

THE GEOMETRY OF MINIATURE GOLF



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If you roll a ball against a wall without spin, the ball will always act in a certain way. It will bounce off the wall at the same angle that it hit the wall. In other words, if you pretend that the ball could continue rolling through the wall, but instead think of that path as being reflected back over the wall, you can find the path of the ball.

Another way to say this is to use a formula from science that says that the angle of incidence equals the angle of reflection. This is true of things like light rays, sound waves, and radio waves. For example, when you look in a mirror to see a person, your eye receives as images only those light waves which bounce off the mirror in your direction. The image appears to be as far “behind” the mirror as the person is in front of it.

In miniature golf, a ball might strike and rebound from several reflective surfaces. The object of miniature golf is to get the ball in the hole as quickly as possible, and preferably with a hole in one. However, miniature golf holes often contain obstacles and walls which make it impossible to hit the ball straight into the hole. This is where geometry becomes a very handy thing to know!

Look at the following example. (USE DIAGRAM ONE) Use your protractor and ruler to draw a line from the B (ball) to the wall at the top of the pretend miniature golf hole. Measure the angle between the line and the upper part of the wall. Then draw another line that has the same measure with the wall going out from the wall. Continue this process until your line will hit the hole, or point H.

The same idea can be used to get a hole in one by bouncing off more than one wall. For example, you may hit the ball down first instead of up. Then the ball will have to bounce off two walls in order to get a hole in one. Sometimes this might be necessary in mini-golf if there is an obstacle in the way of the hole. Try finding a path that will cause the ball to have to bounce off of two walls to get a hole in one.

Use DIAGRAM 2 and DIAGRAM 3. Plot two paths on the pretend mini-golf hole. Use different colors for each path. The paths must either have the balls bouncing off one, two or three walls.

DIAGRAM ONE

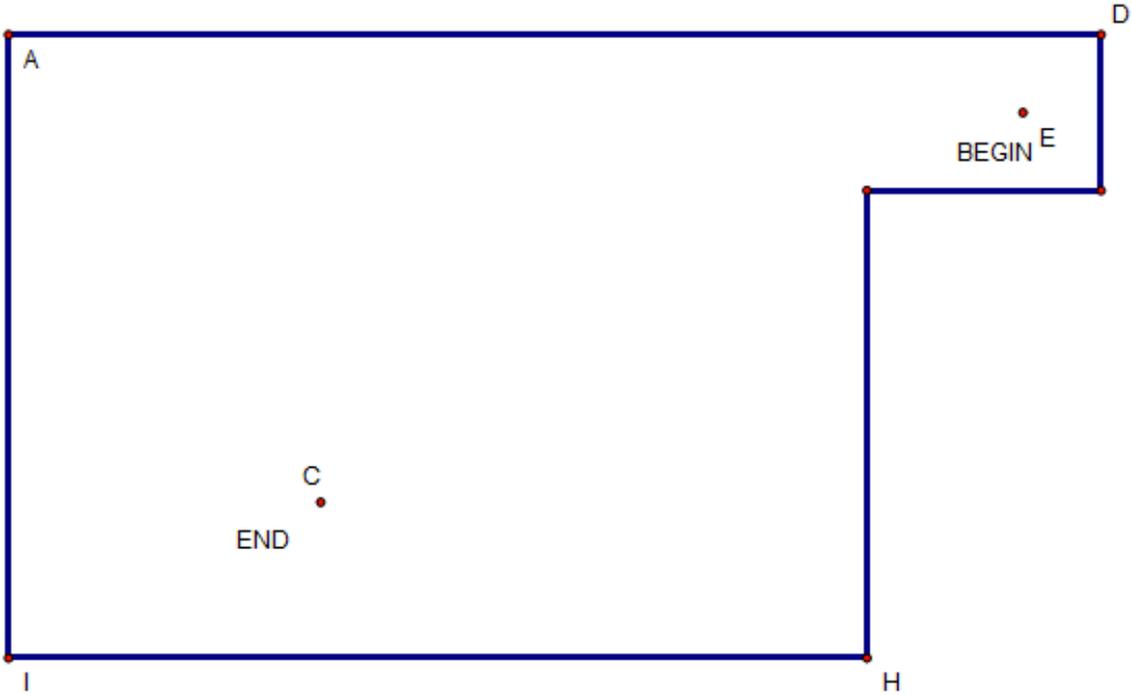
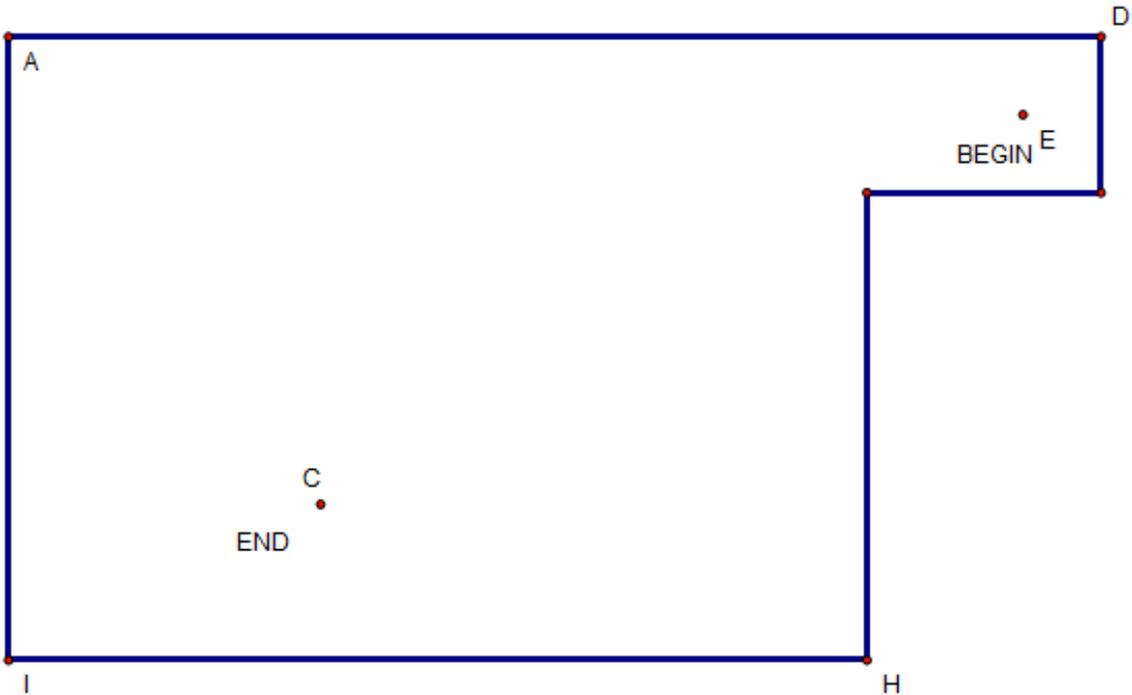


DIAGRAM TWO

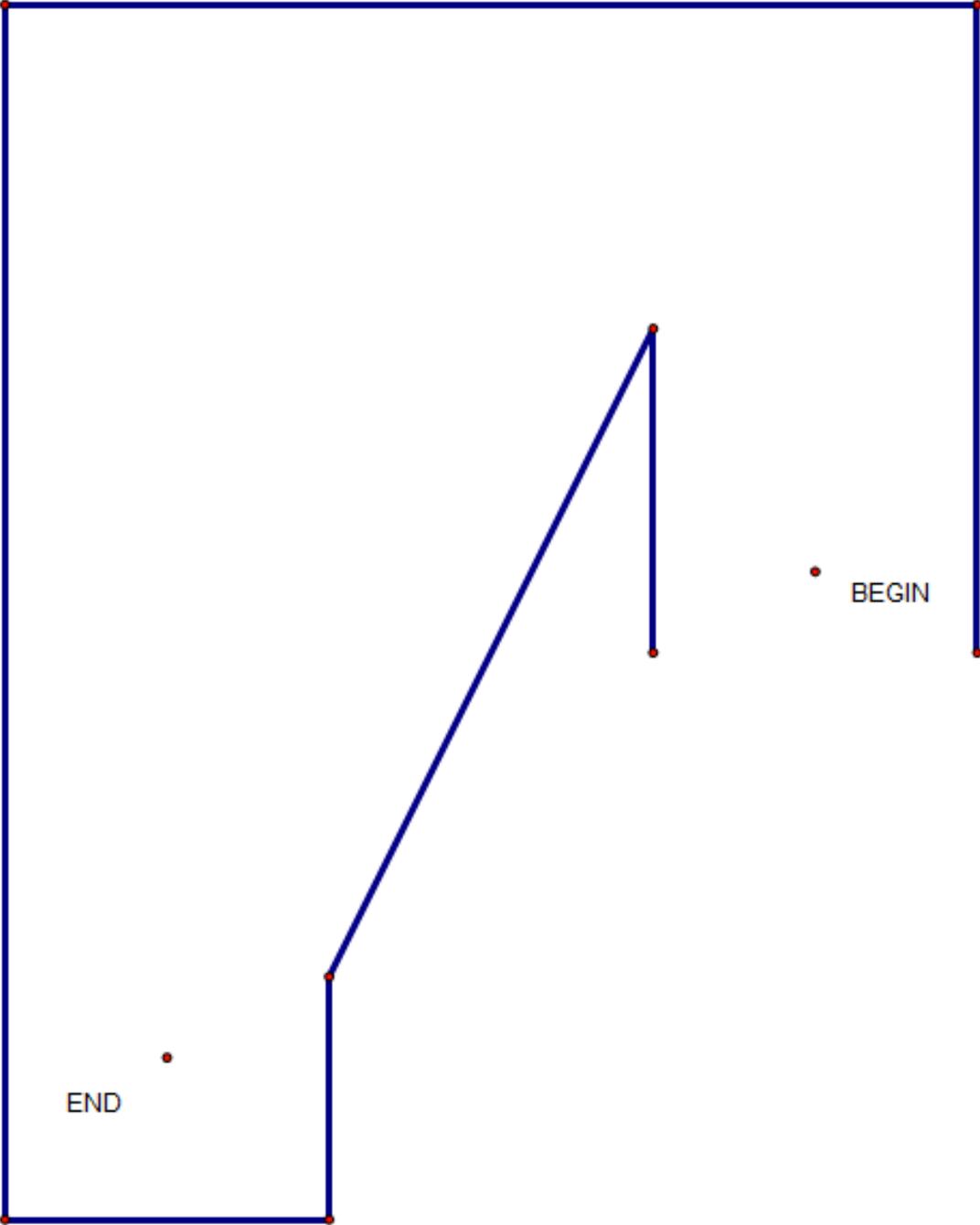
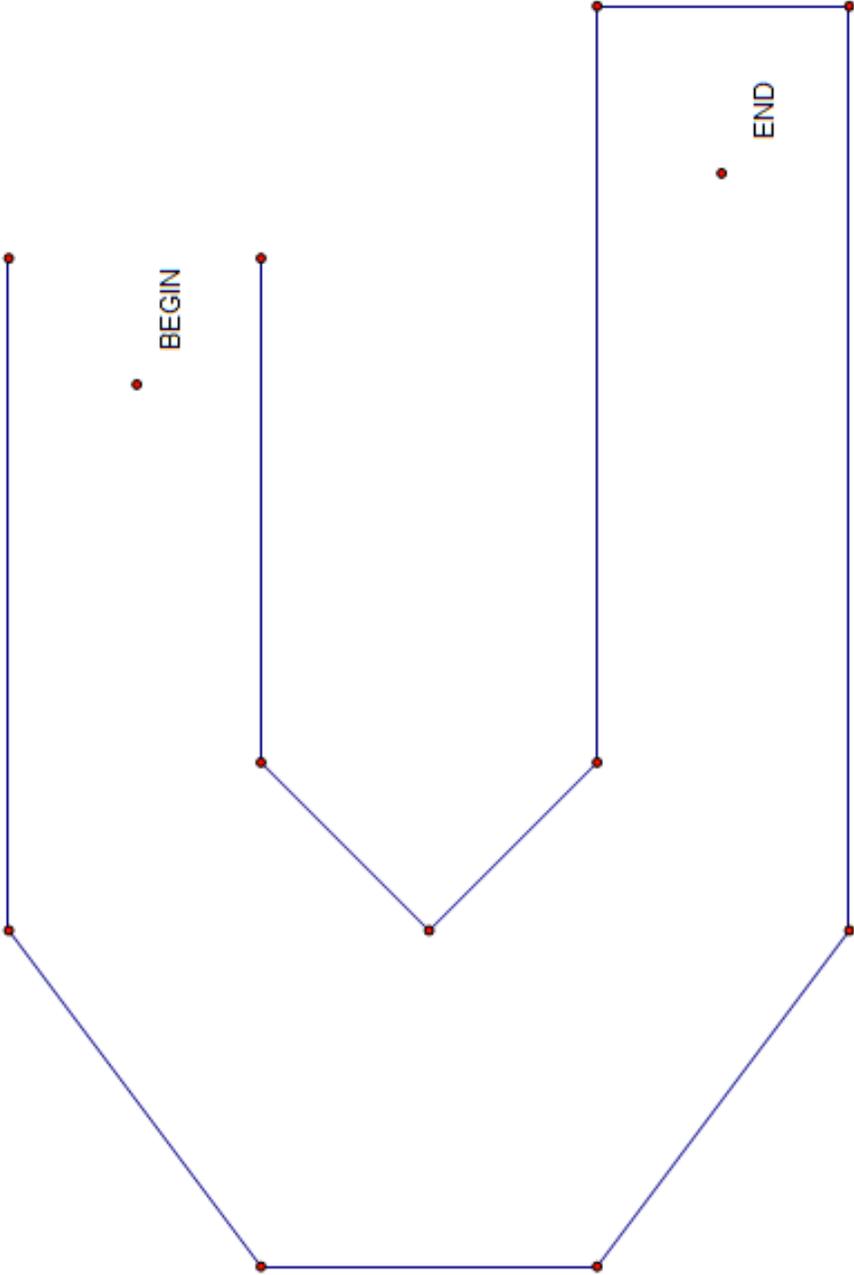


DIAGRAM THREE



MINIATURE GOLF PROJECT

1. This project is due _____.
2. You may work by yourself or with one other partner.
3. This project will be graded on neatness, creativity, and accuracy.
4. You will be turning in two things – A Guide to Playing Your Hole and a model of your miniature golf hole.
5. The Guide to Playing Your Hole should consist of:
 - a. A Cover Page describing and advertising your hole
 - b. Three diagrams showing the path a ball would take to get a hole in one by bouncing a ball off of one wall, two walls, and three walls – you must design your hole in such a way that all of these three things are possible.
 - c. On your diagrams, you should just put the basic design of the hole. You do not have to draw in obstacles, etc. Just show where the ball begins and where the hole is. If you like you can put boxes where your obstacles will be so that you remember where they are.
6. The Model
 - a. The model of your hole should be no smaller than 6 in x 6 in and no larger than 12 in x 12 in.
 - b. You should try to think about how you will get your model to school ahead of time – build it in something that will be easy to carry.
 - c. Your model must show the paths a ball would take to make a hole in one by bouncing the ball off of one wall, two walls, or three walls.
 - d. Your model must closely resemble your diagrams.
 - e. This is where you get to be creative...think about miniature golf holes you have played before – look online for examples – make a challenging and beautiful hole :)
7. Consult the attached grade sheet to determine how this assignment will be graded.



GEOMETRY MINIATURE GOLF GRADE SHEET

MODEL

_____ Neatness (10 points)

- Is the hole put together neatly?
- Does the project appear to have taken some time and effort?
- Is the hole of an appropriate size? (no larger than 12 x 12 or smaller than 6 x 6)

_____ Creativity (15 points)

- Use of materials
- Actual arrangement of the hole – some shape other than simple rectangle
- Are there obstacles that show creativity and thought?

_____ Resemblance to the original diagram (5 points)

- Are the paths shown to get a hole in one on the model
- Does the model resemble the original diagram

GUIDE TO PLAYING THE HOLE

_____ Cover Page Included (5 points)

- Is everything spelled correctly
- Is the cover page neat
- Would someone want to visit the student's miniature golf hole based on the advertisement?

_____ Diagrams included (15 total points possible)

- bounce the ball off of one wall – angles must be measured and labeled(5 points)
- bounce the ball off of two walls – angles must be measured and labeled(5 points)
- bounce the ball off of three walls – angles must be measured and labeled(5 points)

POSSIBLE EXTRA CREDIT

_____ Difficulty of Design – Given at the discretion of the teacher

_____ Voted Class Favorite

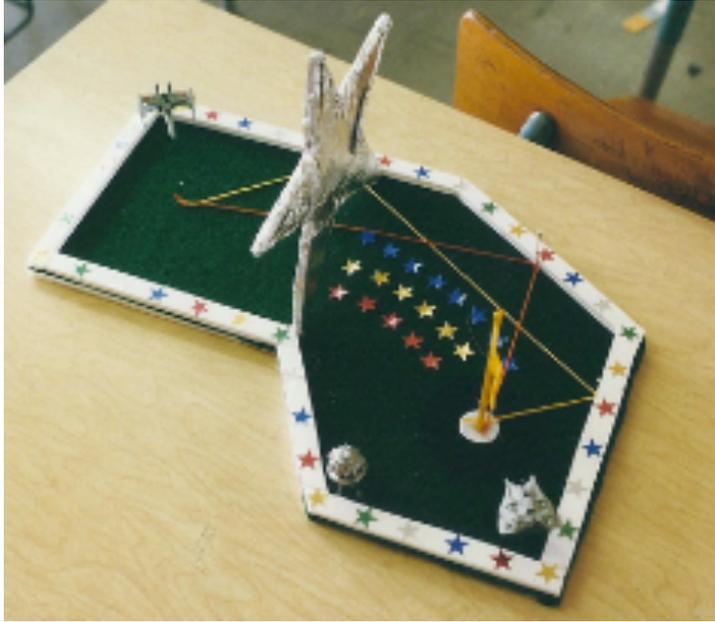
- Students will vote for one class favorite design and extra credit will be given to those group members

_____ TOTAL POINTS (50 points possible)

TEACHER'S NOTES

GEOMETRY OF MINIATURE GOLF

Here are some examples of work that my students have done previously.



If you have a computer geometry program such as Geometer's Sketchpad available to your students, I would suggest allowing the students to draw their diagrams on Sketchpad. They can then use the technology to measure the angles. This will allow them to be more accurate.



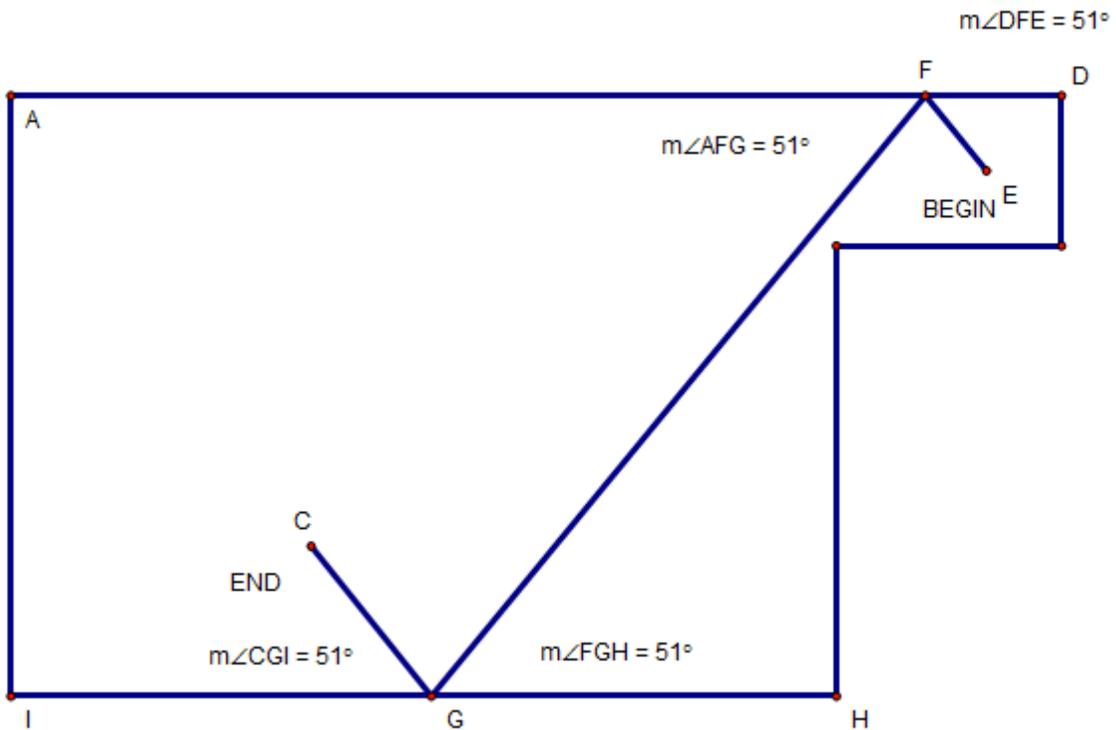
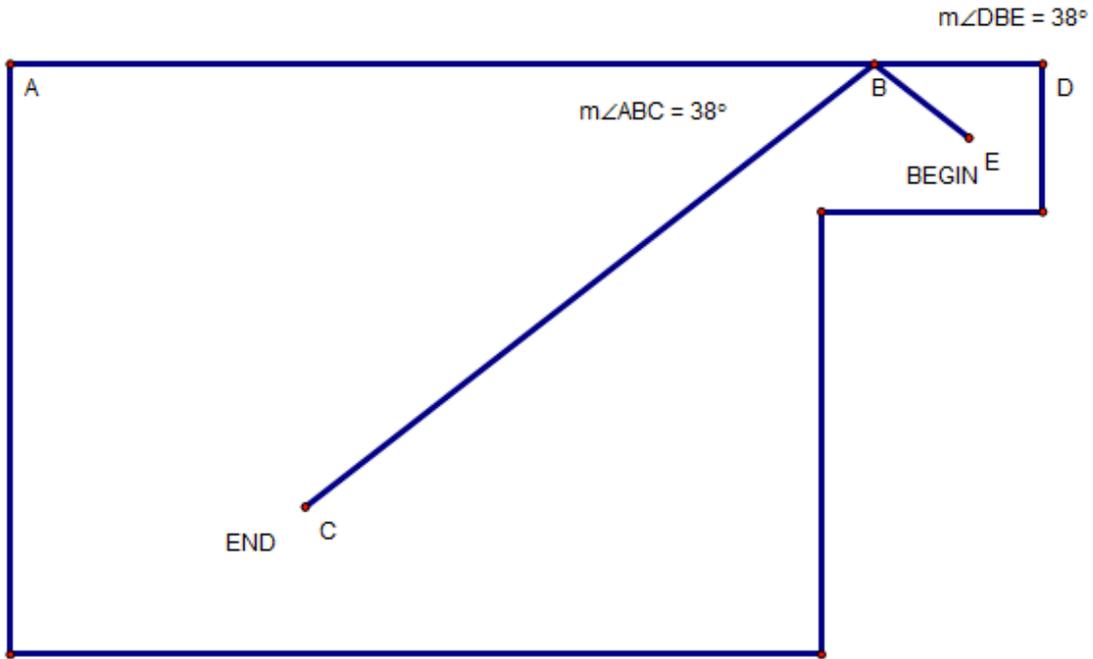
However, if you want the students to practice using a protractor, this activity also provides the option for that type of practice.

Another suggestion, if you have them available, would be to use the TI-Nspire calculator to have your students draw and measure the angles of their project. This may be trickier though because they cannot draw the picture the same size as the model of their miniature golf hole.

POSSIBLE PROJECT EXTENSIONS

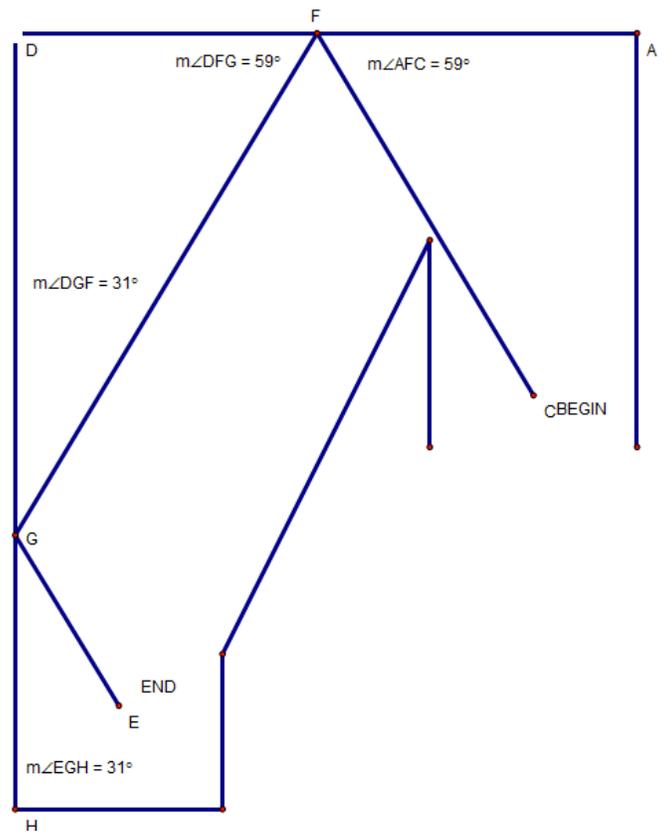
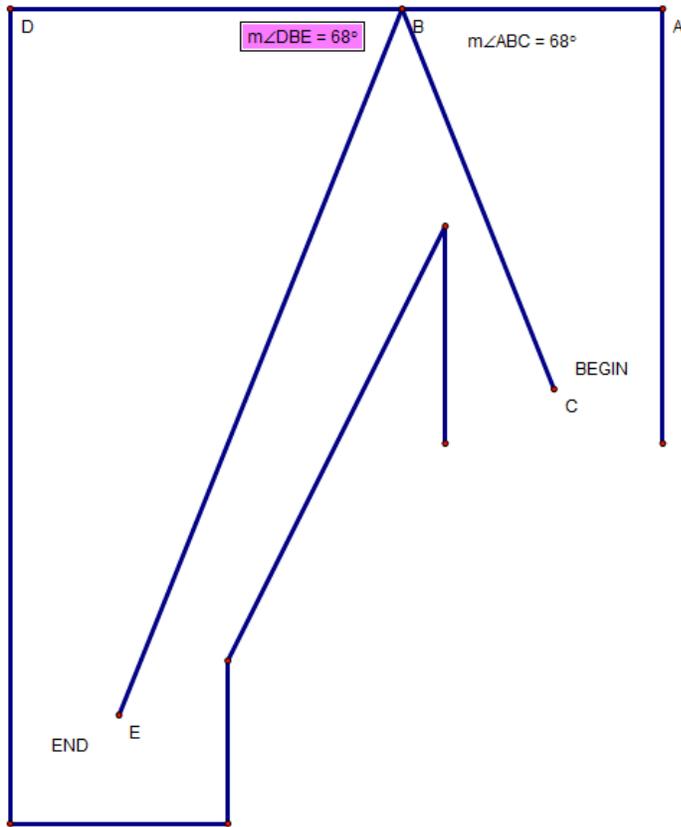
- You might also ask students to find the slope or equations of the lines of the path of the ball.
- You might ask about the coordinates of the place where the ball begins and where the hole is placed.
- You could have students find out how much it would cost to actually build their hole.
 - Many extensions are possible here that could involve area and perimeter, proportion, scale drawing, etc.
- If you are feeling very adventurous, you could take your class to a local miniature golf course. They could use yardsticks and large chalkboard or whiteboard protractors to decide where to hit the ball to get a hole in one – have them try it!

For example, these diagrams made in Geometer's Sketchpad.
 (POSSIBLE ANSWERS TO THE STUDENT QUESTIONS ON PAGE TWO)

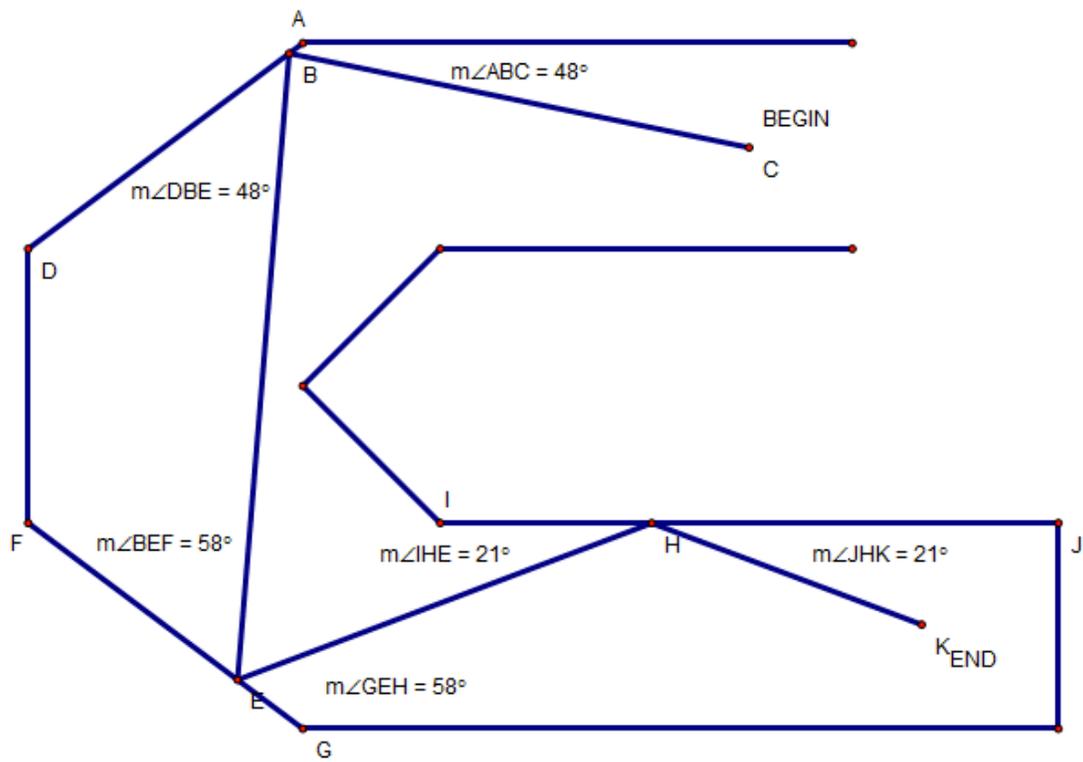


POSSIBLE ANSWERS

DIAGRAM TWO



POSSIBLE ANSWER
DIAGRAM 3



THANK YOU FOR PURCHASING THIS ACTIVITY.

I HOPE YOU ENJOY IT!

I welcome your comments and suggestions to enhance this project.

I would appreciate you leaving feedback for this activity on the Teachers Pay Teachers website.

I also have a blog – please visit and follow if you are interested.

<http://teachinghighschoolmath.blogspot.com>

Jennifer Lamb
Marian Catholic High School
Chicago Heights, IL 60411
jlamb@marianchs.com

A large, elegant cursive script that reads "Thank You". The letters are fluid and connected, with a prominent loop at the end of the word "You".