

2022 MidMCM

Problem C: Polygon Paradise Park

Note: Only teams with all members younger than 14 ½ years old may choose Problem C.



A group of four friends want to go to Polygon Paradise Park next summer. Polygon Paradise Park is a small amusement park open from 9am to 9pm. The park has ten rides of different types and thrill levels. The Trapezoid Show, a location with several different performances throughout the day, offers a circus acrobatics show, a magic show, and evening fireworks. The Games building has both arcade and carnival games. Food options include the Triangle Restaurant, the hot dog stand, and the ice cream cart. The hot dog stand and the ice cream cart are “*take away*” options, while the Triangle Restaurant requires 30-60 minutes to sit at a table and enjoy a meal. The **restrooms (WC)** are centrally located in the park for easy access. Visitors can purchase souvenirs in the gift shop located near the park entrance.

The group has hired your team at the MidMCM Travel Agency to make sure each member has a great time during their one-day trip to this amusement park. Your team is to develop a schedule to make the group’s day at the park the best possible. The group has provided you with the following information.

- Ming loves to play games and win prizes. Ming gets motion sick on fast moving rides, especially after eating.
- Ishmael loves roller coasters and wants to ride as many of them as possible during the day. Ishmael also likes performing card tricks and is interested in seeing the magic show.
- Karine is very impatient and hates waiting in long lines. Karine wants to attend the circus acrobatics show. Karine does not eat hot dogs.
- Freya likes to spend time on water rides to cool off. Freya likes to go with the flow and is happy spending time with friends. Freya wants to make sure she gets a souvenir to remember the trip.

Your planning resources from MidMCM Travel Agency include a show schedule for the Trapezoid Show location, tables containing ride categories and durations, expected ride wait times throughout the day, food options and wait times, and a map of the park. These resources are included at the end of the problem statement.

Requirements

1. **Get Started.** Familiarize yourself with Polygon Paradise Park and the group of friends.
 - a. What does the Polygon Paradise Park have to offer this group of friends to enjoy a great day at the park?
 - b. Given the information about the friends, what considerations do you need to incorporate into your plan? For example, you should be able to make some *assumptions* about how each would most like to spend their day.
 - c. Describe an ideal day at the park for each of the friends.

2. **Create the Schedule.** The group of friends would like to spend most of the day together as a group of four. They are willing to split up into groups of two for up to 4 hours of the day if it will increase everyone's enjoyment of the trip.
 - a. Make a list of the various activities you need to include into your schedule.
 - b. What are the times required for those activities? For example, to walk from one location to another. Don't forget that a whole day at the park might require time to eat and use the restroom (WC).
 - c. Identify and describe any activities that might require the group to split up to increase enjoyment. Explain.
 - d. Create a detailed schedule for the group of friends to use as a guide for their day at Polygon Paradise Park.

3. **Share Your Schedule.** Write a one- to two-page letter to the group of friends that describes the highlights of your recommended schedule and explains why it will offer the best possible day at Polygon Paradise Park.

4. **Reflect.** How is the schedule for Ming, Ishmael, Karine, and Freya different from a schedule you might create for your own MidMCM team to go to the park? Could you use the process you used to create the schedule for Ming, Ishmael, Karine, and Freya to create a schedule for your MidMCM team? (You **do not** need to create an actual schedule for your team, but you need briefly describe the process and what would be different!)

Your MidMCM PDF solution document should include the following:

- a. One-page Summary Sheet.
- b. Table of Contents.
- c. Your complete solution to the problem and requirements. See MidMCM Guidance at the end of this document.

- d. One- to two-page letter to the group of friends.
- e. References List (for example, any websites you used to gather information).

There is no specific required page length for a complete MidMCM submission. You may use up to 25 total pages for all your solution work and any additional information you want to include (for example: drawings, diagrams, calculations, tables). Partial solutions are accepted.

Glossary

Assumptions: hypotheses or educated guesses that take the place of an unknown or uncertain piece of information.

Restrooms (WC): A facility containing flush toilets; sometimes called a bathroom or a water closet (WC).

Take Away: food and drink vendors where you can purchase food and drinks that can be easily consumed while walking to your next destination.

Resources

Trapezoid Show Schedule

Time	Show	Duration
10 am	Circus Acrobatics	1 hour
12 pm	Circus Acrobatics	1 hour
2 pm	Magic Show	1 hour
4 pm	Circus Acrobatics	1 hour
6 pm	Magic Show	1 hour
8 pm	Firework Show	1 hour

Ride Information

Name of Ride/Activity	Ride Type/Activity	Duration
Heptagon Coaster	Extreme Thrill	2.5 min
Decagon Coaster	Extreme Thrill	3.0 min
Rhombus Ride	Extreme Thrill	4.0 min
Hexa-Swings	Medium Thrill	2.0 min
Pentagon Bumpers	Medium Thrill	5.0 min
Square Scramble	Medium Thrill	2.5 min
Concave Train	Basic	15.0 min
Starburst Carousel	Basic	3.0 min
Dodecagon Rapids	Water	10.0 min
Octagon Flume	Water	5.0 min

Ride Wait Times (Minutes)

Time	Concave Train	Decagon Coaster	Dodecagon Rapids	Heptagon Coaster	Hexa-Swings	Octagon Flume	Pentagon Bumpers	Rhombus Ride	Square Scramble	Star Burst Carousel
9:00 AM	0	0	0	0	0	0	0	0	0	0
10:00 AM	5	15	0	10	0	10	0	5	0	10
11:00 AM	10	30	5	20	5	10	5	10	5	15
12:00 PM	15	45	10	30	10	10	5	15	10	15
1:00 PM	10	60	15	40	10	30	5	10	10	10
2:00 PM	10	75	20	40	15	60	10	10	10	5
3:00 PM	15	75	15	30	15	60	10	15	10	5
4:00 PM	15	60	10	30	10	60	10	10	10	5
5:00 PM	15	45	5	20	10	30	10	10	10	5
6:00 PM	5	30	0	20	5	10	5	5	5	5
7:00 PM	5	30	0	10	0	10	0	5	5	5
8:00 PM	5	15	0	10	0	0	0	5	5	5
9:00 PM	5	0	0	10	0	0	0	5	0	0

Food Options

Name	Types of Food	Hours of Operation
Hot Dog Stand	Take Away	10:00 AM – 9:00 PM
Ice Cream Cart	Take Away	11:00 AM – 9:00 PM
Triangle Restaurant	Sit Down	9:00 AM – 8:00 PM

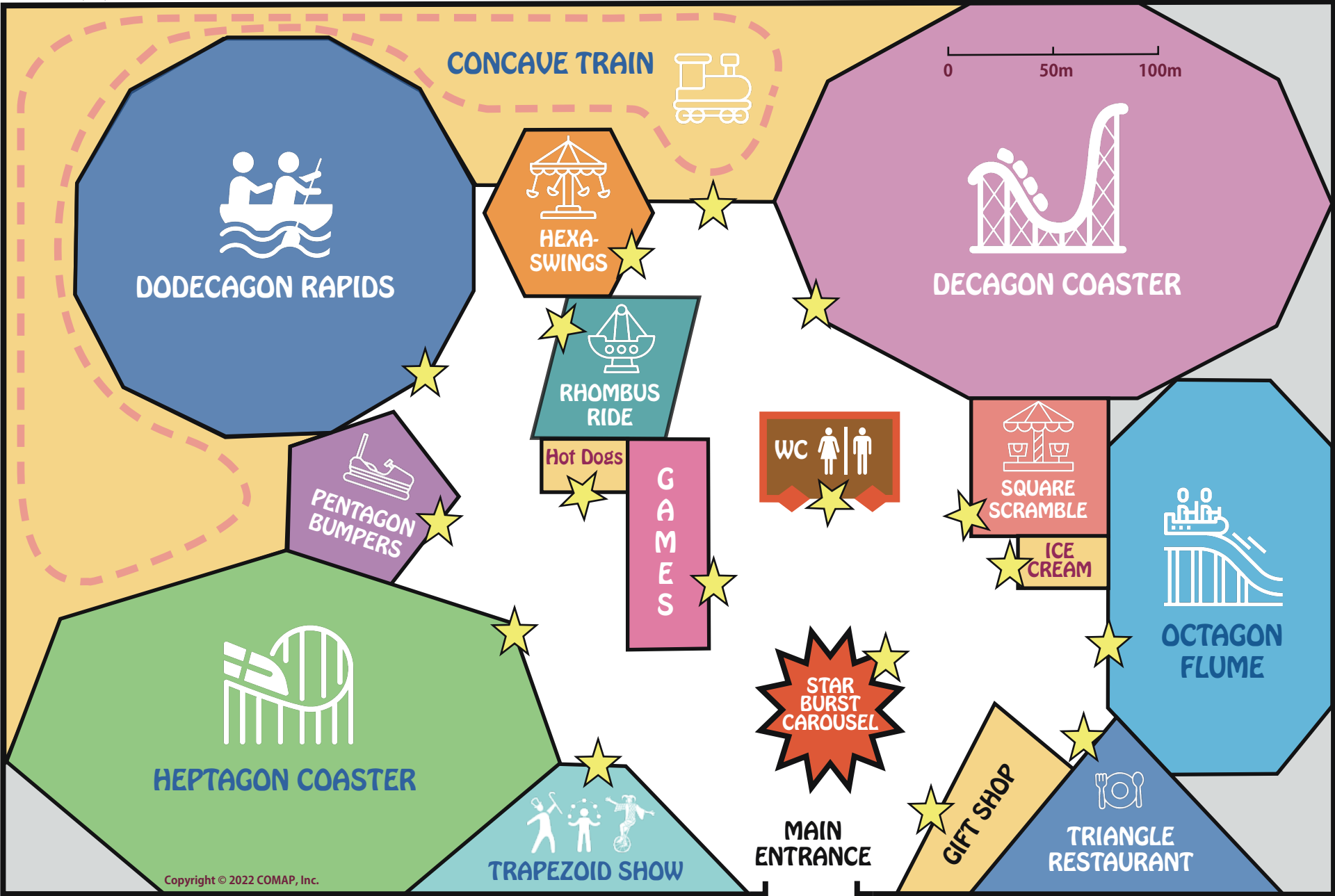
Food Wait Times (Minutes)

Time	Hot Dog Stand	Ice Cream Cart	Triangle Restaurant
9:00 AM	Closed	Closed	0
10:00 AM	0	Closed	5
11:00 AM	5	0	30
12:00 PM	10	5	60
1:00 PM	10	10	20
2:00 PM	5	15	0
3:00 PM	0	15	0
4:00 PM	5	10	10
5:00 PM	10	5	40
6:00 PM	10	5	60
7:00 PM	10	5	10
8:00 PM	5	0	0
9:00 PM	5	0	0

★ = ENTRANCE / EXIT

Polygon Paradise Park

SCALE: 1 Centimeter = 25 Meters



Guidance for MidMCM

COMAP has a Judges' Commentary article about the 2021 MidMCM along with the two Outstanding 2021 MidMCM papers at https://www.mathmodels.org/Problems/2021_MidMCM_Commentary.pdf. The commentary article provides guidance to both advisors and students. We also provide the following general guidance about MidMCM submission organization.

Solutions must be in PDF format and submitted in one PDF document. However, this does not preclude MidMCM teams from doing mathematics, graphs, tables, sketches, etc. by hand and including pictures of their work in the single PDF document submission. As students move to high school and the HiMCM, we expect that submissions will be typed. For the MidMCM, advisors may technically assist students in putting their solution components into one PDF format file for submission.

As with HiMCM, there is a 25-page limit for the submission document. This does not mean your solution must be 25 pages. A shorter submission is certainly acceptable. All portions of your submission (text, graphs, tables, charts, pictures, etc.) must be within **one** PDF document that is 25 pages or less. We accept partial solutions.

In general, a complete solution submission is organized as follows:

Executive Summary – Write this summary after you have done all your work. This one-page summary is Page #1 of your solution document. It provides an overview of your work and includes actual results.

Table of Contents – List the major items in your solution document to show the organization of your paper.

Introduction and Restatement of the Problem – Introduce the problem. Restate the problem and requirements in your own words.

Assumptions with Justifications – State any assumptions you made to simplify and solve the problem and state why you made those assumptions.

Variable Definitions – Define any variables you use in your model and equations.

Presentation of Model and Solution – Ensure you address all requirements and describe what you are doing in solving the problem. Show and explain all your work. Use representations that help you tell the reader how you solved the problem (for example: equations, tables, graphs, pictures, etc.).

Analysis of Your Work – Address any strengths (good points) and limitations (weaknesses) of your model and solution.

Concluding Paragraph – End your solution paper with a final concluding paragraph that summarizes your results and/or makes recommendations for future work.

Reference List – List any sources that you used to solve the problem (for example, website pages, newspaper, or magazine articles, etc.).