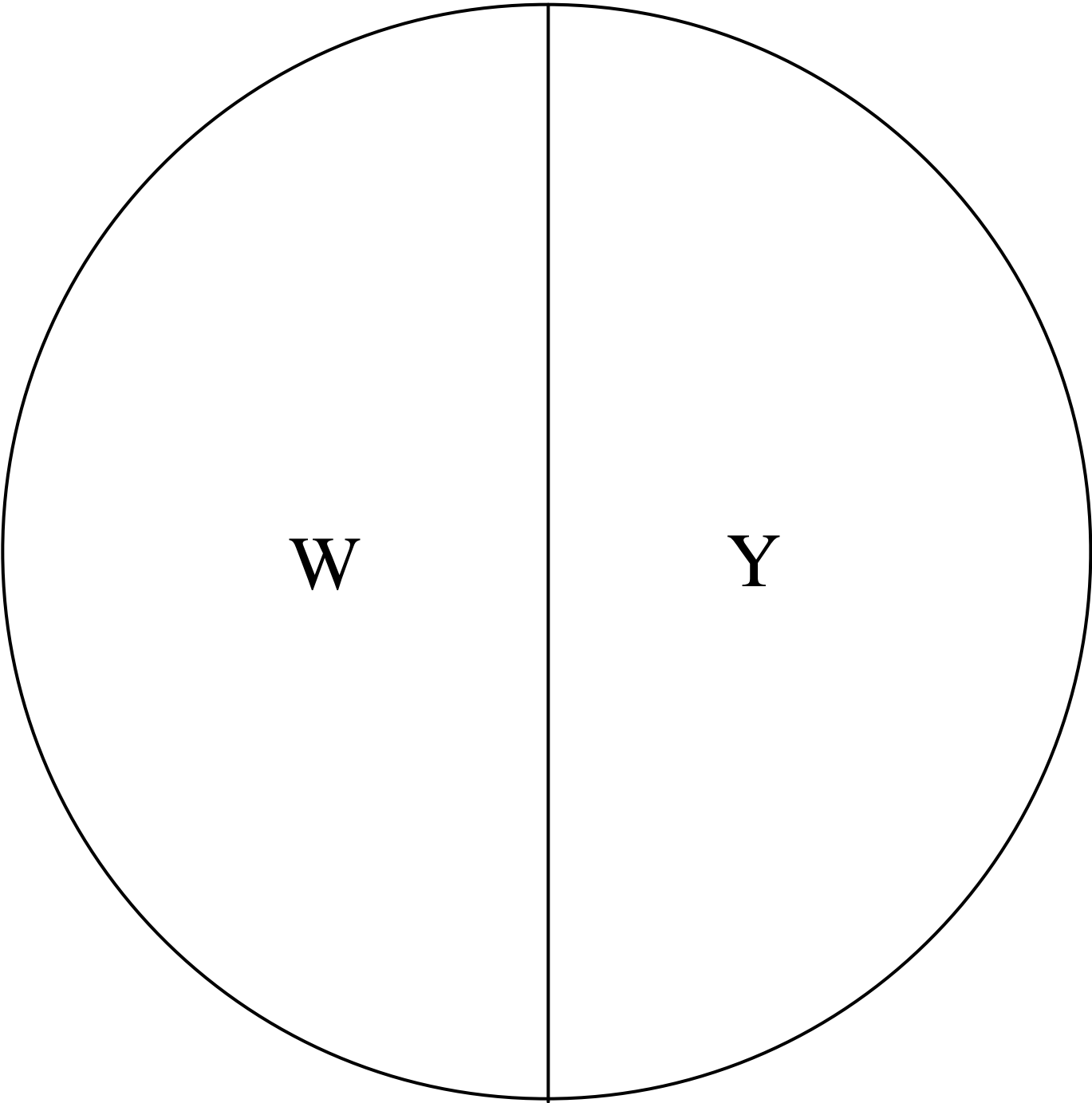
This pattern is suitable for children 8-10 years old in groups of four. Sort the pieces into four envelopes marked W, X, Y, and Z. The figure below indicates one solution. Ask the groups that finish first, "How many *other* ways of forming four circles can you discover?"





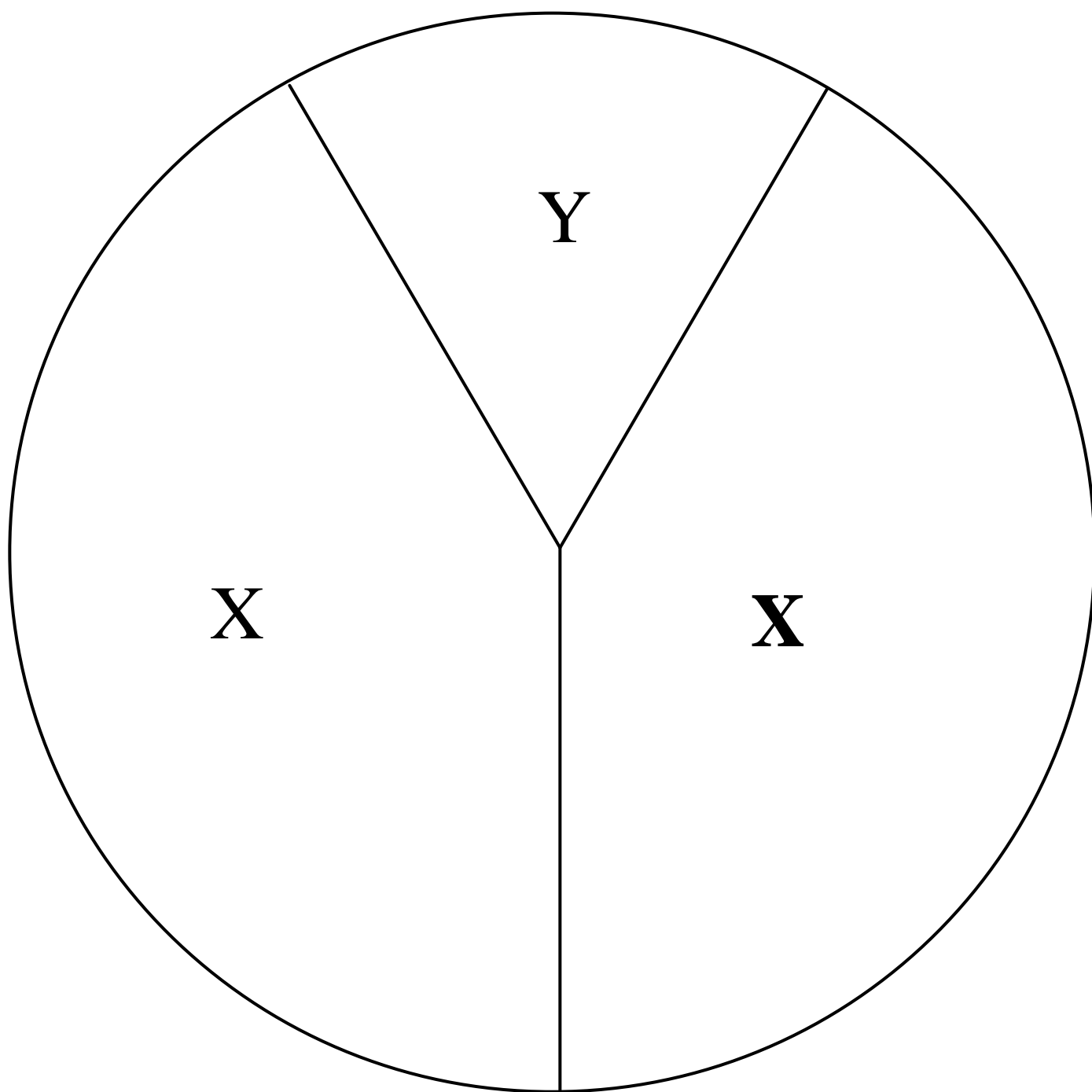






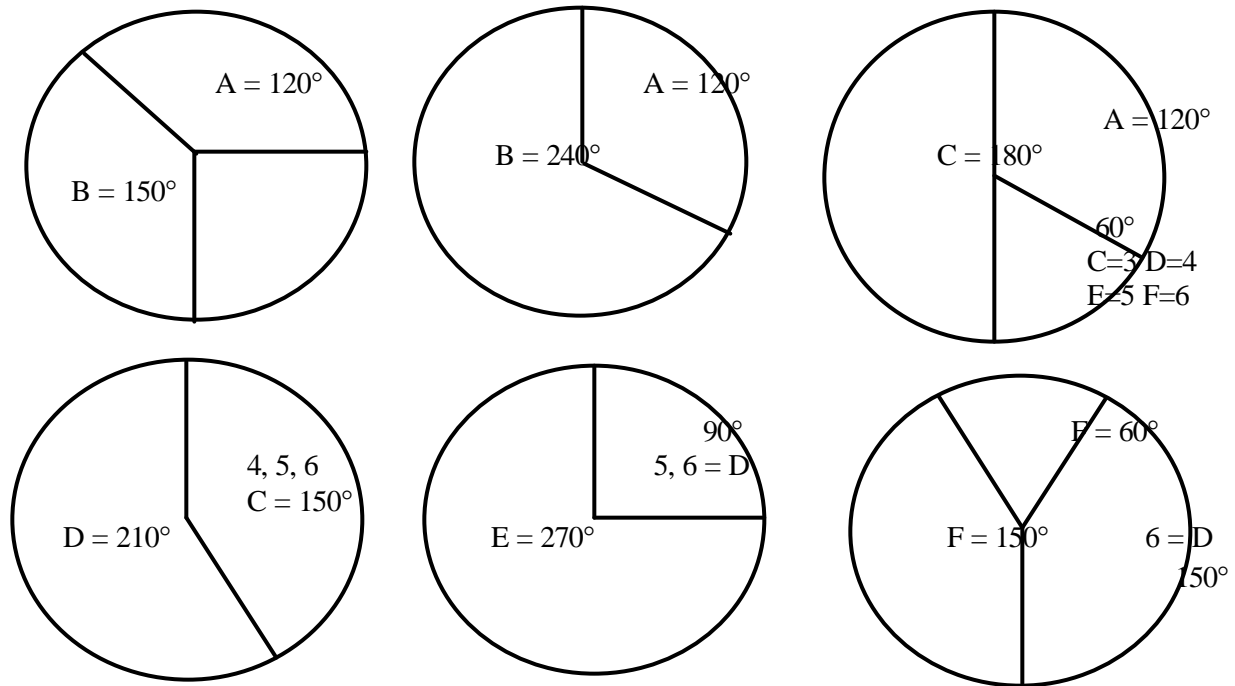
W

Y



## ADVANCED BROKEN CIRCLES

This pattern is suitable for children 8 - 10 who have had some experience with simple Broken Circles. It may also be used as a first exercise with older children and adults.



### Instructions For Making A Set Of Broken Circles

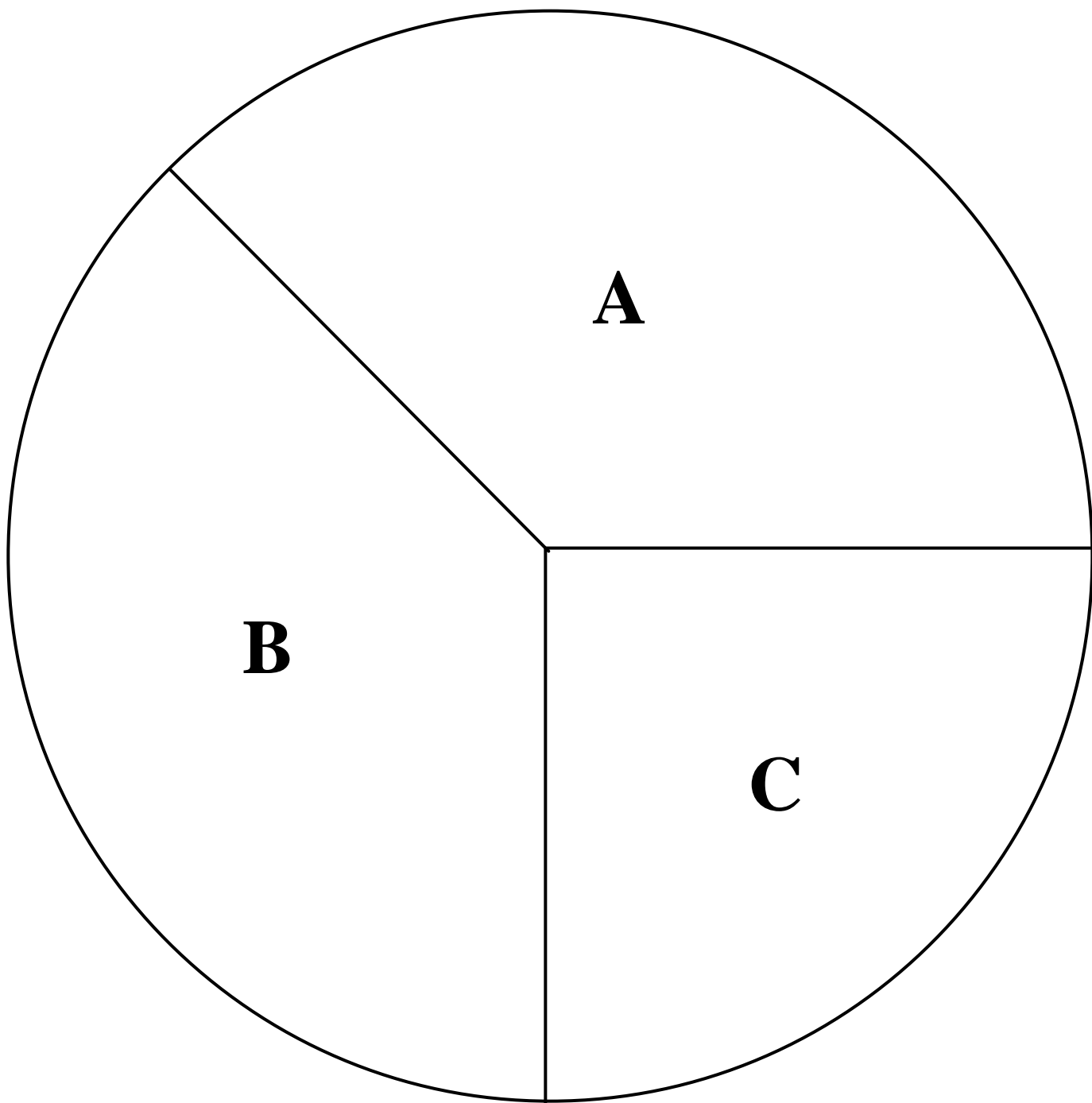
Make your set (one per group) from heavy cardboard, with the circles about 20 cm. in diameter. Each set of six circles should be a different color, with the letters and numbers (indicating which pieces go into which envelopes for groups of different sizes) marked on the back of each piece. Angles used are  $60^\circ$ ,  $90^\circ$ ,  $120^\circ$ ,  $150^\circ$ ,  $180^\circ$ ,  $210^\circ$ ,  $240^\circ$ , and  $270^\circ$ .

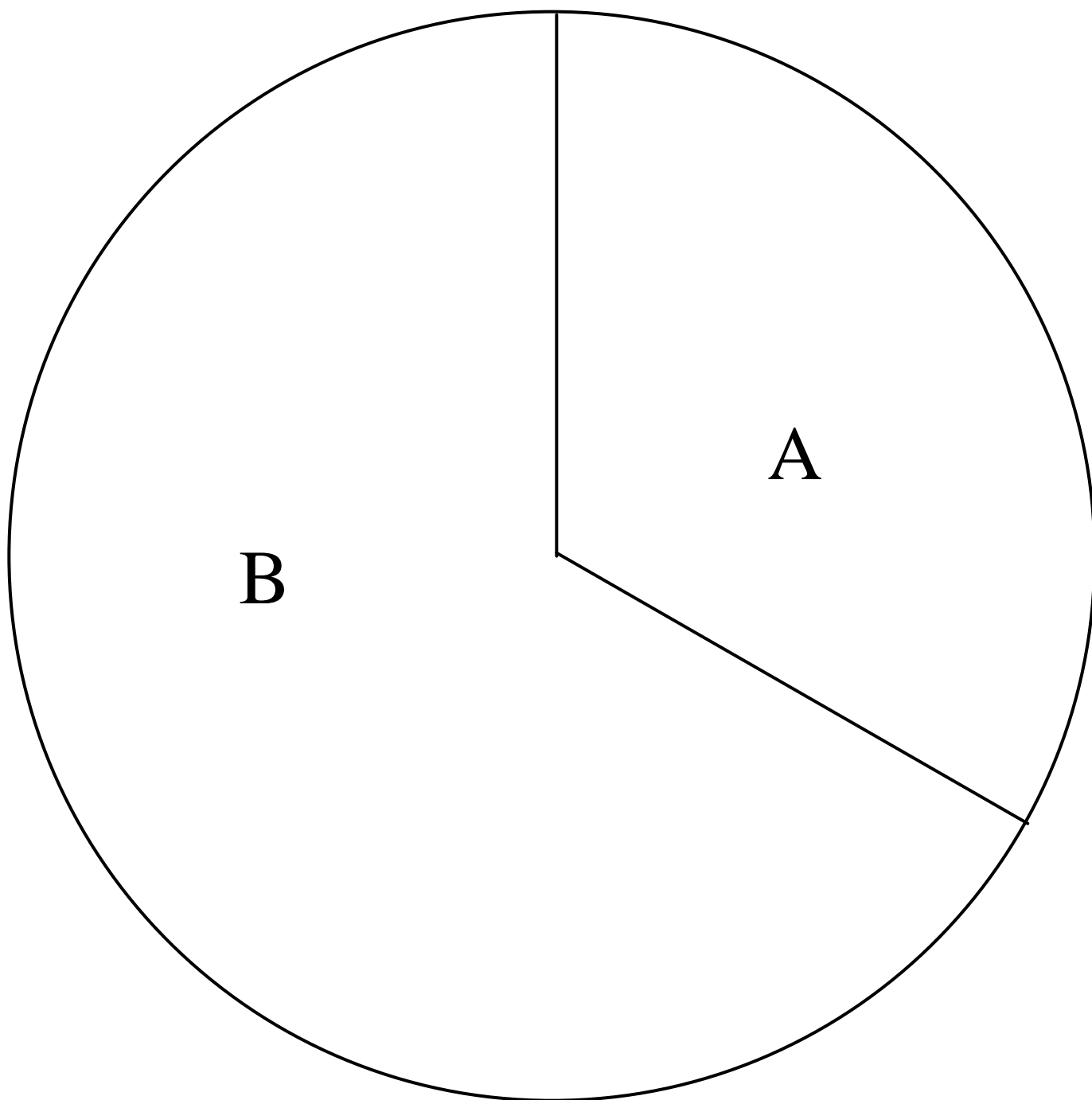
On the diagram above, the numbers indicate the group size, while the letters indicate the proper envelope.

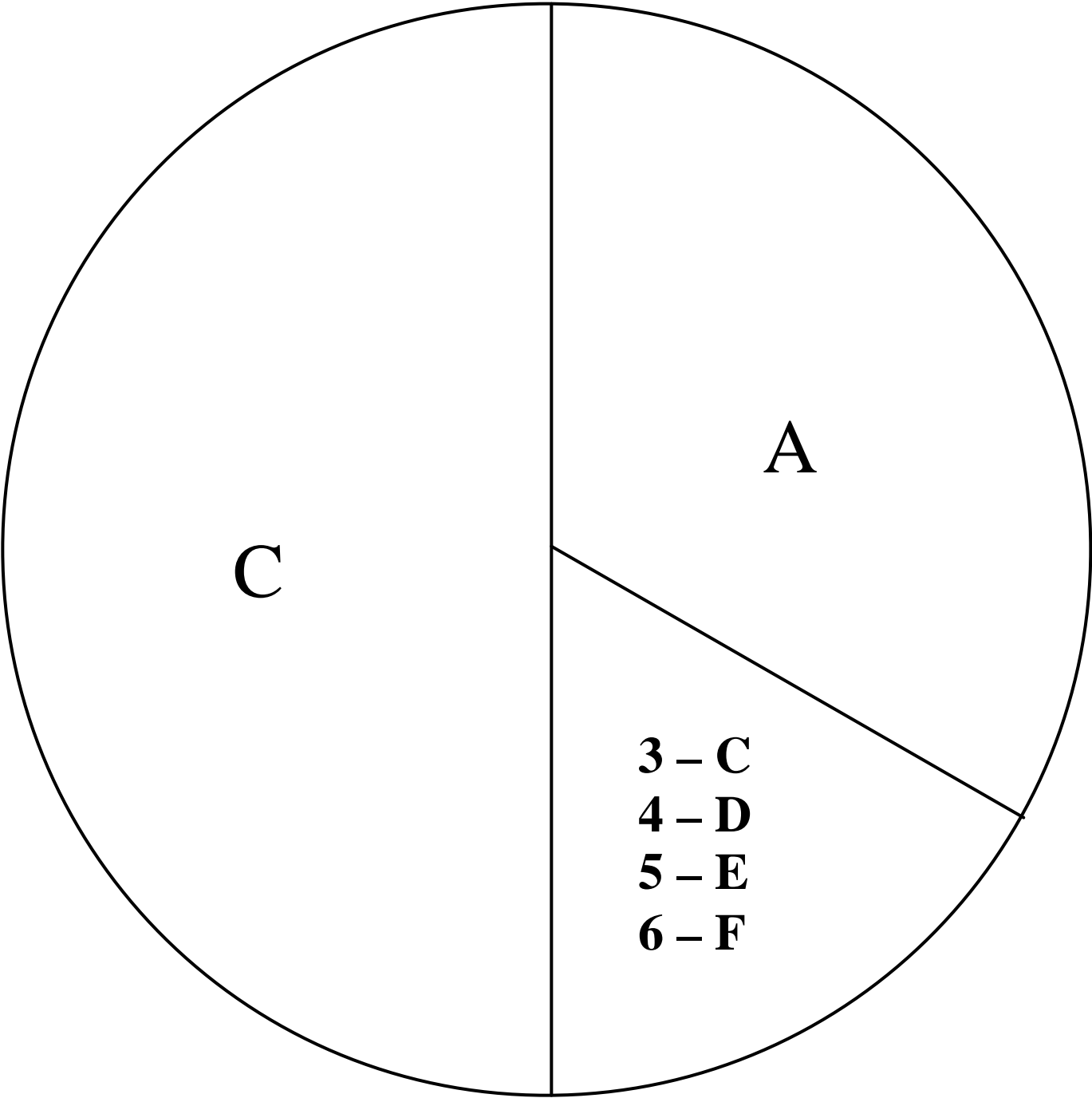
1. Take all the pieces with only a letter on them and put them into envelopes marked with those letters. These never change regardless of group size.

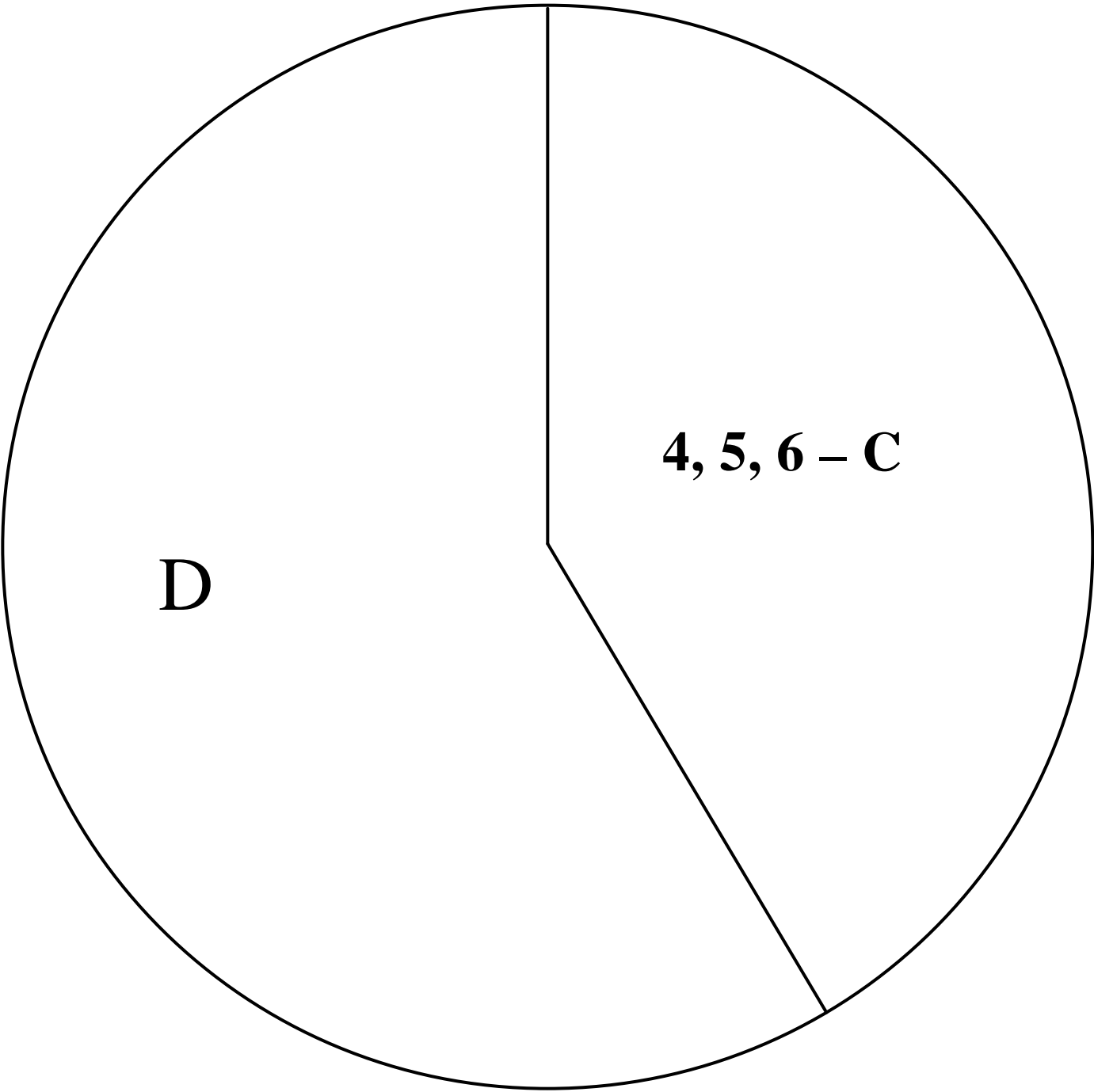
2. The placement of the other four pieces varies with the size of your group. For example, if you are working with six person groups, then the piece marked 6-F ( $60^\circ$ ) goes into the F envelope. You would add the 6-E piece ( $150^\circ$ ) to the E envelope, the 6-D piece ( $90^\circ$ ) to the D envelope, and the 6-C piece ( $150^\circ$ ) to the C envelope. Repeat this pattern for each six person group.

Although it is fairly easy on the spot to modify a set of six circles for groups of five or less, once you are familiar with the exercise, you may prefer to make up and label sets of varying sizes in advance. Then these can be quickly substituted where required.

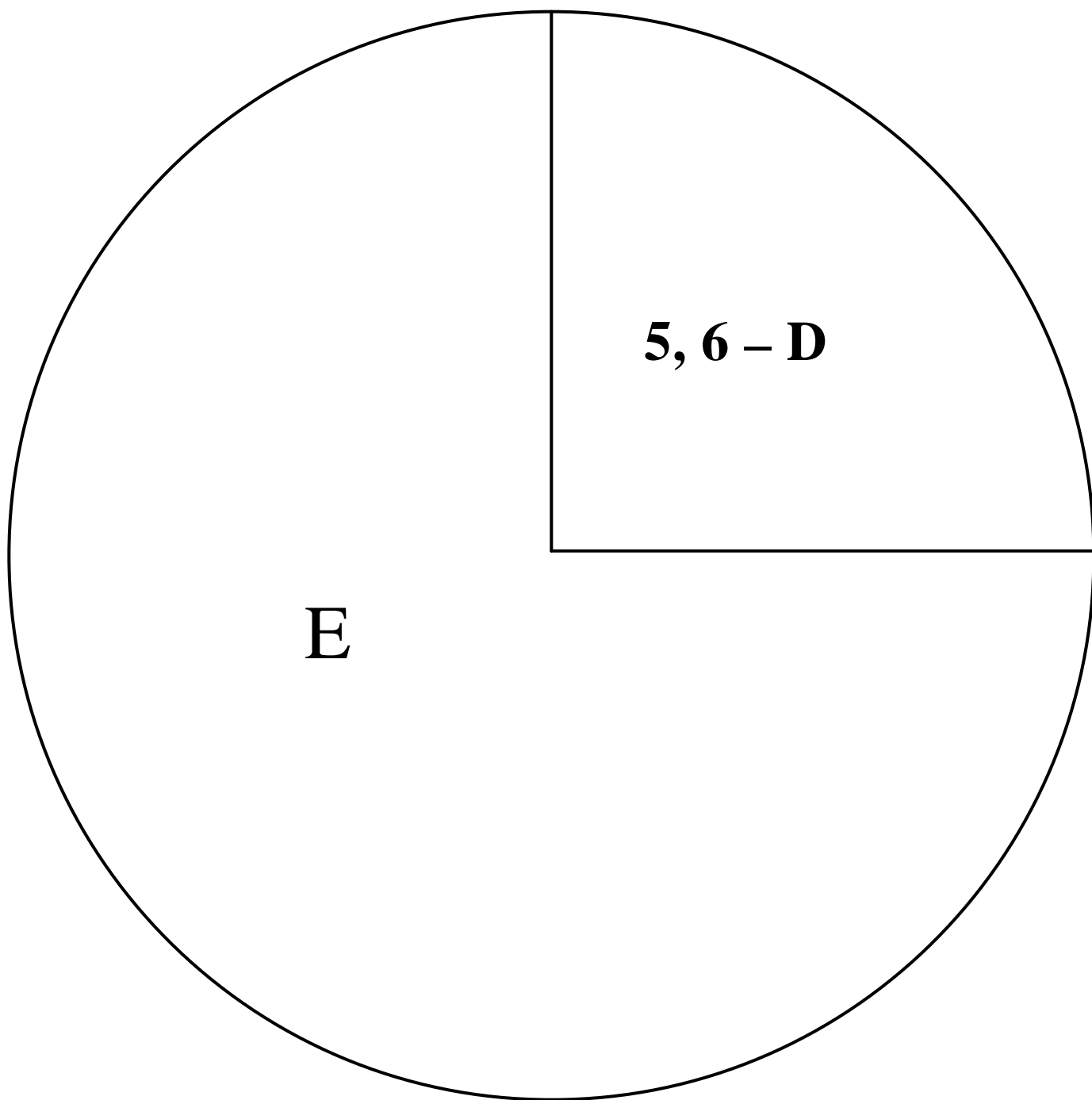


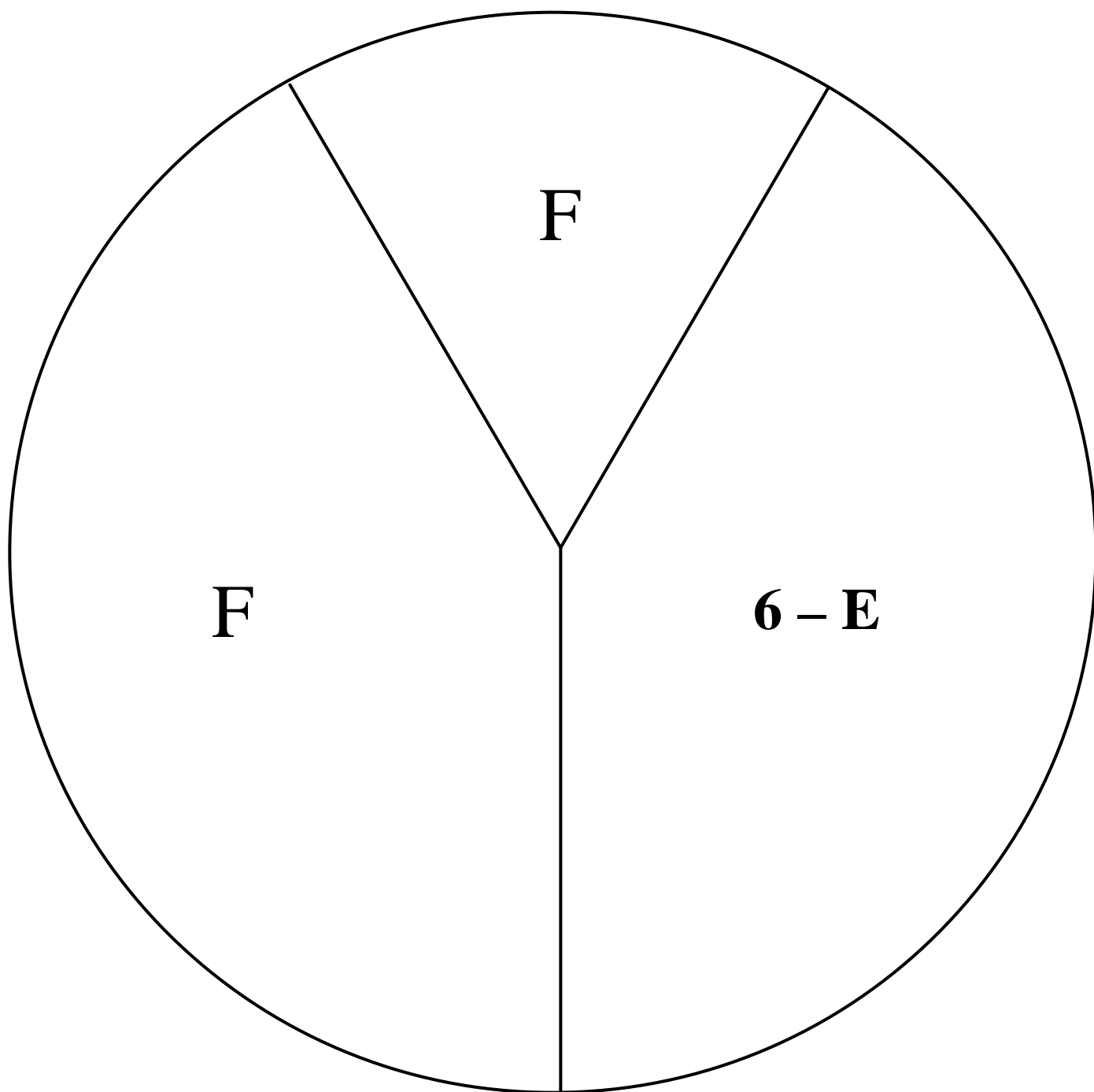










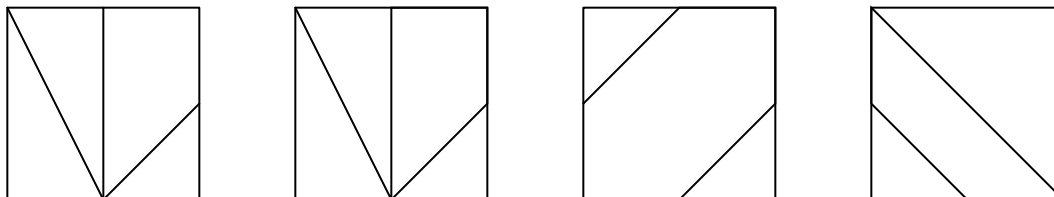


## BROKEN SQUARES

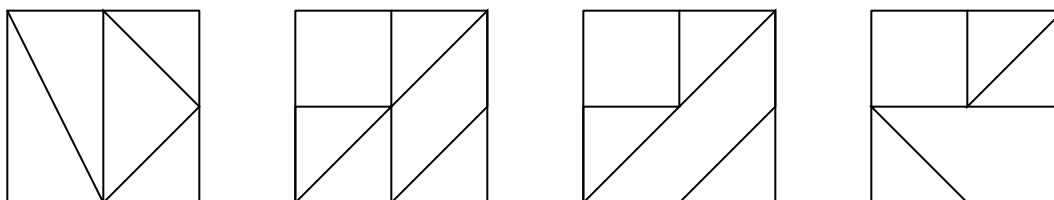
This is essentially the same activity as Advanced Broken Circles. The goal is for each person to put together a complete square rather than circle. We include three versions here. Versions I and II are designed to be worked only with groups of four. Version III can be set up for groups of 3–6 members. Use the same rules as for Advanced Broken Circles simply substituting the word "Square" for "circle" whenever it occurs. See the following pages for patterns for Broken Squares.

To set up for Versions I and II, put four or five pieces of the square in each person's envelope. You will need a complete set of shapes for each four-person group. As in Advanced Broken Circles, one member of the group can assemble a square and think he or she is finished, thus preventing the rest of the group from achieving a solution. For Version III, separate the pieces by letter (according to the number of group members) and place the pieces in an envelope labeled with the letter. Set unused pieces aside for later use (you may want to re-make the sets for a different number of group members).

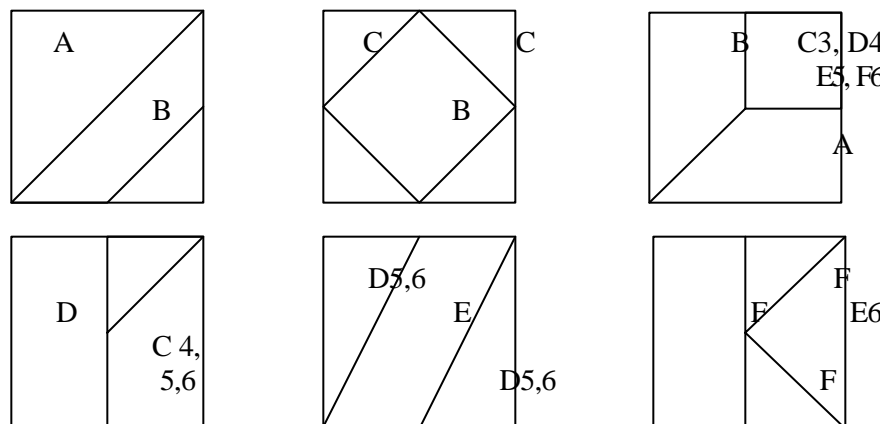
Version I

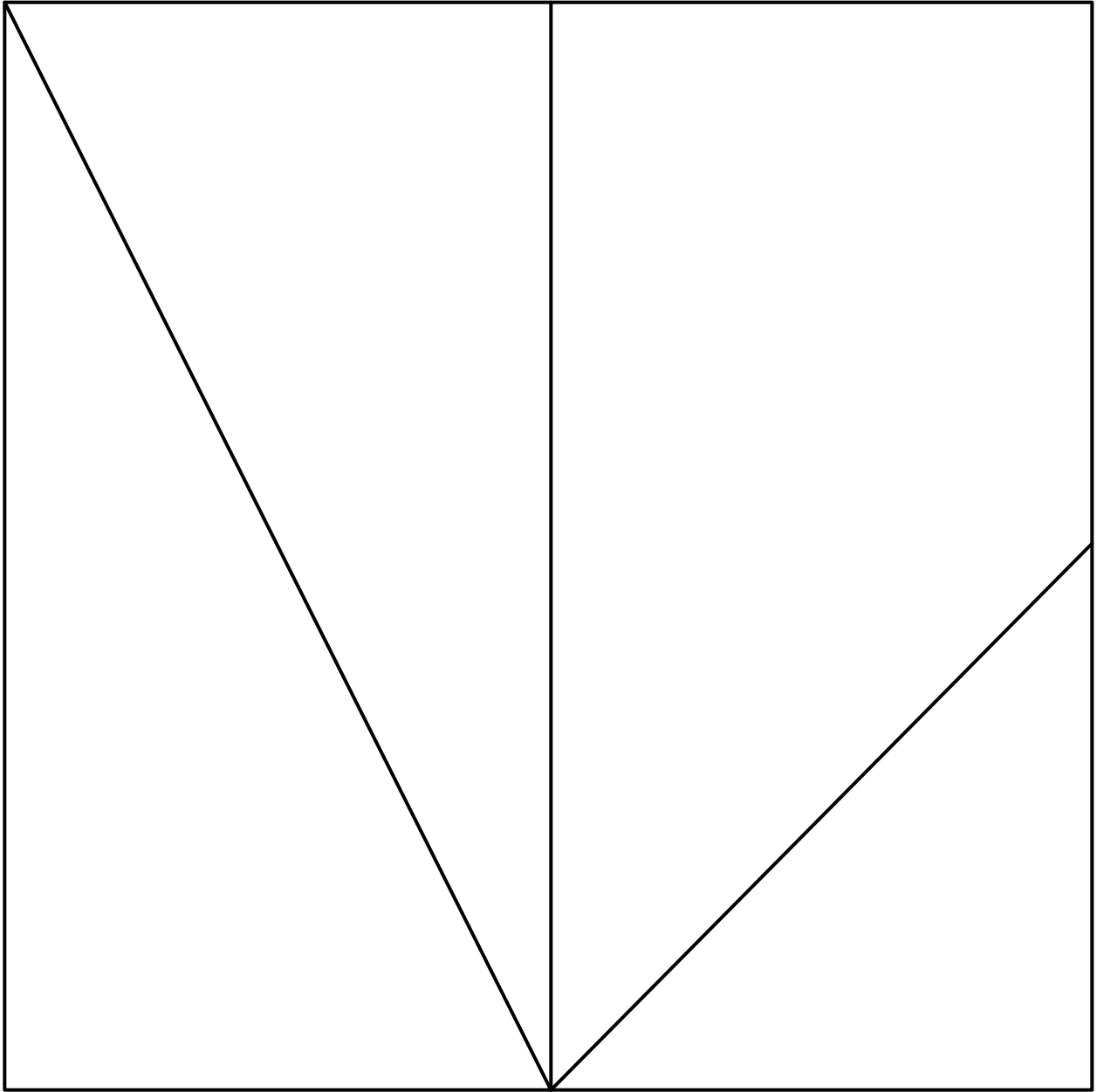


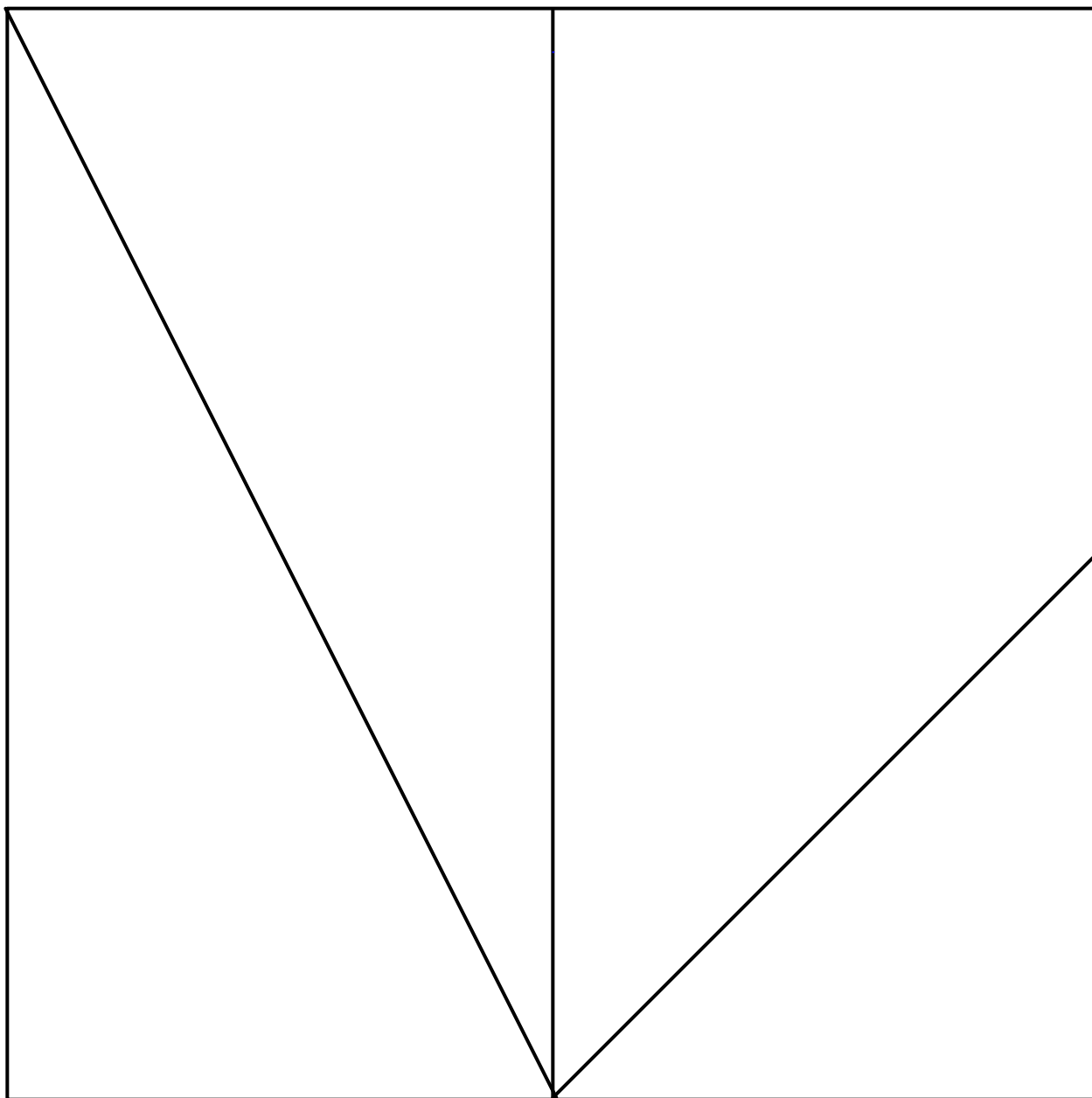
Version II

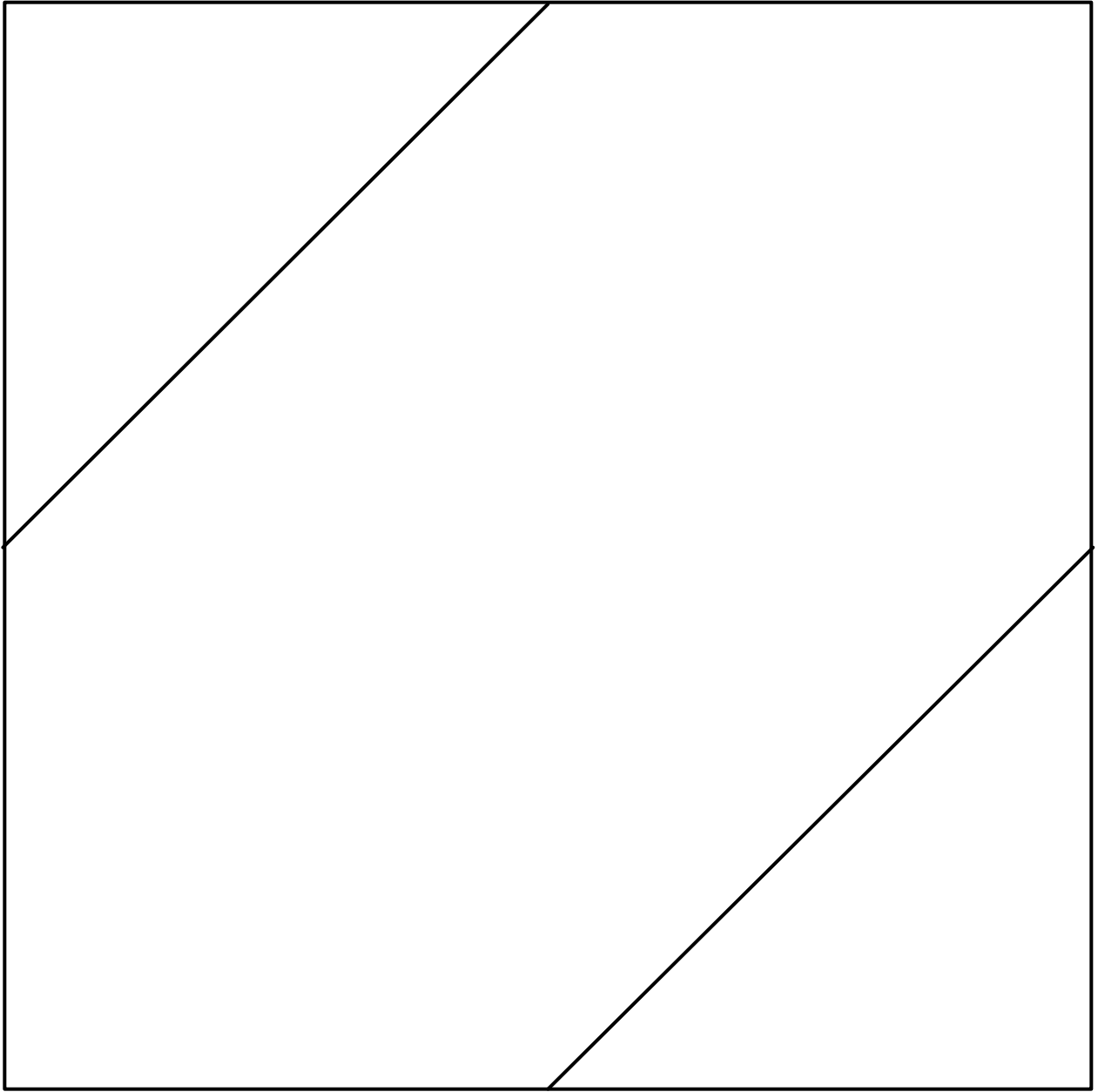


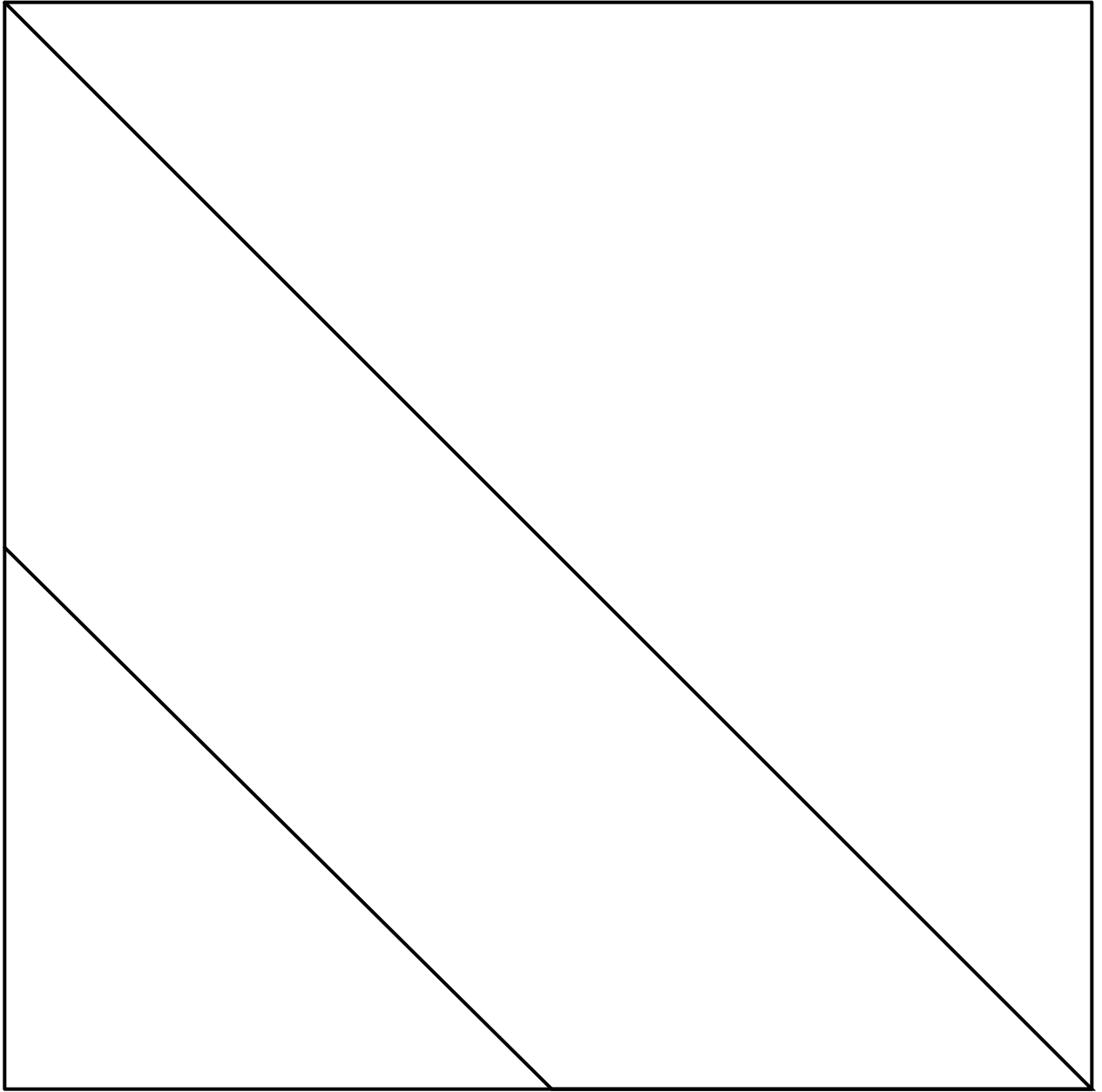
Version III

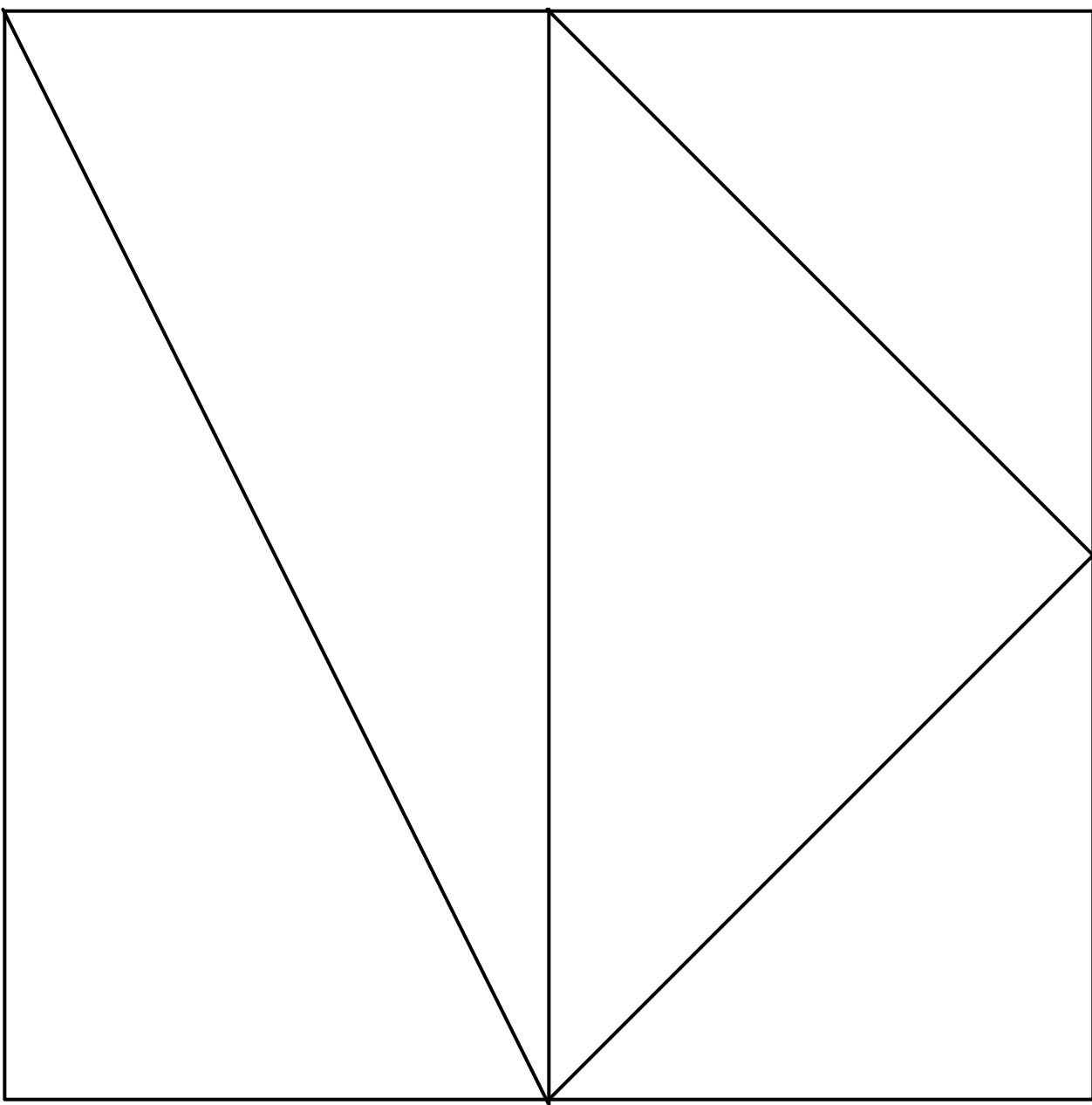




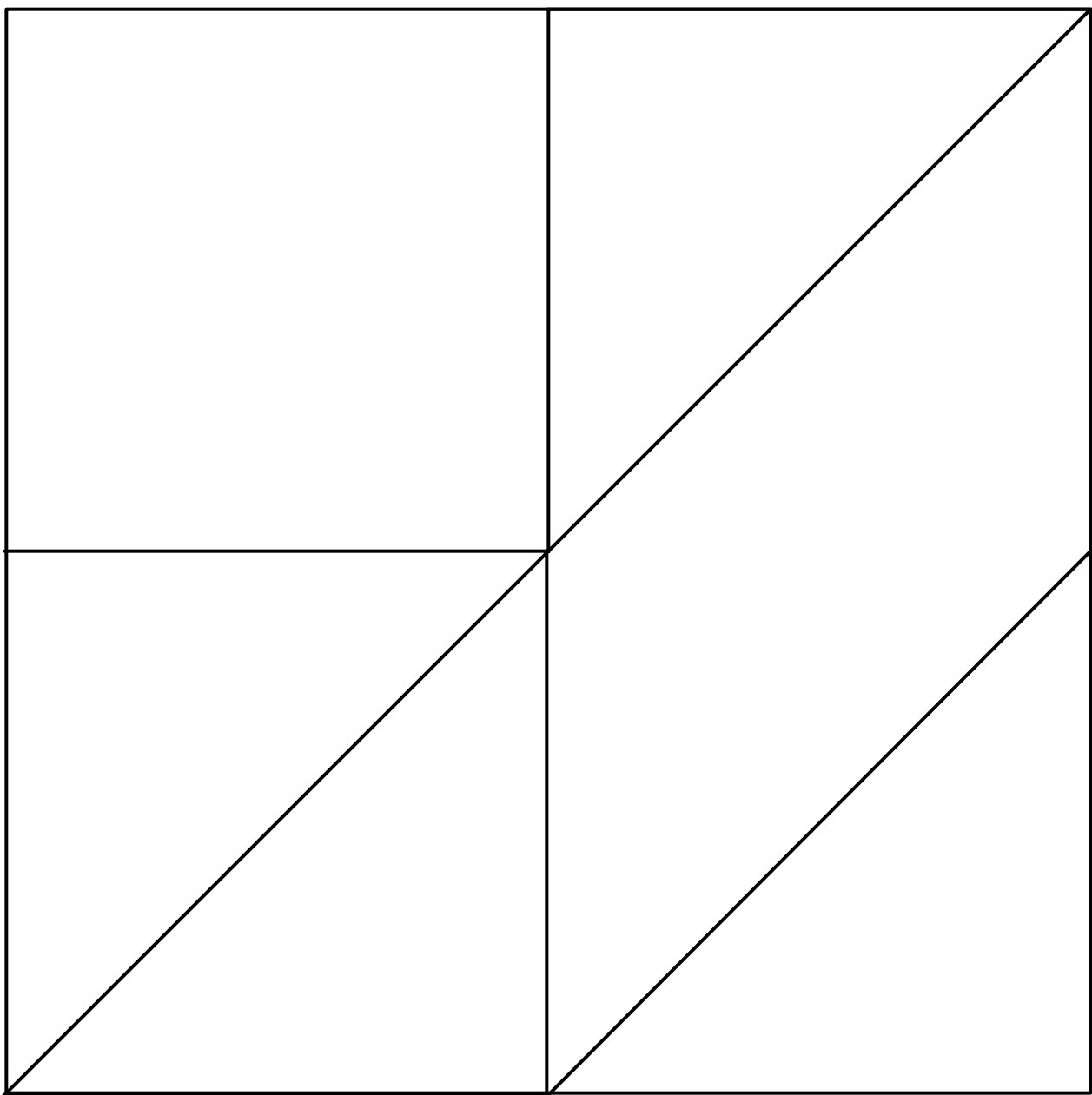


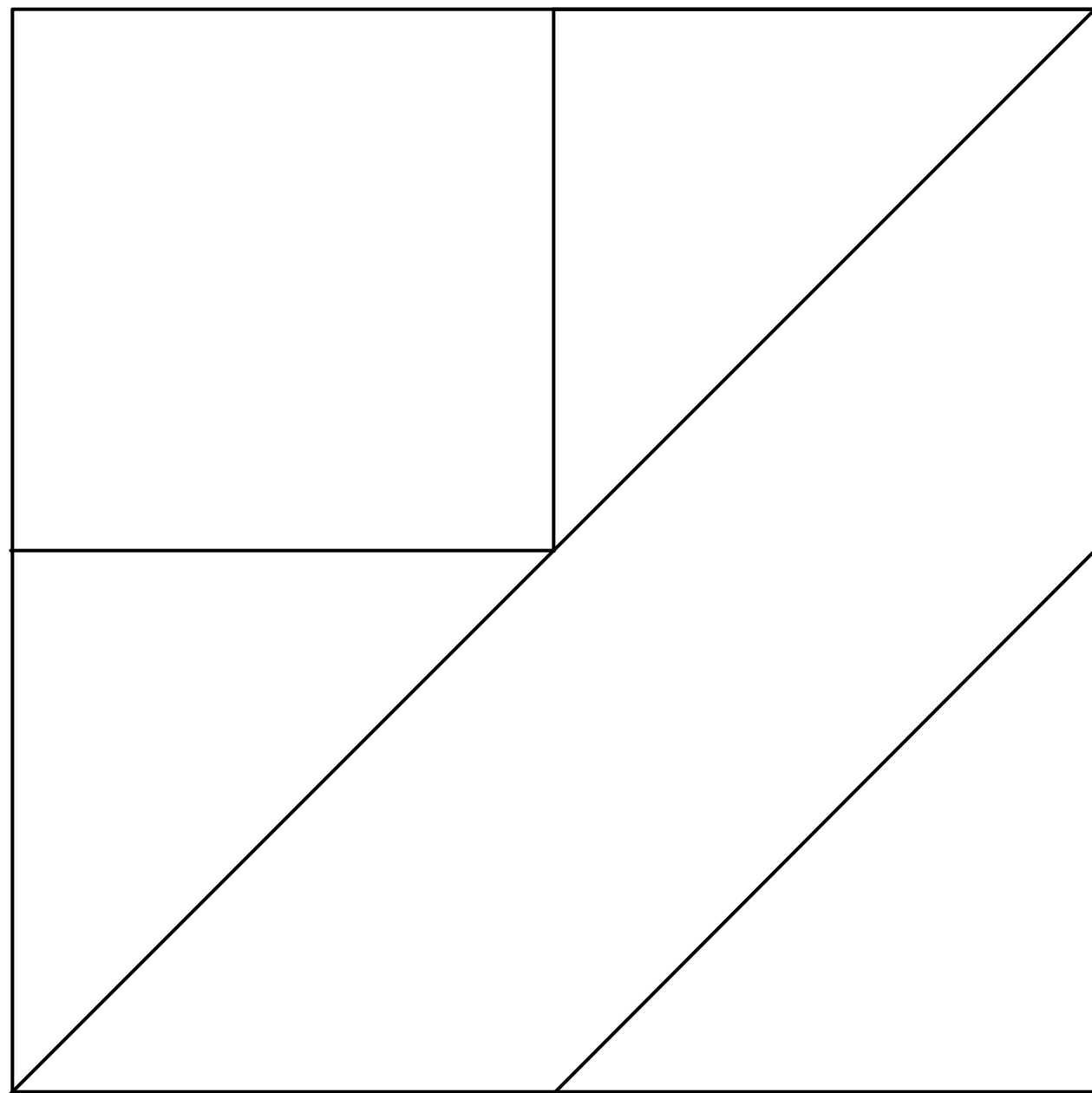


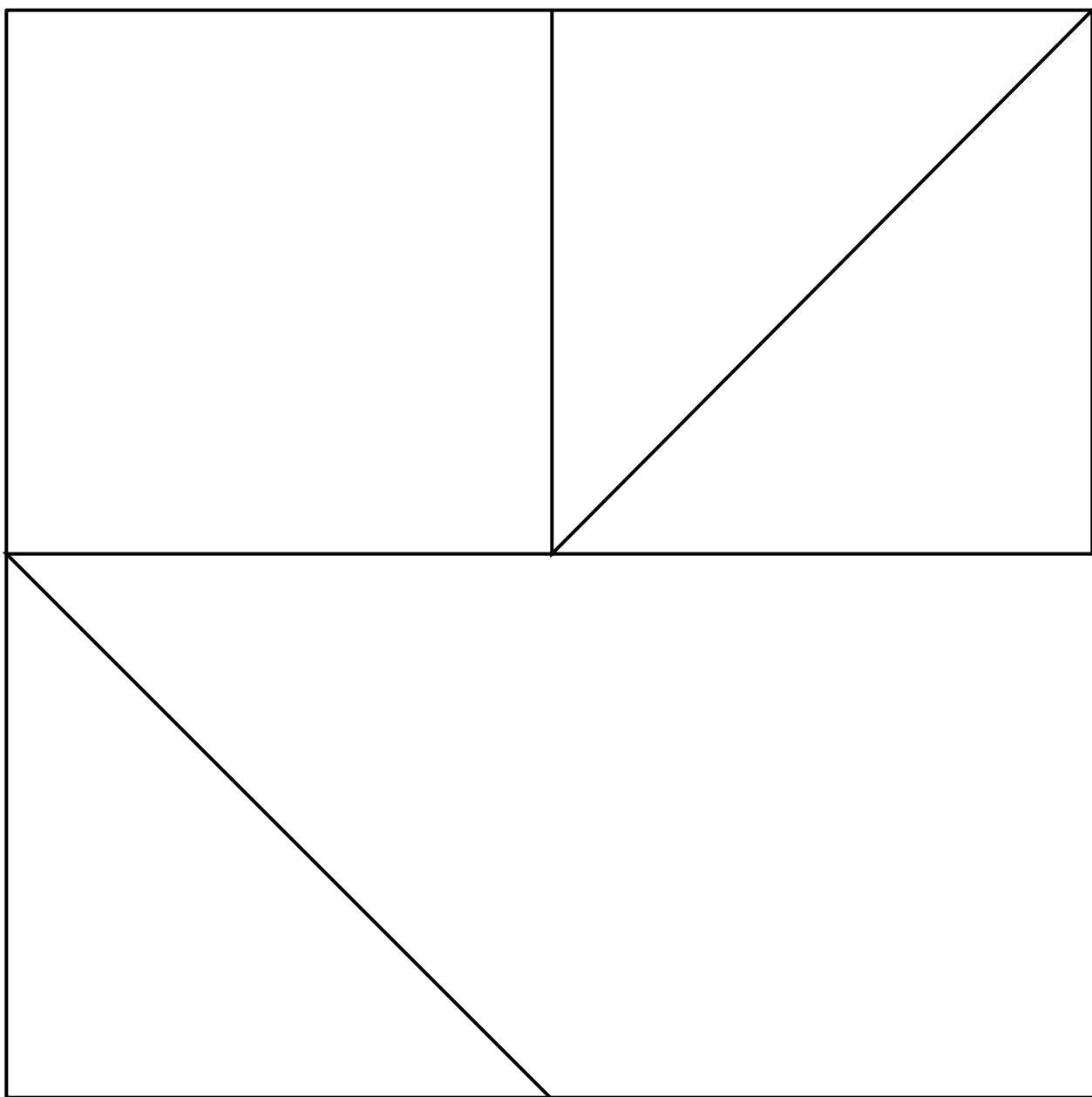


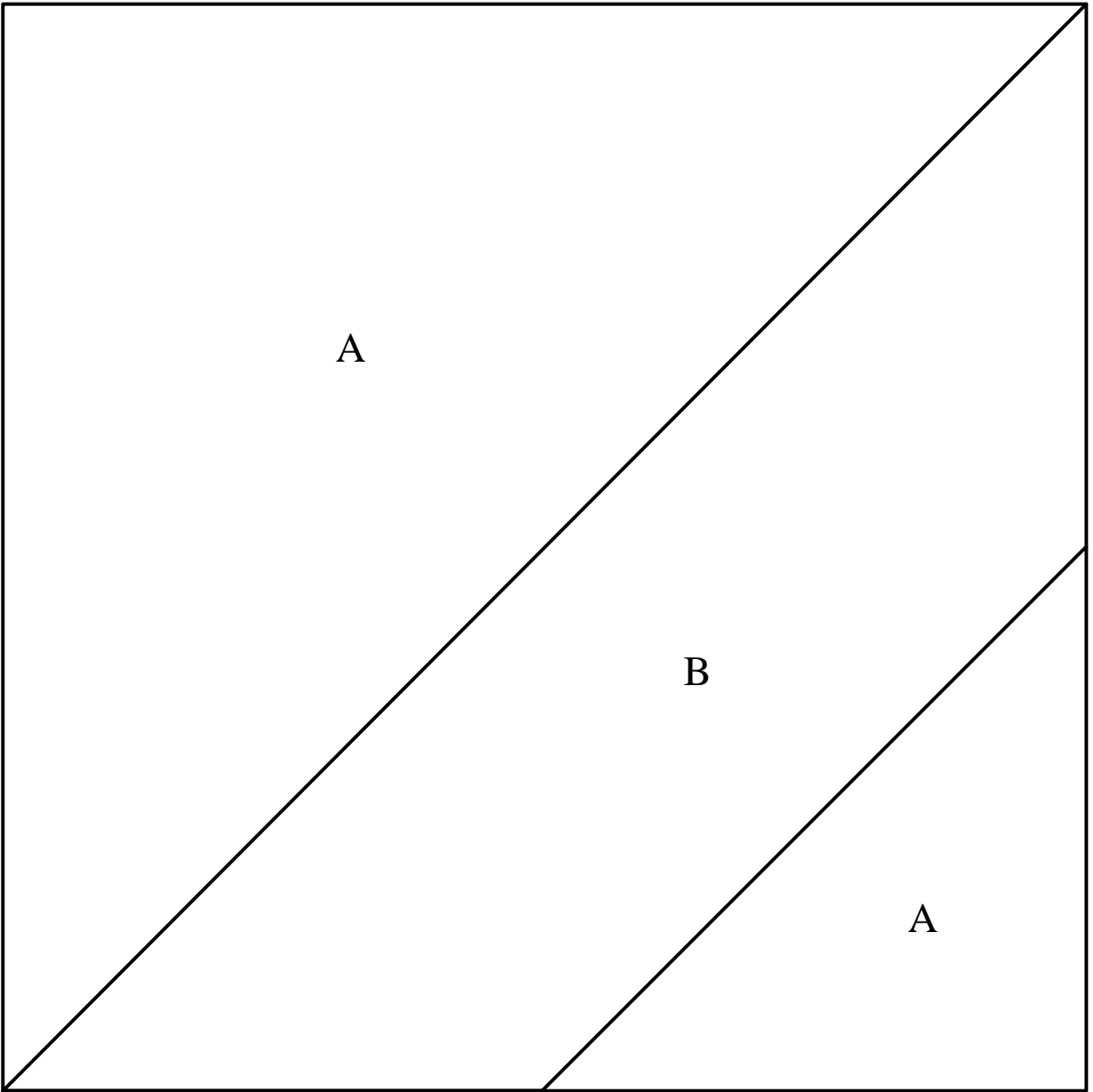


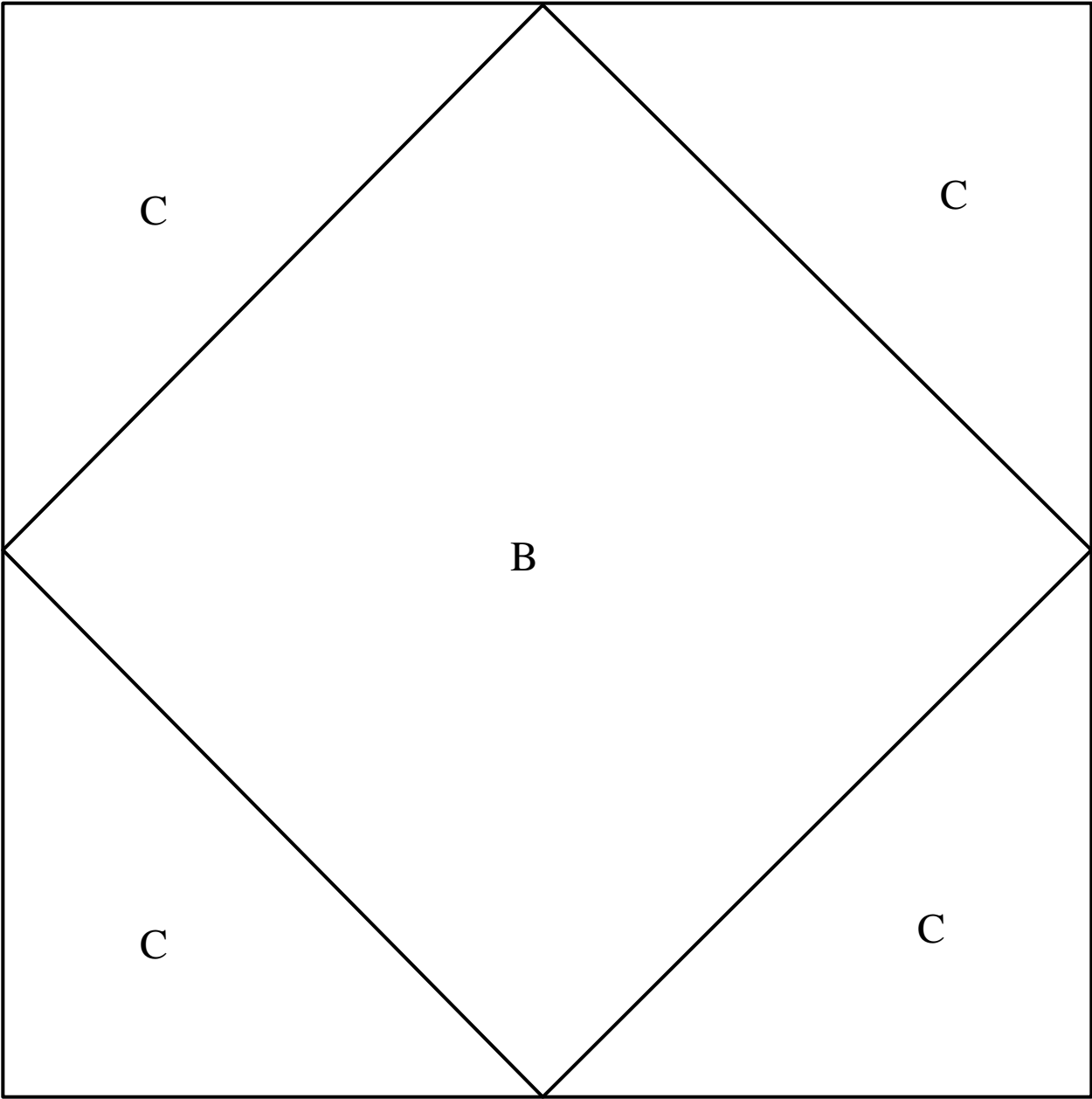


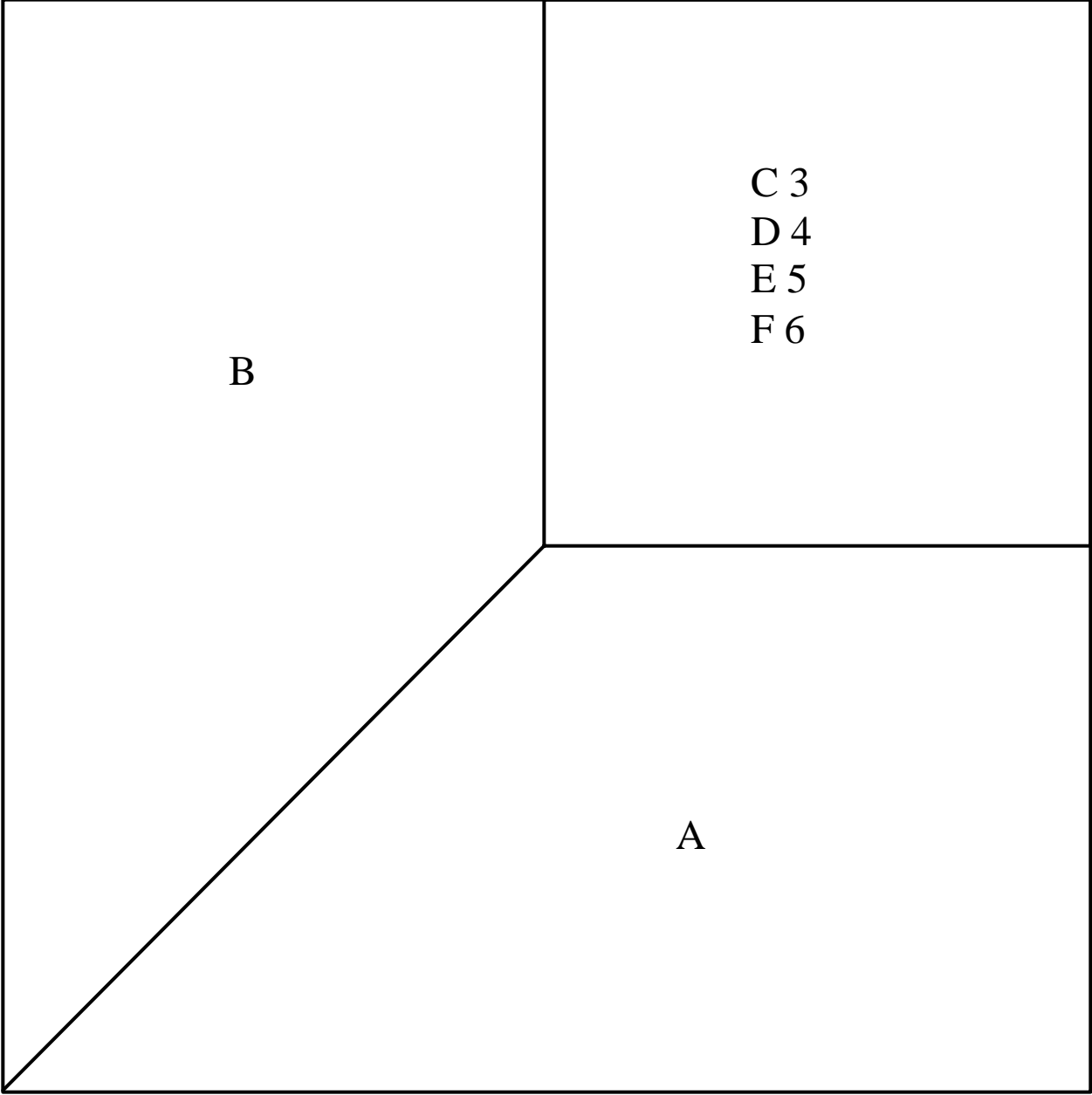


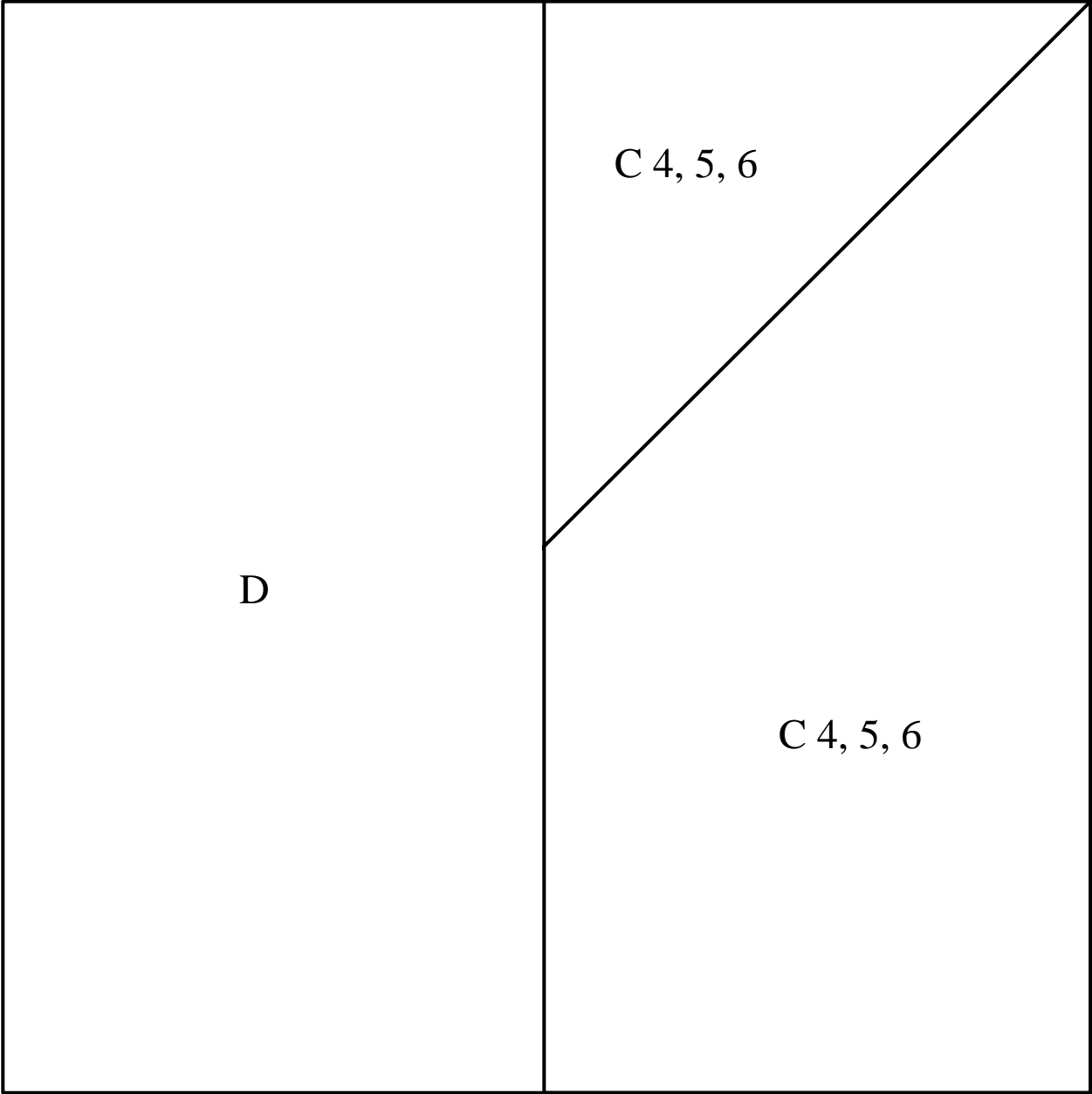


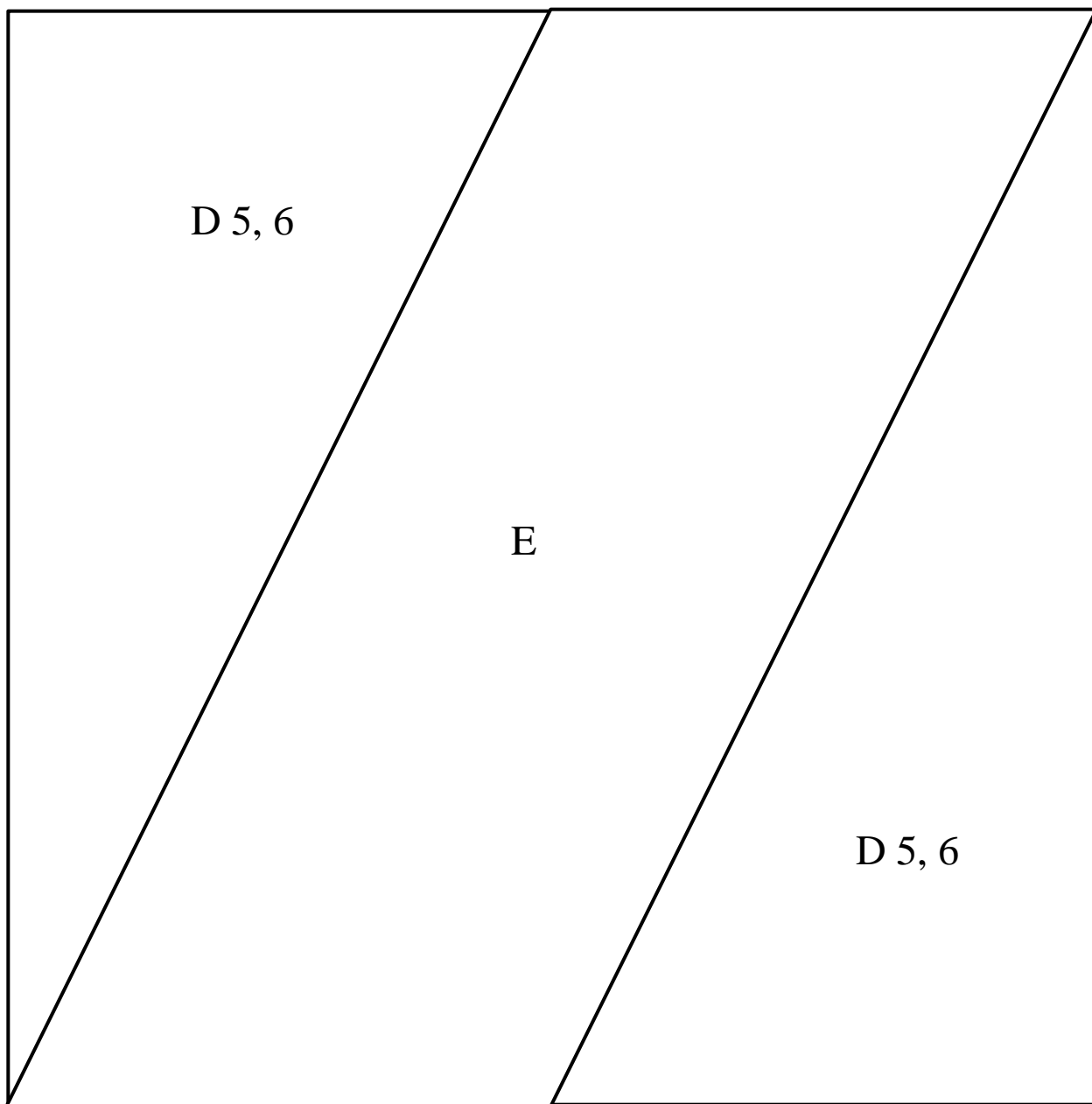




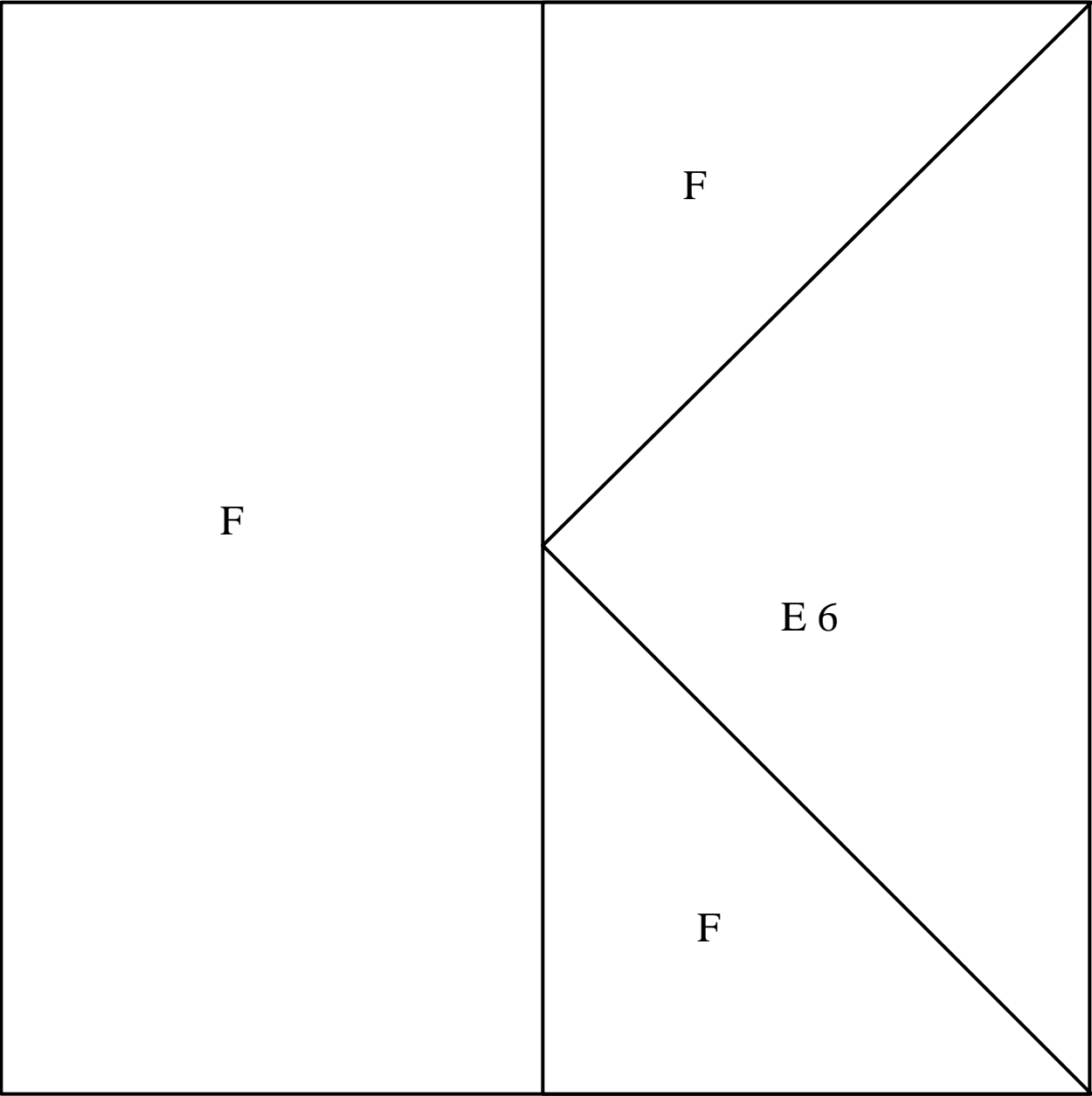






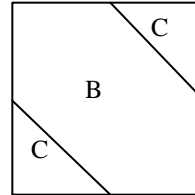




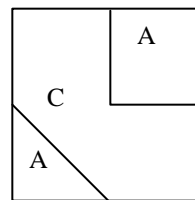


Modifications:

Substituting this for the B square will simplify the puzzle, but eliminate one trap.



Substituting this for the C square will change the puzzle.



Substituting this for the F square will make the puzzle much more difficult

