

# Mathematics Day for lower secondary 2016: Glasses, tubes and tennis balls

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During the day you will be working on a major open problem with a group of three to four students. The intention is that by the end of the day you will have written a paper as a result of your work.

Below you find a checklist with issues of concern.

<i>Method</i>	<i>check</i>
- First read the entire assignment and consider the following: <ul style="list-style-type: none"> <li>○ Approach</li> <li>○ Division of tasks</li> <li>○ Availability computer</li> <li>○ Time planning (make one!), keep in mind that most time will be spent on the final assignment.</li> </ul>	
- Work together: regularly discuss whether you are still on the correct route and whether the planning is still accurate; do not forget to plan in time at the end of the day to construct a coherent report.	
- Do not be satisfied too easily. Try different variants/ methods/ strategies within the assignments and process these in your report.	
- Always substantiate your choices with arguments and describe your work method.	
- Construct a real report, not merely a list of answers to the questions; ensure that it is a logical entity.	
- <b>Ensure that your report can be read as an independent entity without the jury needing to have the assignment with it. The report consists of a table of contents, an introduction, then the FINAL ASSIGNMENT (the manual, and a report of the research) with in the APPENDIX the results of the entry assignments.</b>	
- Remember to number the pages.	
- Mention the names of the team members and the school on the cover sheet.	

## *The assessment*

With this assignment it is not about the “one correct answer”; there isn’t merely one, with several assignments there are multiple options. In the assessment the following aspects are taken into account:

- Whether your work method has been described clearly (use notes, pictures, illustrations!);
- whether the choices and results have been well substantiated;
- how you have dealt with the assignment, whether you have worked systematically, and whether the use of math and calculations is correct, useful and clear;
- how the final assignment have been executed; the FINAL ASSIGNMENT outweighs the entry assignments in the assessment!
- whether the report/paper is a coherent entity (a real report) that can be read as an independent piece without the use of the assignment;
- whether you used your creativity.

**Have fun and good luck!**

## Glasses, tubes and tennis balls

*It is not always immediately clear what form can hold the most volume. Sometimes it appears that one glass can hold much more water than another, but then it shows that this is actually not the case! So you cannot completely trust your instinct in estimating what can hold more volume. The first assignment investigates this aspect.*

### Entry assignment 1: research in the sizes of glasses

There are different types of glasses on the table.



a) What glass can hold most volume? With your group place them in order of volume on the basis of *intuition* and *estimation*.

b) Also try to *estimate* with your group which is larger: the height or the circumference? Do not measure yet, but look at the glasses!

Fill in the table:

	Glass 1	Glass 2	Glass 3	Glass 4	Glass ...
Which is larger? (height or circumference?)					

c) Now check: what is *really* the height and the circumference of the top of the glass, and can you find a connection in the circumference, the height and the volume?

Write down what you have discovered. Mention at least the different types of glasses, connections that you have found and anything else that you have noticed. (not more than one single A4 page)



*You have now found out that ‘what you see’ really needs to be measured or calculated to find out what the volume is!*

*We will focus on the “cylinder-shaped” figures, and this time not made of glass but paper. With paper you can roll a tube, holding the ends together. This can be done in two ways: along the length and the width. Will that make a difference to the volume of the tube?*

*The second assignment investigates this aspect!*

### **Entry assignment 2: research in the sizes of paper**

A sheet of A4 paper can be rolled along the length and be made into a tube, but this can also be done along the width. Which results in the largest volume?

When taking a rectangle with different measurements than A4, does the same apply? Find the correlation between the sides of a rectangle and the most volume, write down the result of your research.



*You now know more on the different volumes that can be created with a fixed paper format. In the final research you will investigate this time what happens when the volume is set: can you then still vary with the “packaging”? We will use tennis balls as content.*

### **Exploration**

Four tennis balls can already be packaged in many different ways. Explore how four tennis balls can be laid down for packaging. This does not need to be calculated!



### **Final assignment**

Design a paper packaging with as little paper as possible, packaging ten tennis balls as efficiently as possible. The less space used the better!

Provide a manual with illustrations for making the packaging in such a way that someone else can reproduce it.

Show with calculations, drafts and pictures that the packaging consists of a minimum amount of paper, and is highly efficient.

TIP: Investigate several options on efficiency and investigate what happens with the packaging when there are one (or two) balls less or more.