# *There are enough rotational solids to go around*

Introduction

Here you will learn to indentify and construct various rotational solids. For the purpose you will use the Math Wheel and the Bottle Design software.
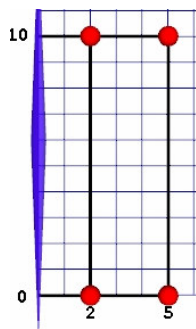
The challenge

Below you see the pictures of three machine details, each one next to a sketch of the profile used for their manufacture. Which one has the biggest volume?
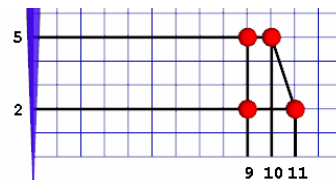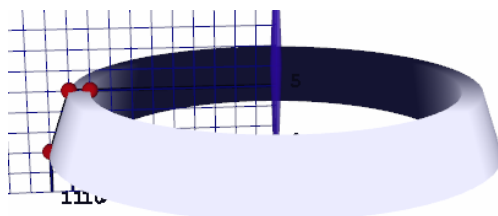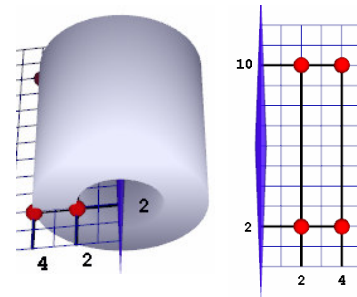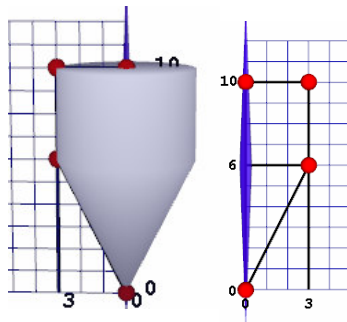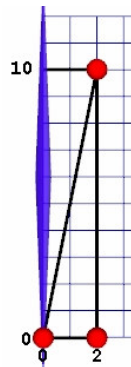
Raising the bar

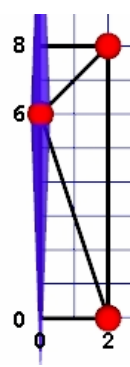Find the volume of the solids obtained after rotating the polygon through the red dots around the blue axis.
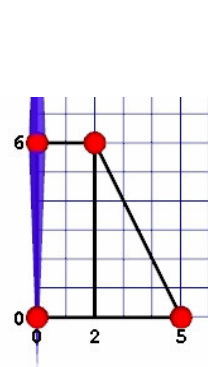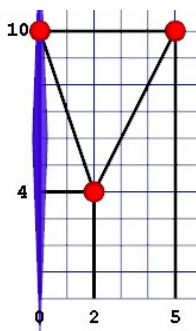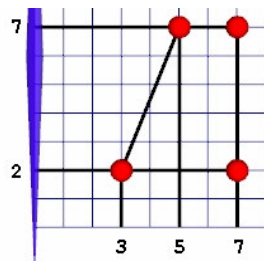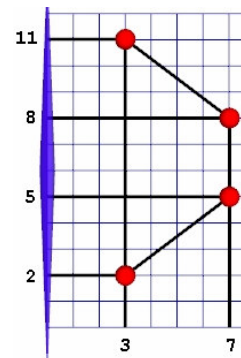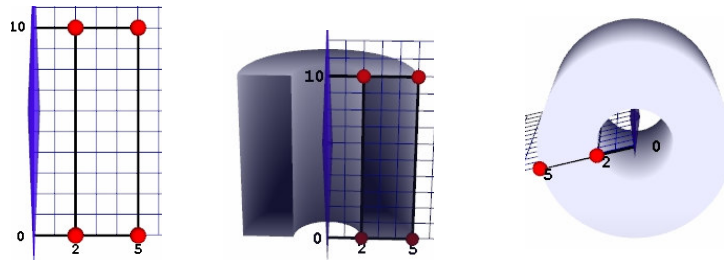
a)

b)

c)

d)

e)

f)

g)

Use the *Math Wheel* software to visualize the rotational solid obtained.
If you face difficulties look at the next page where you will some tricks for finding the volume being sought.

Some tricks ...

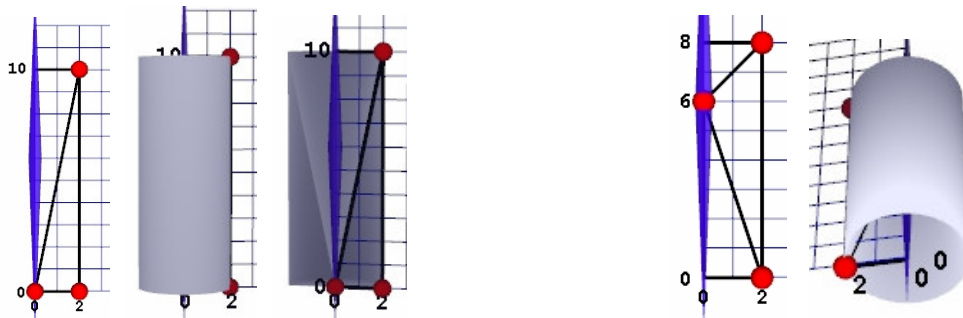The volume of the rotational solids could be considered as a difference of the volumes of:
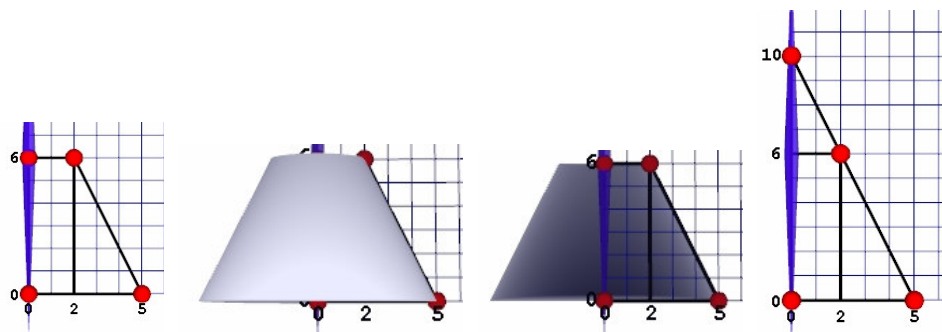
- Two cylinders in **a),**

- a cylinder and a cone in **b),** and
- a cylinder and two cones in **c).**

In the case of **d)** it is convenient to complement the solid to a cone. Then the volume of the solid under question will be the difference of the volumes of the two cones. Such a solid is called *truncated cone.*

Some tricks ...

We remove:
- a cone from a truncated cone in **e)**
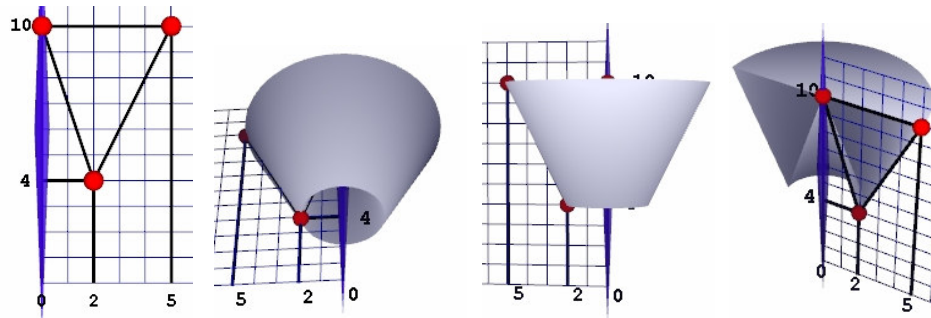
- a truncated cone from a cylinder in **f)**

In **g)** the solid is a sum of a cylinder and two truncated cones. You figured out that the two truncated cones are equal, didn't you?

Exploration

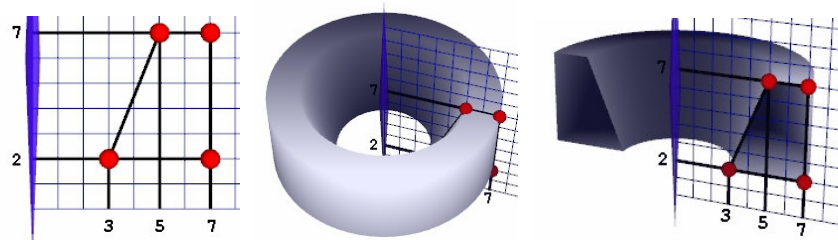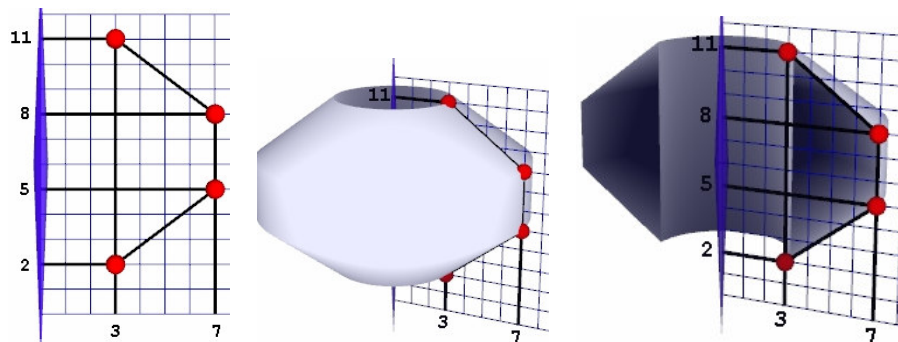Compare the volumes of the rotational solids obtained after rotating the rectangles with vertices the red dots around the blue axis. Think of situations when the *donut* with a bigger whole is better.
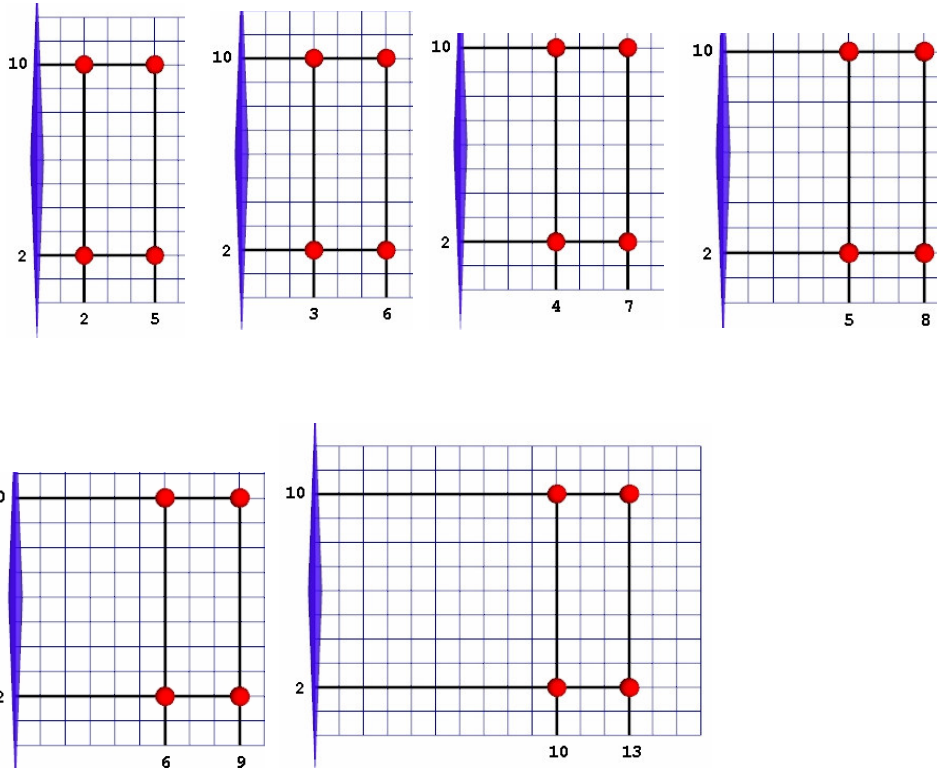
Try to make two different using the same quantity of dough. Before taking the flour, make computer models of the donuts.

Modeling vases

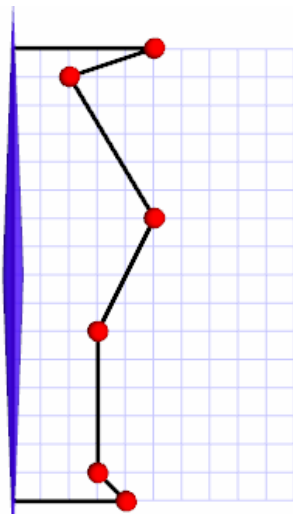Now you will use *Bottle Design* to create models of vases under specific requirements for the volume. It is sufficient to construct the profile of the vase.
The vase obtained by rotating the profile below is of volume 200π cubic units..
Change the profile so that the volume of the vase is greater than 215π cubic units and smaller than 225π cubic units by
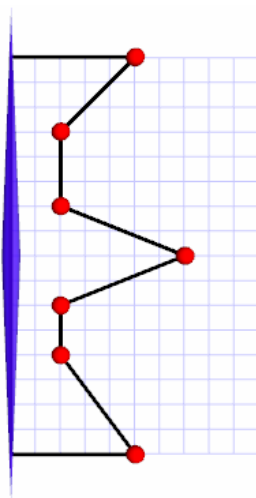
a) adding a dot   b) removing a dot
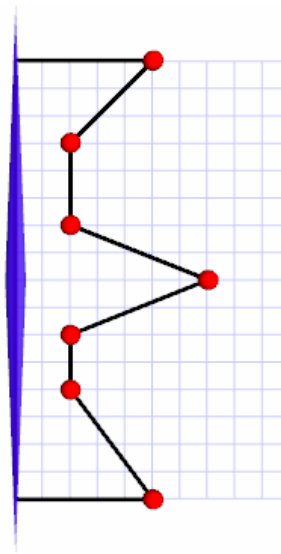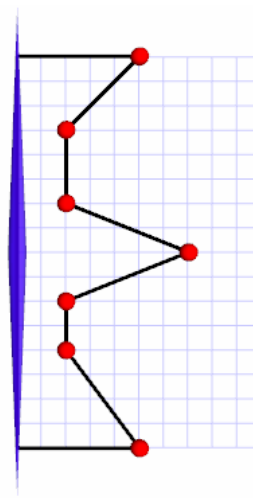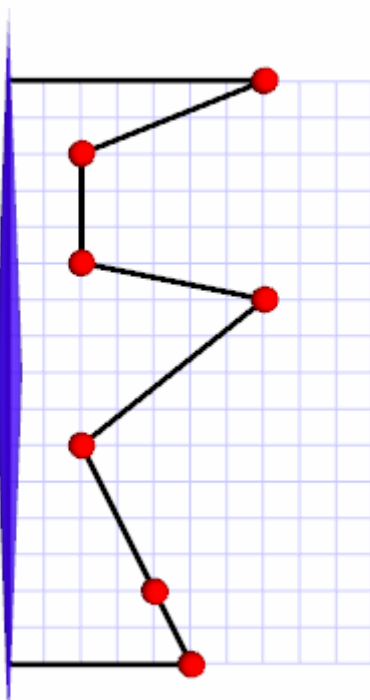
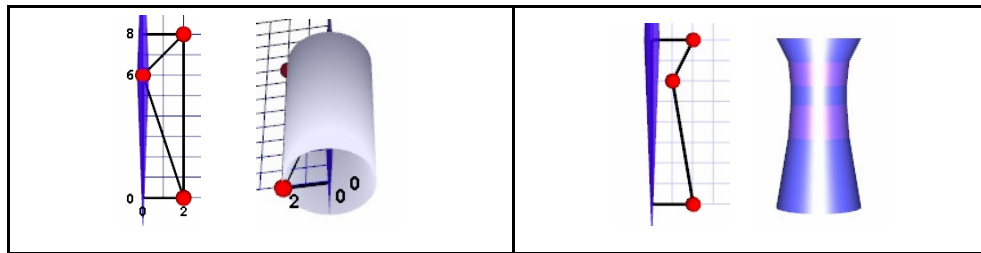c) moving a dot   d) moving two dots.

Can you move a dot in the profile so that the volume of the vase remains the same?

Pay attention to the difference when rotating a triangle in *Math Wheel* and the polygon through 3 dots in *Bottle Design*.
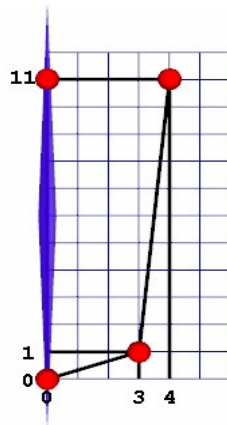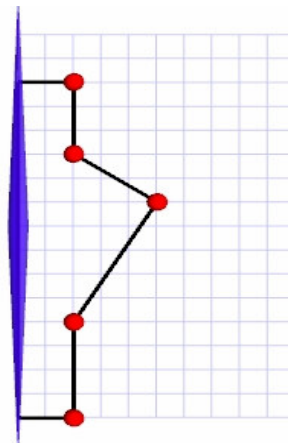
Math Wheel	*Bottle Design*

Move a dot in one of the models below so that the volumes of the vases obtained are approximately equal.

<div align="center">

Math Wheel   *Bottle Design*
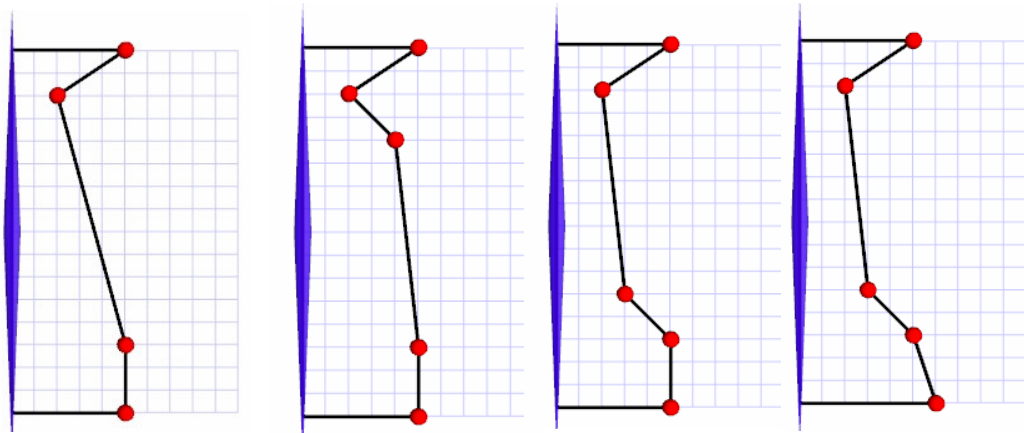
</div>

Modeling perfume bottles

If you are a designer of perfume bottles, it is important to care not only about the shape but also about the volume of the bottle.

Here are a couple of warming-up problems:
- Which one of the rotational solids to be obtained by the models below will have the smallest volume?
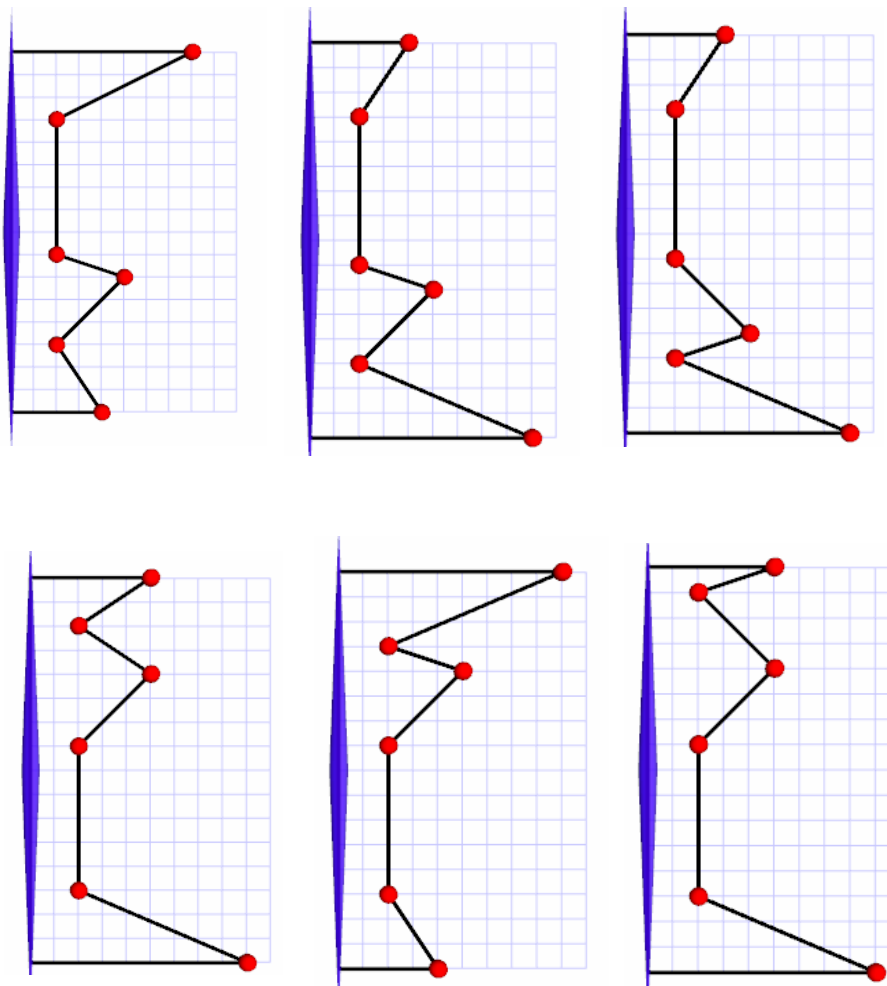
- Which one of the rotational solids to be obtained by the models below will have the smallest volume?
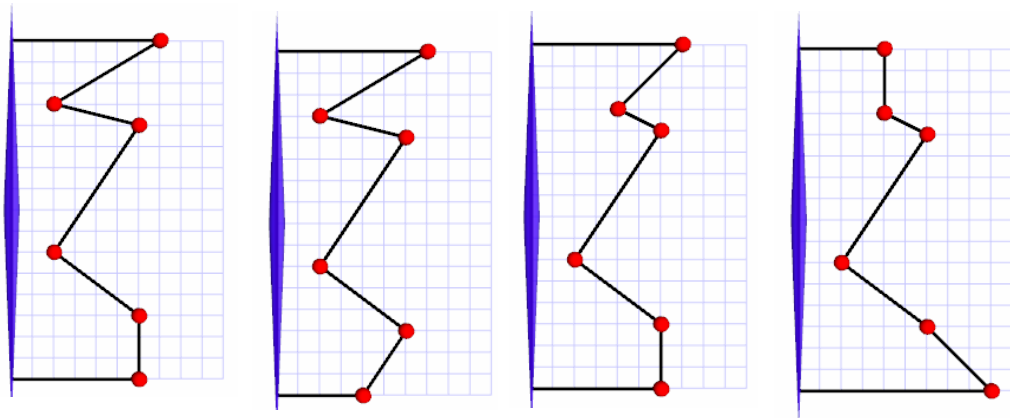
Check your answer with the **Show Math** button and see the bottle model with the **View bottle** button.

Which of the bottles obtained by rotating the profiles below will have equal volumes?

Project ideas:

- Take pictures of rotational solids - archeological artifacts, clay and ceramics containers, vases, bottles, etc.
- Make computer models of those you like the best and calculate their volume and surface
- Make computer models of artifacts with missing parts
- Create problems on rotational solids, present them appropriately and send them to friends.