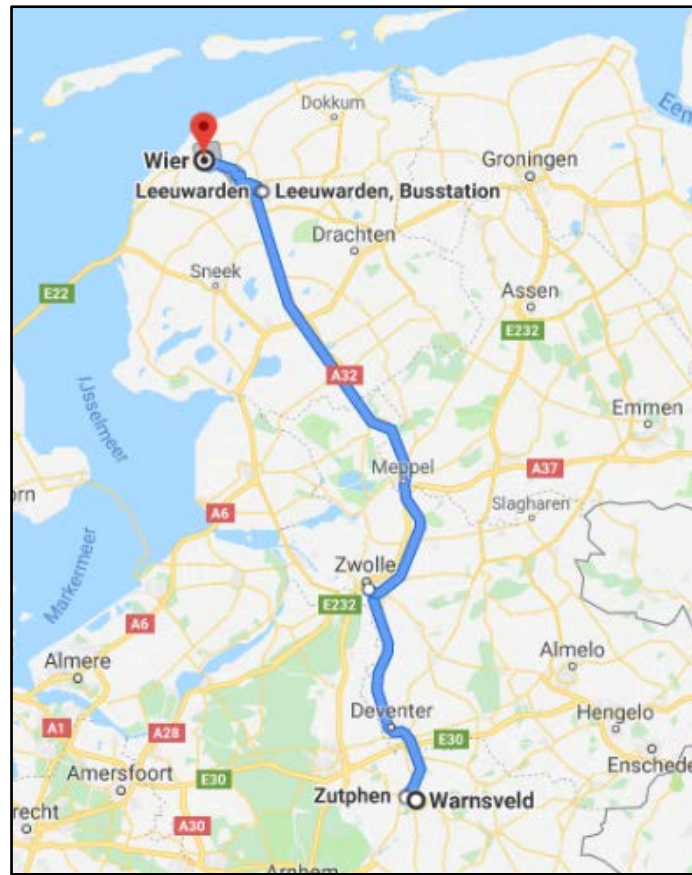


# The middle of somewhere



**Preliminary round Alympiad November 22, 2019**

## **Colophon**

The Mathematics Alympiad (Wiskunde Alympiade) is an initiative of the Freudenthal Institute, Utrecht University. The Alympiad committee is responsible for the organisation of the Alympiad and for producing the assignment. The committee members are:

### **Marcel Daems**

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Lorentz Casimir Lyceum, Eindhoven

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Freudenthal Institute, Utrecht University

## **Guide for the preliminary round assignment for the 2019/2020 Mathematics Olympiad**

This Mathematics Olympiad assignment consists of four assignments with a total of eleven problems. The initial three assignments are a run-up to the final assignment: all knowledge and insights from these assignments can be applied in the final assignment.

### **General advice for working on this assignment:**

- First read the full text of the assignment so you will know what you have to do.
- Keep an eye on the time you spend on the first three assignments; take plenty of time for the final assignment, at least three hours.
- If you divide up tasks within your team, discuss the results with each other after every assignment.
- If you change certain approaches, methods or procedures while working on the assignments, describe your changes in your report and include why you made them.
- It will be a good idea to have internet available during this assignment. An atlas may also be of use.
- List the (internet) sources that you will use.

### **Handing in:**

- The final assignment
- The three previous assignments, possibly as attachments

When you hand in your work, the jury will receive a digital copy. If you have any appendices with your work, hand in everything in a zipped folder. Include the name of your school *and* your own names in the file name.

### **Judging:**

These are some of the points that may be considered by the jury:

- Legibility and clarity of the final assignment;
- How complete the work is;
- The use of maths;
- The argumentation used and justifications of choices that have been made;
- The depth to which the various assignments have been answered;
- Presentation: form, legibility, structure, use and function of illustrations;
- (Mathematical) creativity in your elaboration of the assignments.

**Have fun and good luck!**

## Introduction

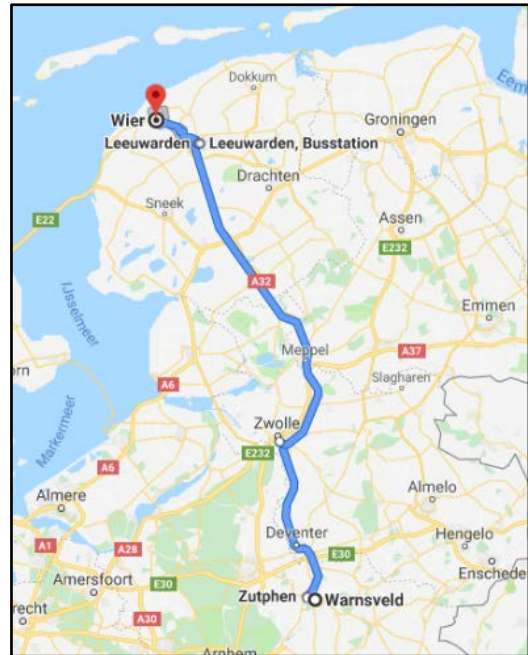
Ruud lives in Warnsveld and wants to meet with Dédé who lives in the Frisian village of Wier in the north of the Netherlands. A logical place to meet would be to choose a place between their two places of residence.

To determine this location, you can use an atlas to find out where Warnsveld and Wier are, but nowadays people are more likely to use apps and websites like Google Maps, 9292, the NS app or Maps.Me.

On the basis of the available connections, the travel distance or the travel time, a good meeting place for two people is easy to arrange.

However, if a meeting has to be arranged between more than two people from different locations, this is more complicated – not to mention if people come from different countries or continents.

This Olympiad preliminary round assignment deals with such cases.



## Assignment 1 - a central spot

Tom lives in Middelburg, Monica in Heerenveen and Kim in Maastricht.

1. Looking at the map, it would be a good choice for these three people to meet in Utrecht. But when you look at the train journey times (using the trip planner on [www.ns.nl](http://www.ns.nl)), they are successively 2:28 hours, 1:39 hours and 1:55 hours. That is not a balanced distribution of journey times. Determine a better place for Tom, Monica and Kim to meet. Describe clearly how you approached it.
2. Johan may also come. Explain that it makes quite some difference in choosing the best place in that case whether Johan is from Schagen or from Arnhem.
3. Provide a general explanation/approach how you can find an optimum choice of location to meet in terms of travel time for three people from different locations within the same country. Choose a good way to depict your choice. Test your approach for a few different situations.



## Assignment 2 - at someone's home

Tom, Monica and Kim could also arrange to meet at one of their homes.

4. Determine which of them would be the best to meet at. Describe the criteria you used in your consideration.
5. Provide a general explanation/approach how to find an optimum choice of location with three people from different locations within the same country, based on travel time. Choose a good way to depict your choice. Test your approach for a few different situations.

### **Assignment 3 - international**

We are going international now. We look at four people from respectively Madrid, Warsaw, Rome and Oslo. To start with, you have of course to consider what is the best way to travel between these four cities and which factors you want to consider.

6. List these factors and explain your choices.
  
7. Next, the question will be: which of these four cities will be the best place to hold the meeting?
  
8. Does this change if the meeting can also be held in another city than one of these four?
  
9. And does this change if there is an additional person from Rio de Janeiro?

### **Final assignment**

Teams from all over the world come together for the Alympiad final. For the last final (in March 2019) there were six teams from the Netherlands, two from Denmark, two from Germany, two from Japan and one from Aruba.

10. Determine the best location for the Alympiad final.

Unfortunately two teams from Iran and one from Sint-Maarten could not be there. If they had been able to come, the 'best location' might have been a different one.

11. Change your solution for the question to include this new information.

In the near future there may be teams from Croatia taking part in the final. Also, there is usually a team from Sint-Maarten, and South-Africa may also join the Alympiad. So the list of participants is changeable.

12. Provide an explanation/approach for how to determine a good location for the Alympiad final in general. Choose a way to display your approach clearly.