Projects

Make a headphone tidy with FreeCAD

Design and 3D print a headphone tidy with FreeCAD

Step 1 Introduction

In this project, you will use 3D parametric modelling software to design a headphone tidy. If you have access to a 3D printer, you can print your model.

The model will be made of two parts that fit together.

What you will make

What you will need +

What you will learn +

Additional information for educators +

Step 2 Create the initial sketch

Open FreeCAD and create a new file. Save this as `Headphone_Tidy_Lower`.

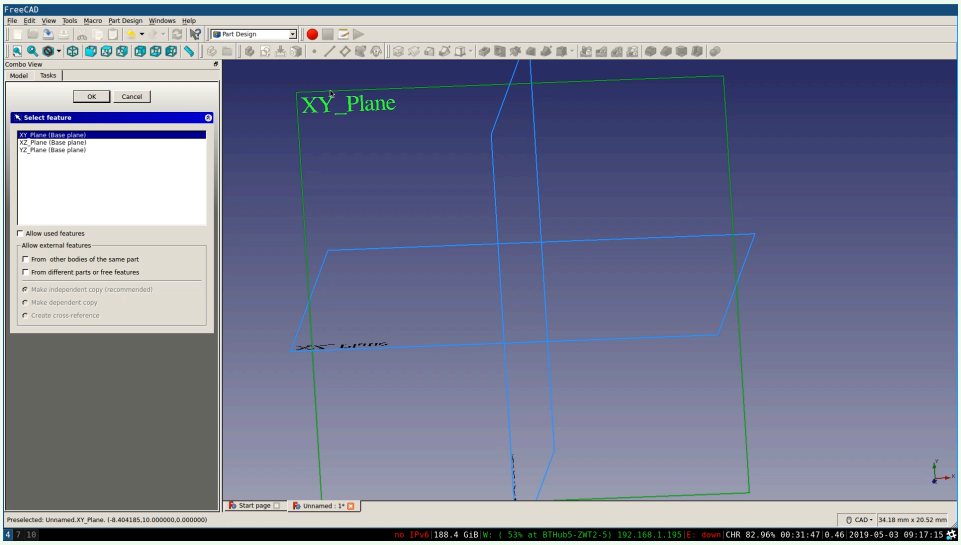
Open the **Part Design** menu, then click on the **New body** icon

.

Next, click on the **New sketch** icon

.

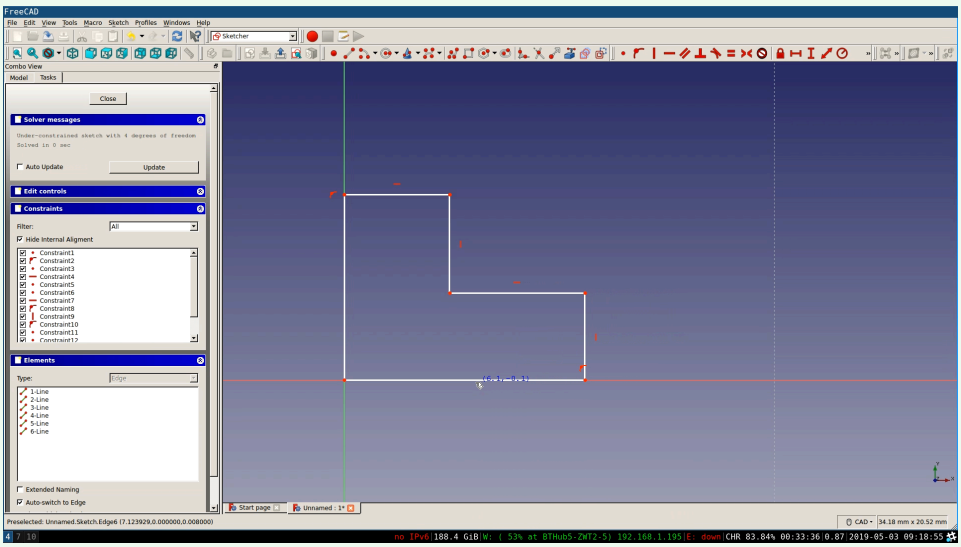
Select the **XY_Plane**. This will allow you to to begin your sketch.



Click on the **Line tool** icon

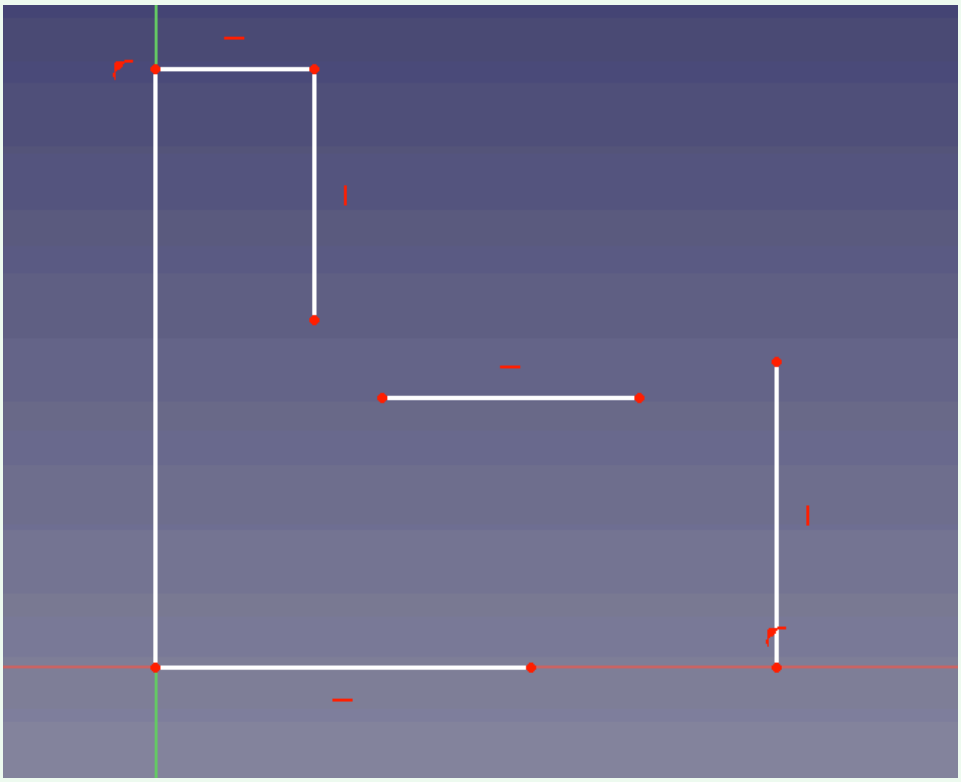
. Use this tool to

draw the shape below. The drawing does not need to be completely accurate at this stage.



Now that you have the basic shape, you can **constrain** your sketch. When drawing sketches, FreeCAD will often intelligently apply constraints for you (although on macOS, this can be buggy). It will do this if you accurately click on an existing point, for example. However, often you will have to investigate your sketch to see which points, lines, and arcs need to be constrained.

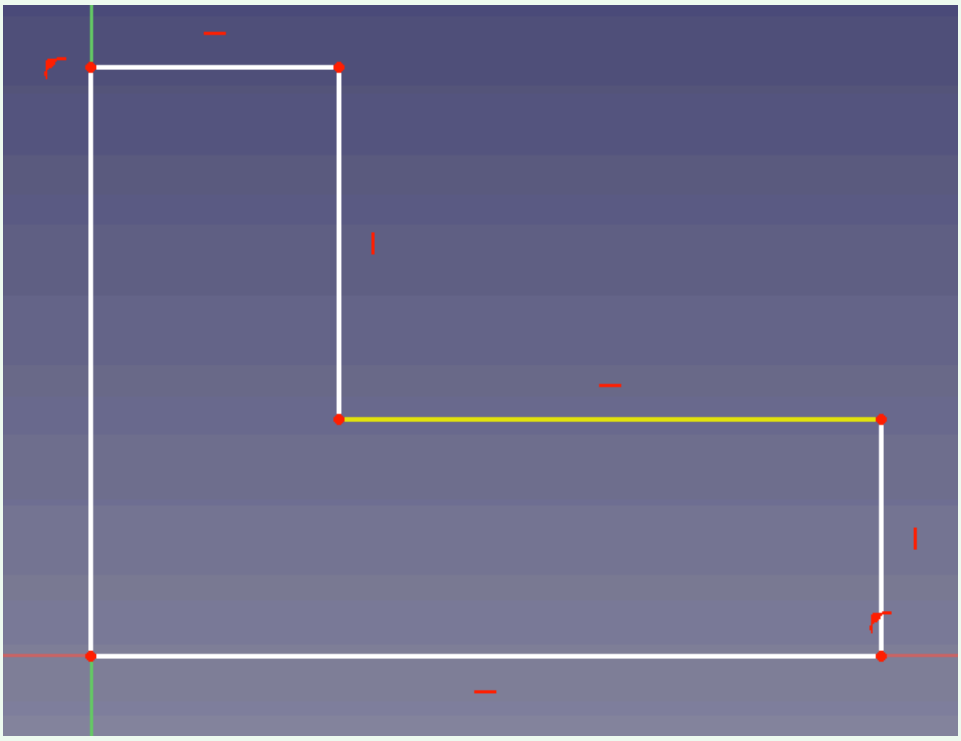
To begin with, click on each of the points and move them around. In the image below, you can see that two lines are unattached to the main shape.



Click on a point that you want to attach, then hold down `Ctrl` and click on the point that it needs to be attached to. Then, to connect the points, click on the **Point constraint tool** icon

.

When you have finished, all of the points should be connected.



Now, click on the **Fillet tool** icon

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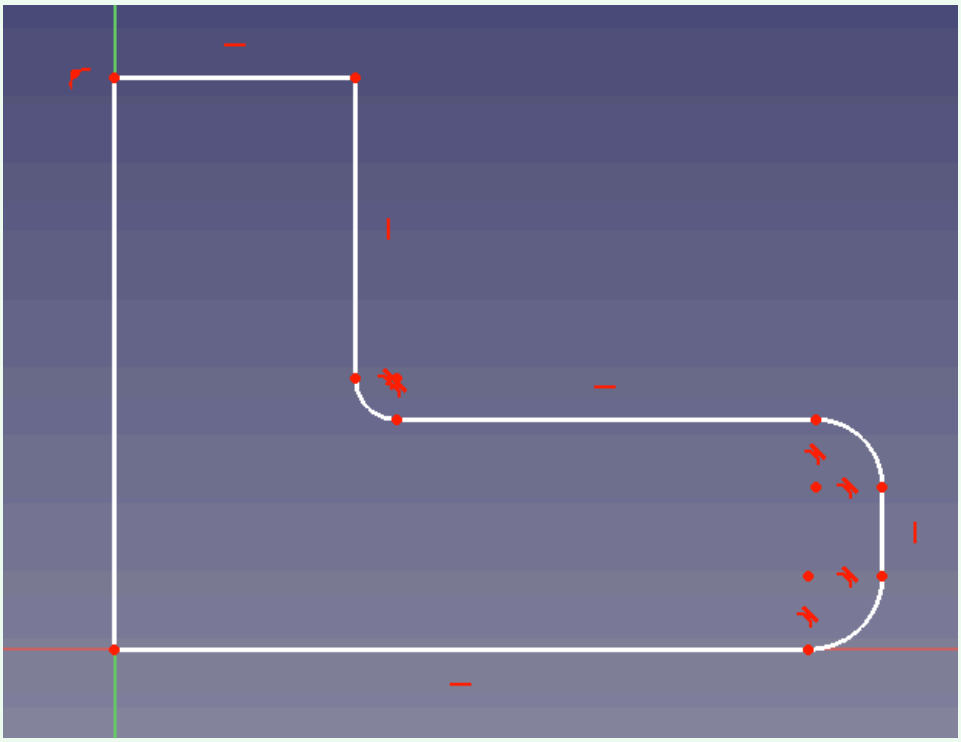
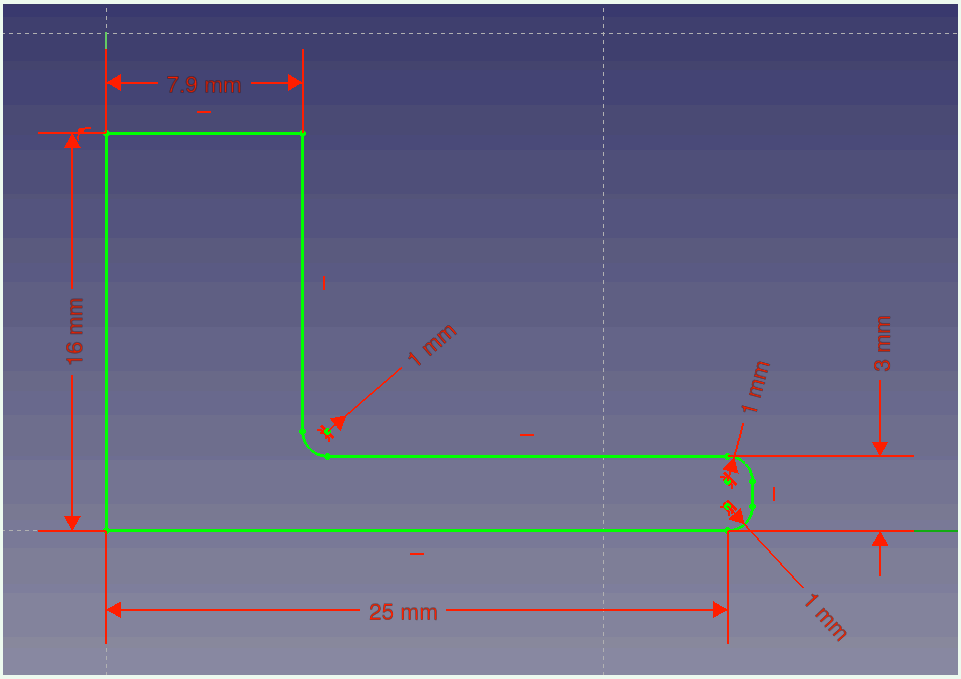
Click on pairs of lines where you want to place a fillet, so that your sketch looks like the one below.



Finally, use the remaining constraint tools to fully constrain your sketch.

1. Lines should either be constrained vertically or horizontally
2. Fillets should have radial constraints
3. Lines should be vertical and horizontal

Your sketch should look like the fully constrained sketch in the image below. It should also have the dimensions shown in the image.

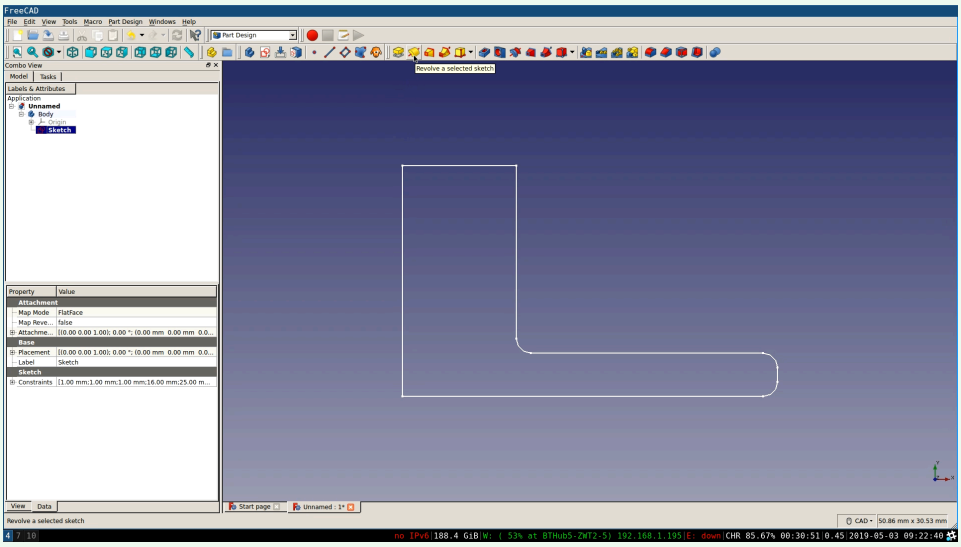


Step 3 Revolve the sketch

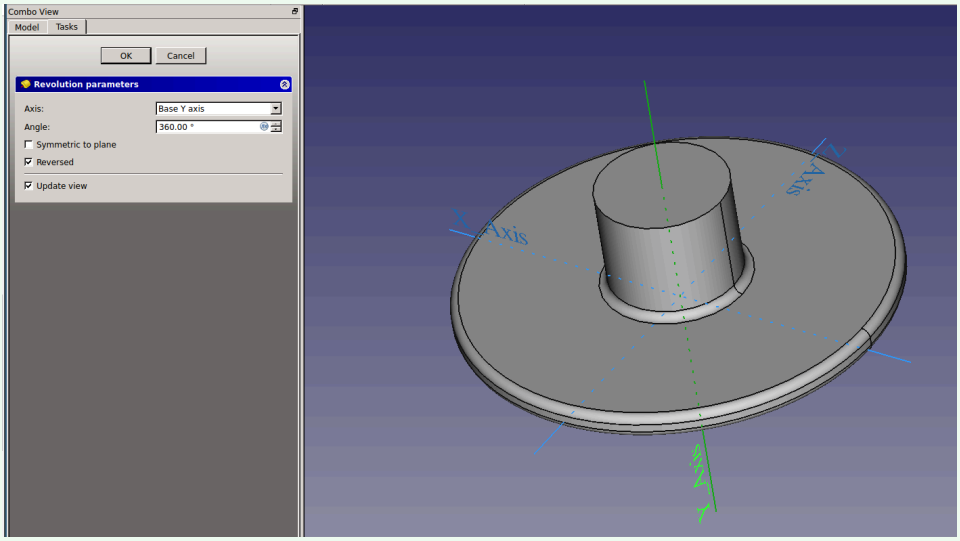
Now that you have a completed sketch, you can use the **Revolution tool** to turn it into a solid object.

Close the sketch, then select the sketch in the **Model** tab.

With the sketch selected, click on the **Revolution tool** icon.



Make sure that the **Base Y axis** is the axis around which the sketch will be revolved, then click on **OK**.



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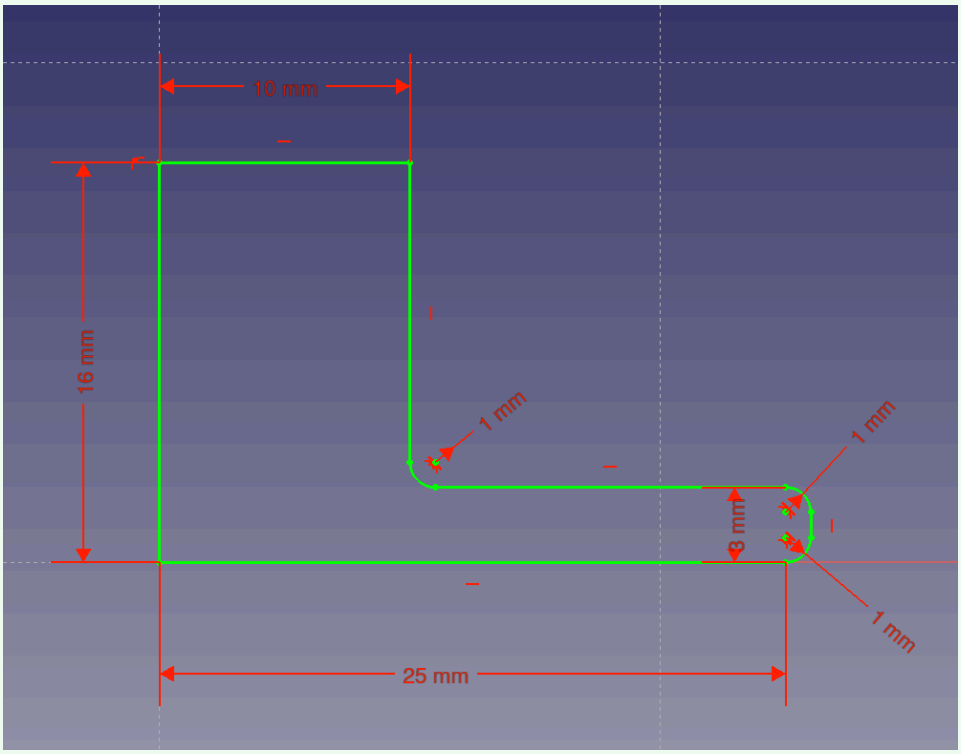
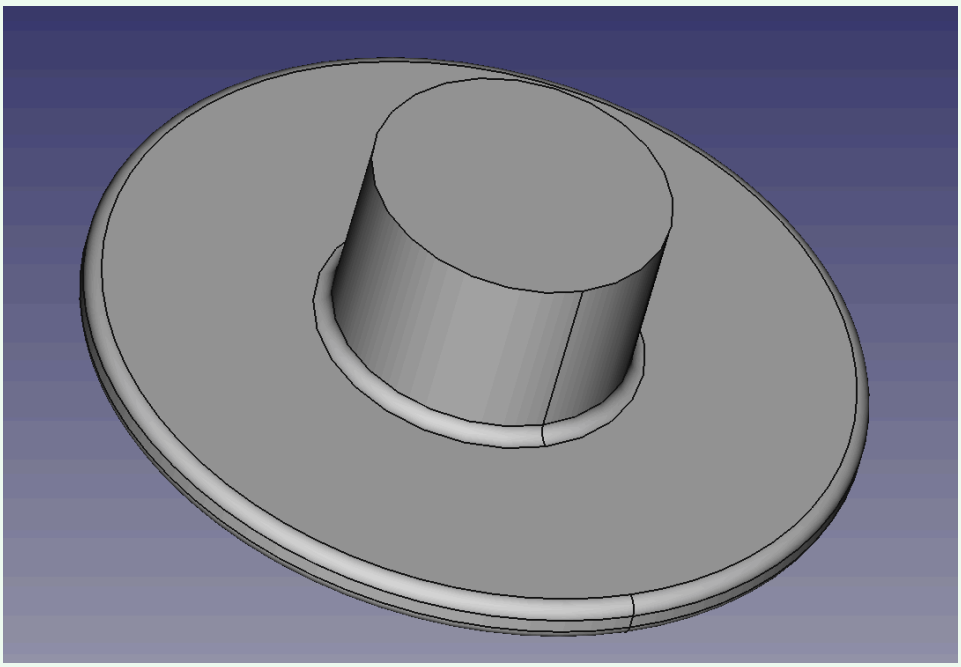
Step 4 Sketch and revolve the upper part

You have now made the basic structure of the lower part of the headphone tidy. In this step, you will make the upper part.

Repeat the previous two steps to create a new sketch with the dimensions shown in the diagram below, and then revolve it around the Y axis.





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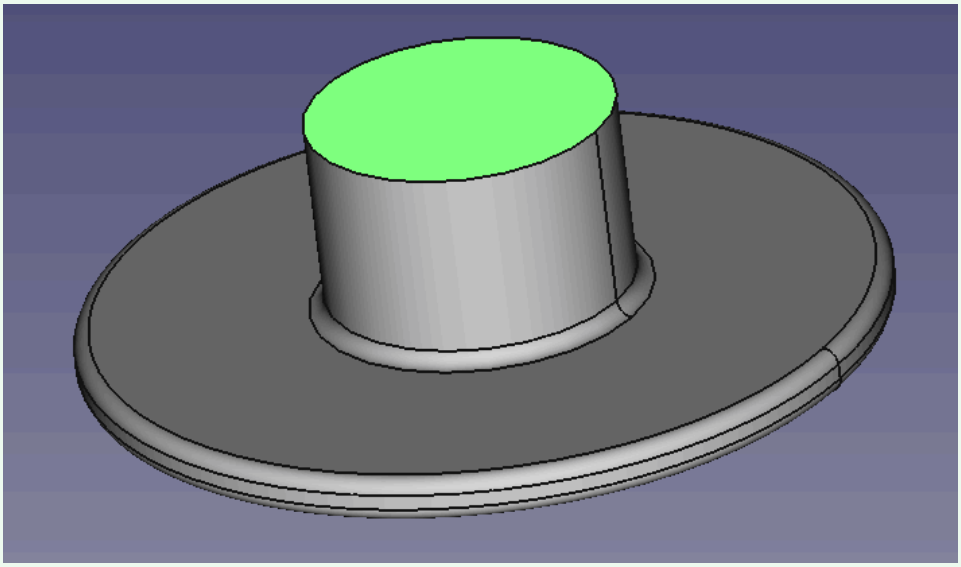
Step 5 Cut a hole

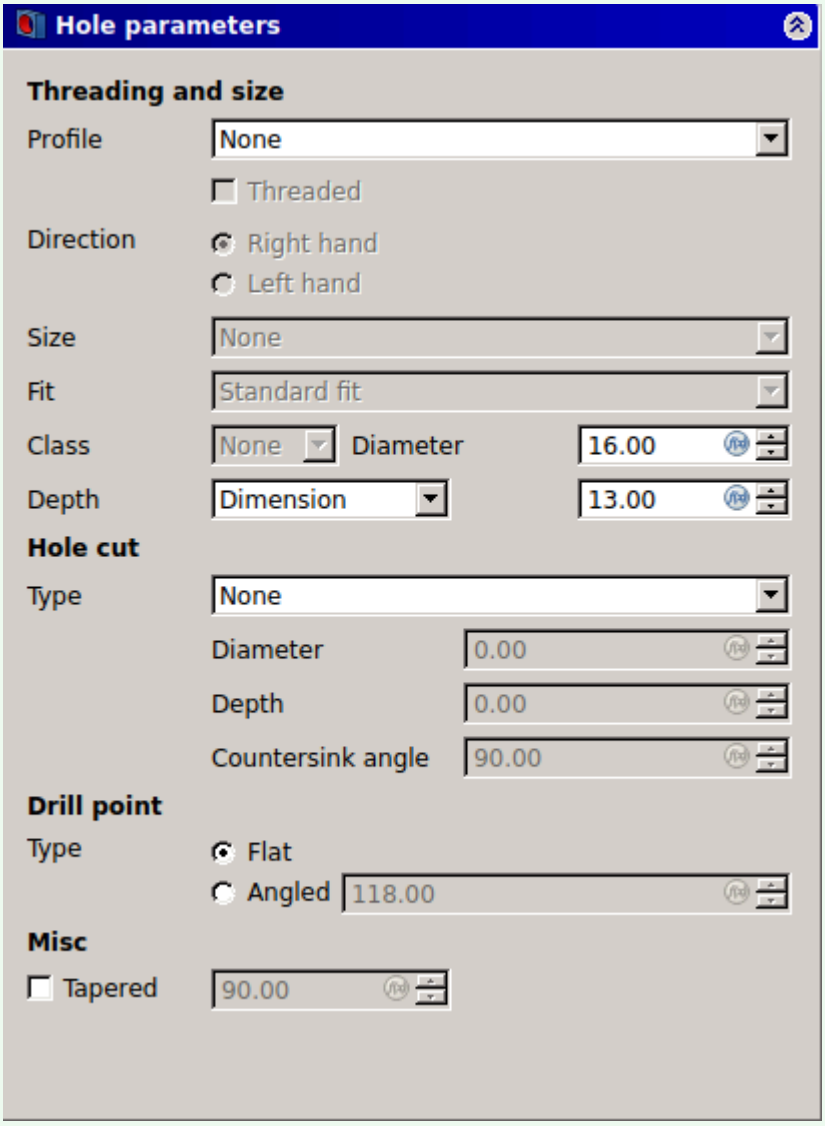
You need to cut a hole in the upper part of your headphone tidy so that the lower part can fit inside it.

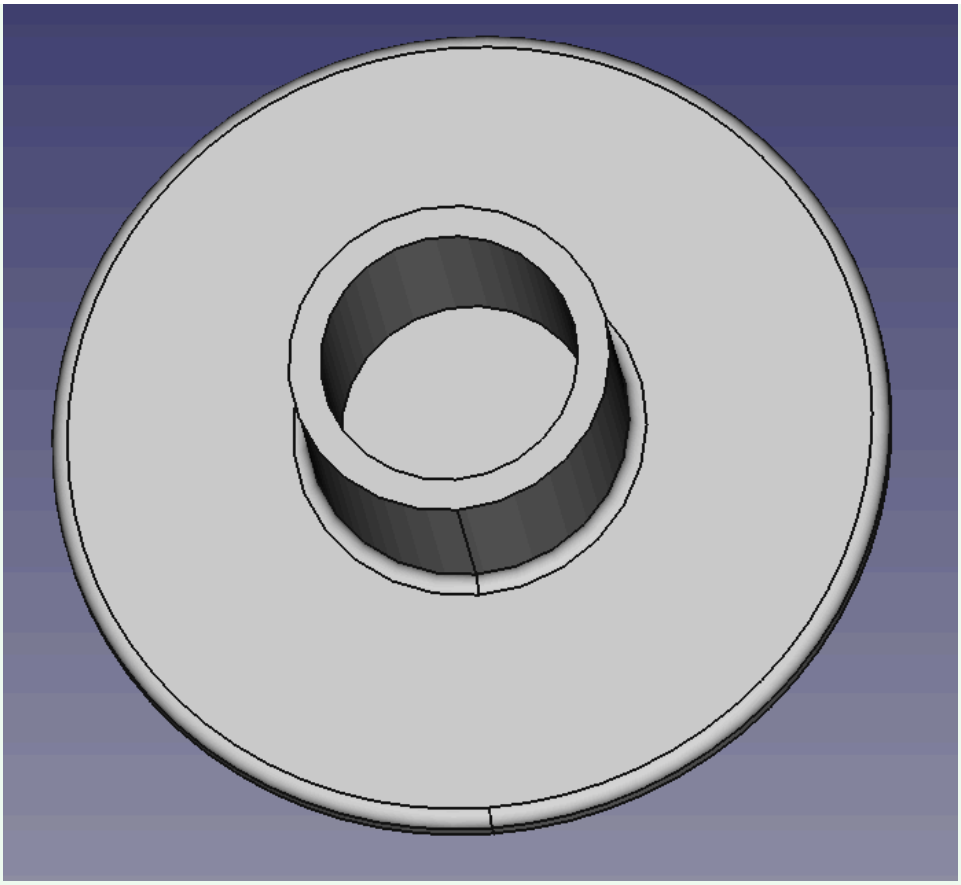
Select the uppermost face of the model.



Use the **Hole tool** to cut a hole in the face and open the **Hole parameters** menu.

Set the hole **diameter** to `16mm`, the **depth** to `13mm`, and the **drill type** to `Flat`, then click on **OK**.





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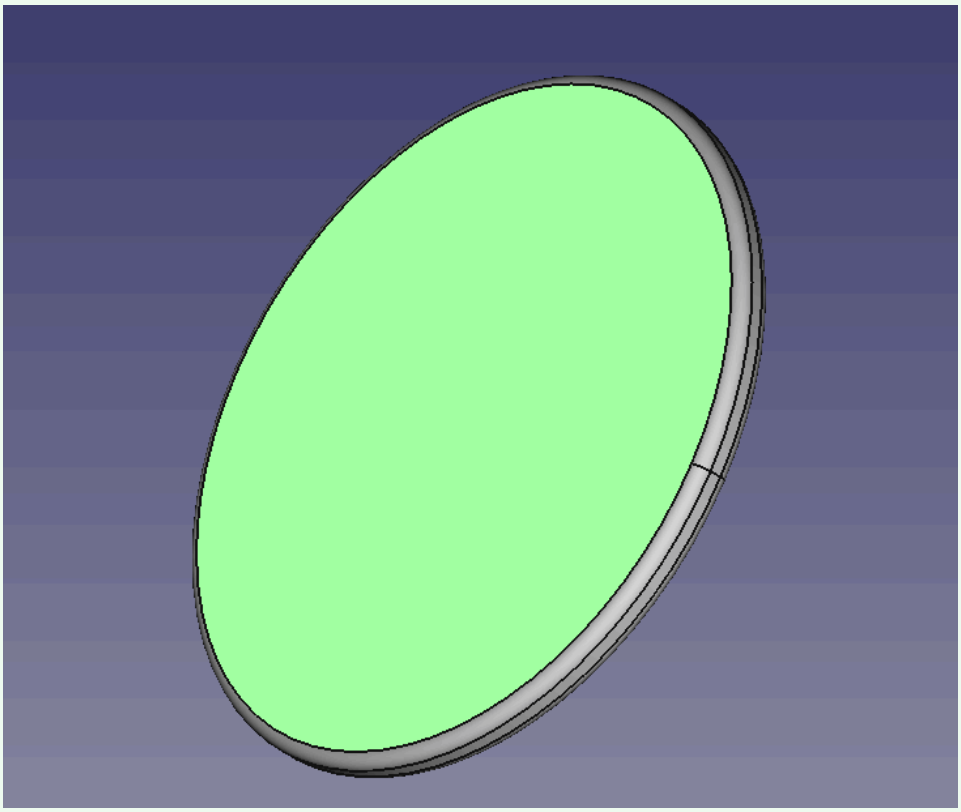
Step 6 Sketch the cable cut-out

Now that you have the basic structure for the headphone tidy, you need to cut holes into the upper and lower sections. This is where the cable will be placed.

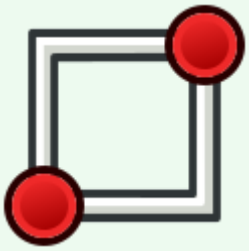
On either the upper or lower section of your model, select the large flat plane on the underside of the tidy.

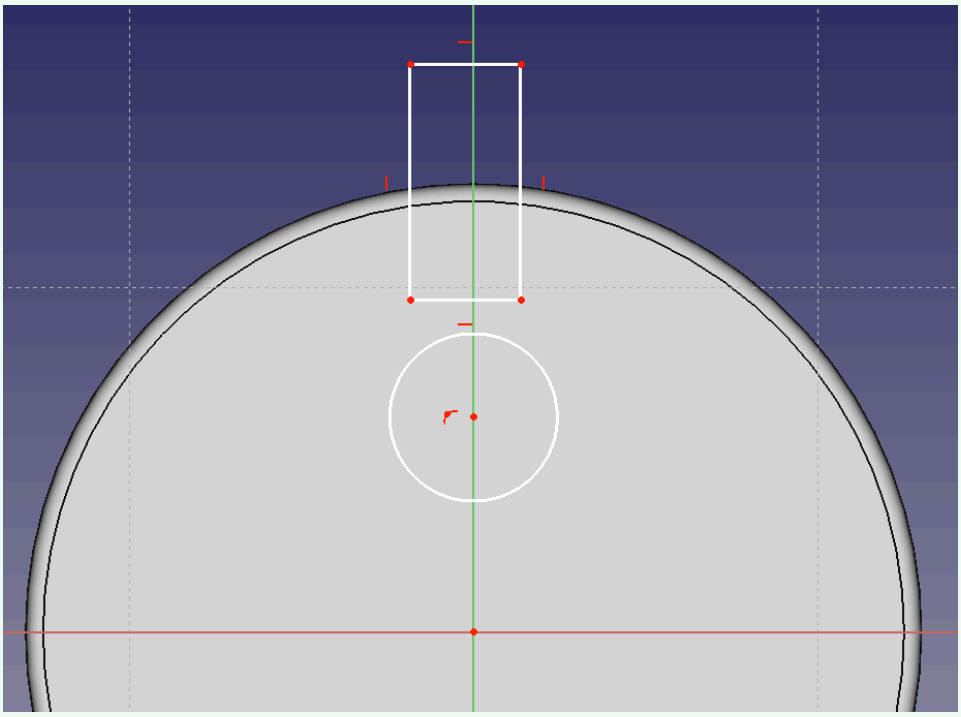


Click on the **New sketch** icon to start sketching on this surface

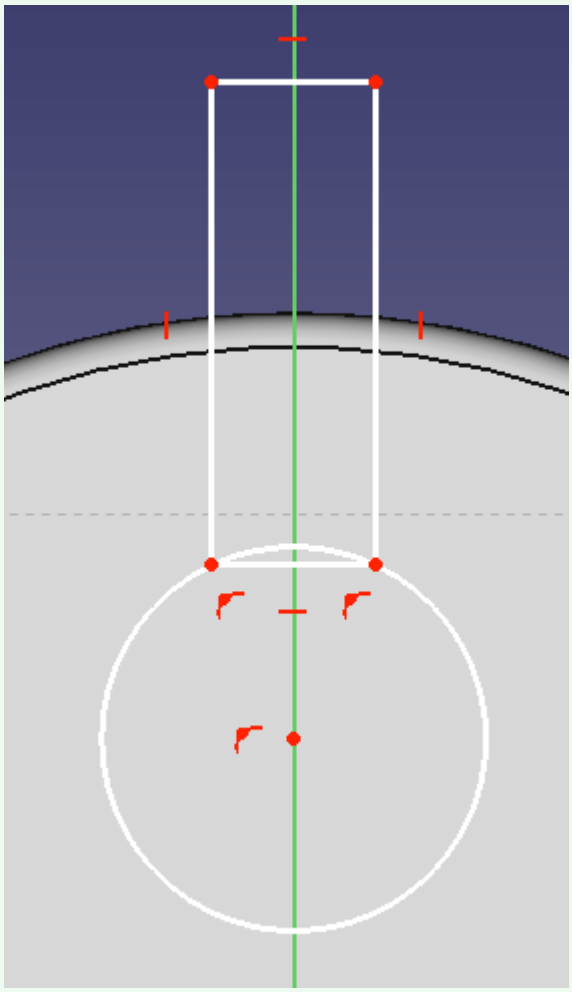
.

Create a circle and a rectangle on the surface of the tidy with the **Create circle tool** and **Create rectangle tool**.

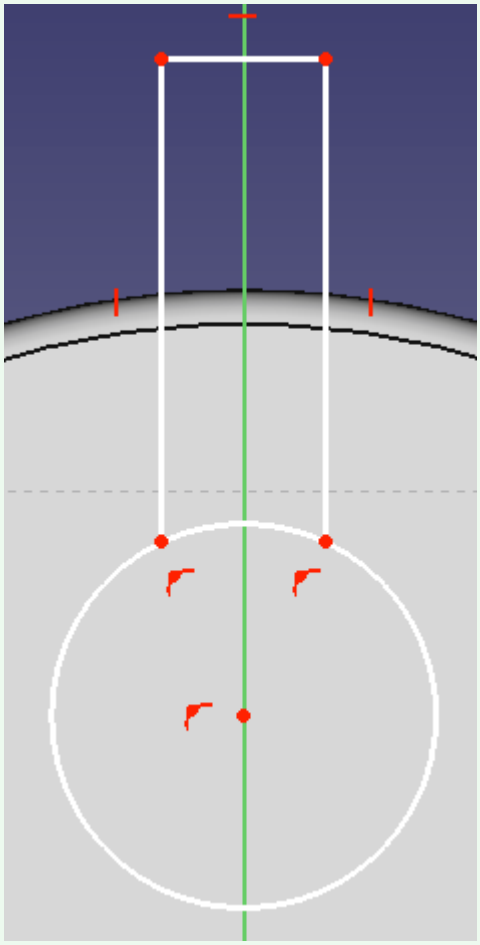




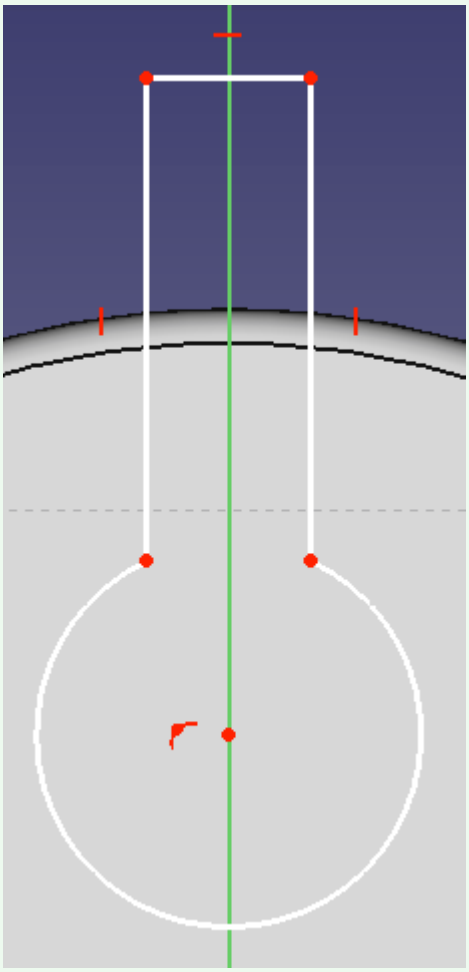
Now, affix the lower two points of the rectangle to the circumference of the circle. To do this, use the **Constrain point on object tool**.



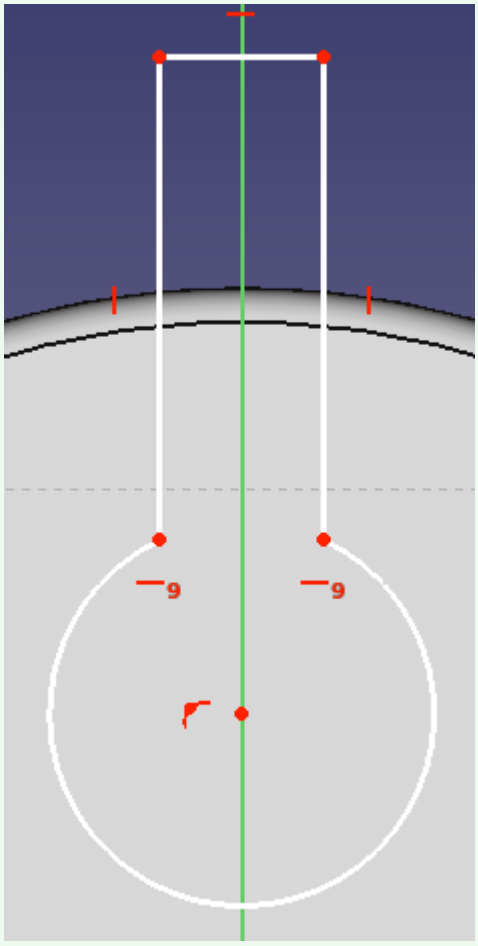
Select the lower line of the rectangle, then press `Delete` (`Fn+Backspace` on macOS) to delete it.



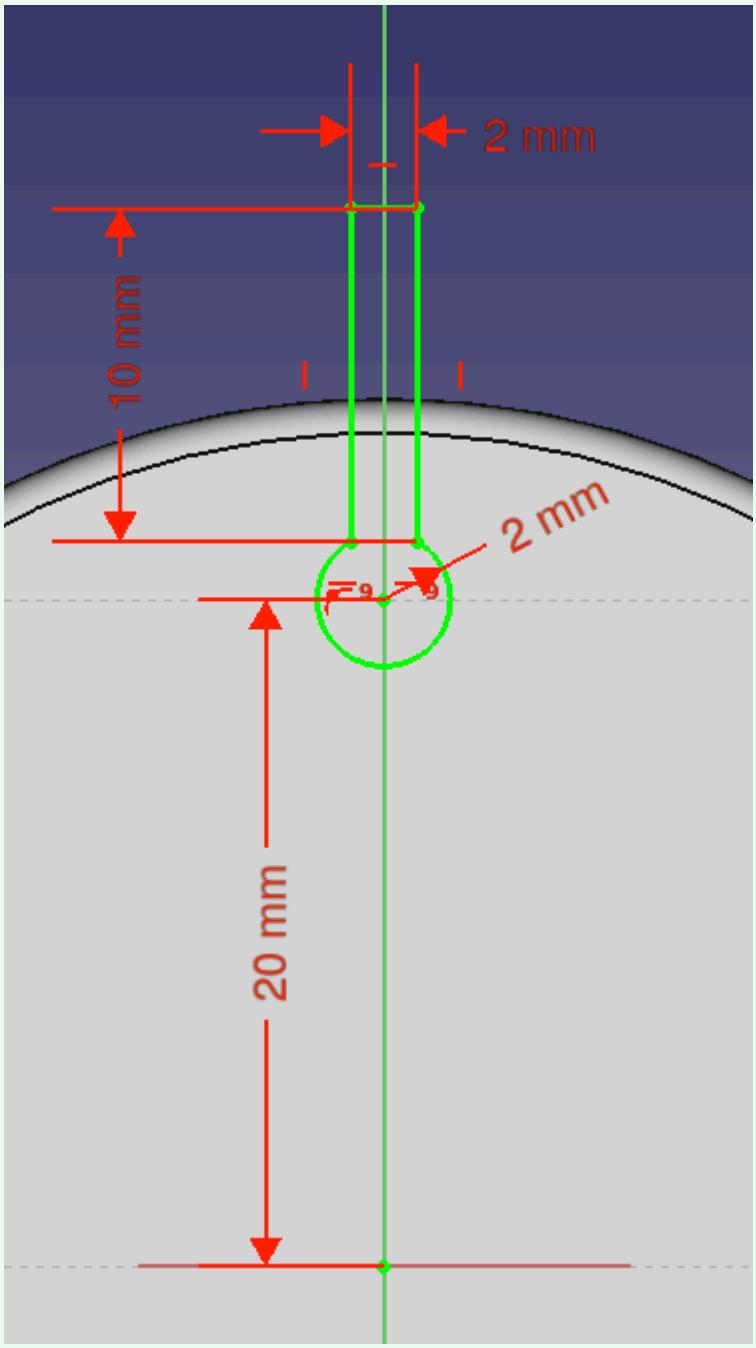
Remove the arc between the lower two points of the rectangle with the **Trimming tool**.



Constrain the two uppermost points on the circle so that they are horizontal to each other.



Finally, use the radius constraint and the horizontal and vertical length constraints to fully constrain the sketch, as shown below.

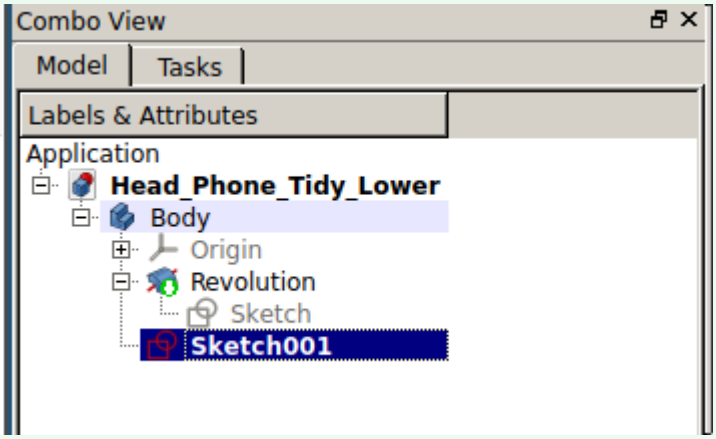


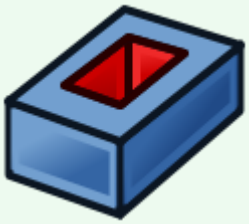
Now that the sketch is fully constrained, close the sketch and return to your model.

Step 7 Create polar pockets

You now have the sketch for the cut-out. In this step, you will create a pocket and repeat the pocket in a radial pattern.

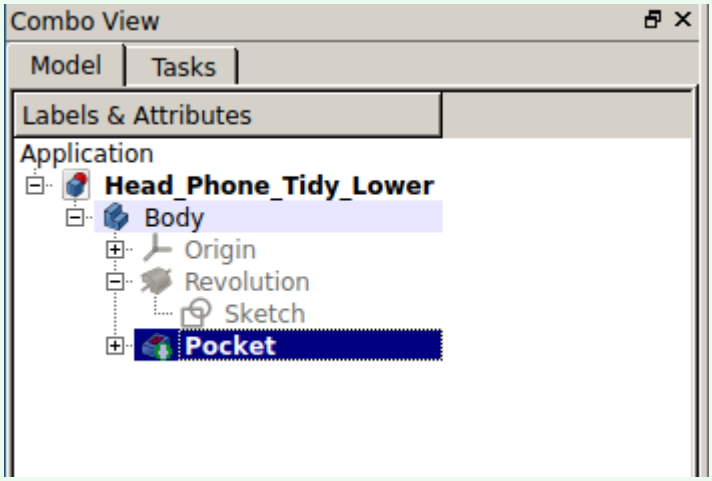
Select your sketch, then click on the **Create pocket** icon.





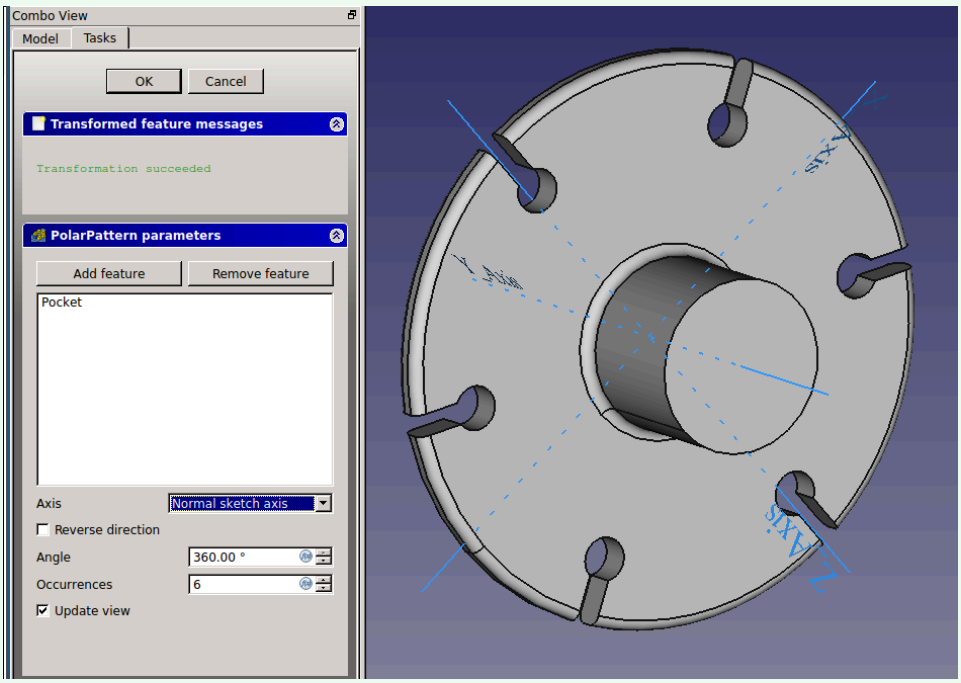
Any length over 3mm will cut through your model.

Select the pocket.



Then, click on the **Polar pattern tool** icon.

Change the **occurrences** to 6.



You have now completed one part of your headphone tidy. Repeat those steps to create the second part.

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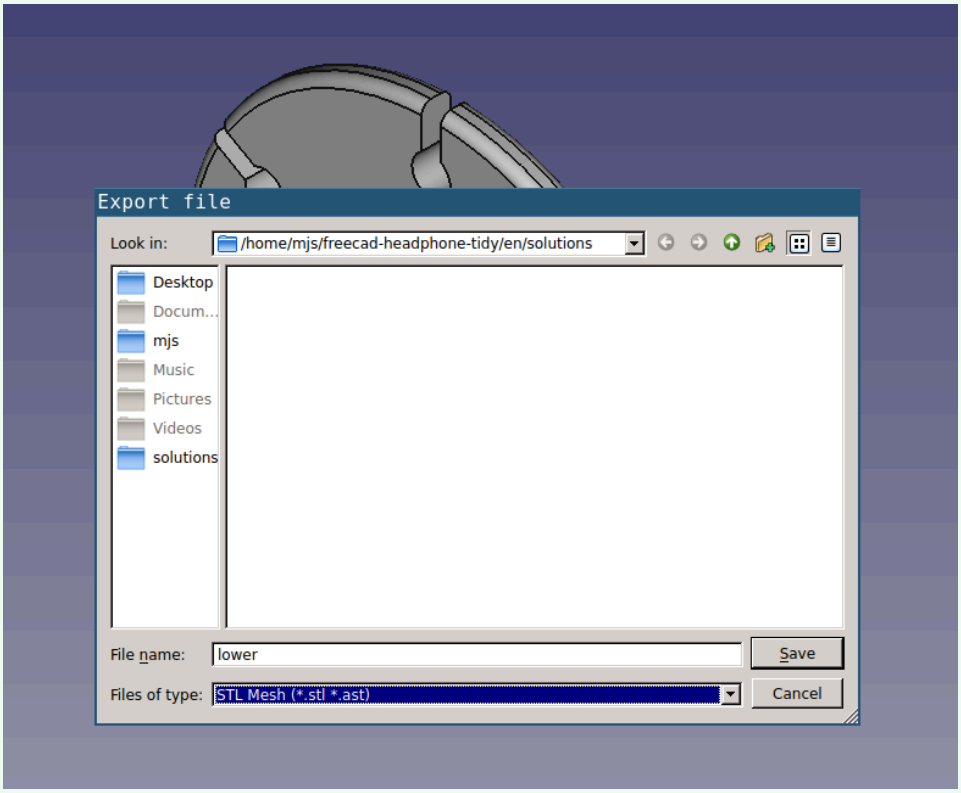
Step 8 Export your headphone tidy

In this step, you will export your model so that it can be printed. There are a lot of different types of 3D printer, but most of them will accept `.stl` files or `.gcode` files. It is easiest to export the model as an `.stl` file and then use

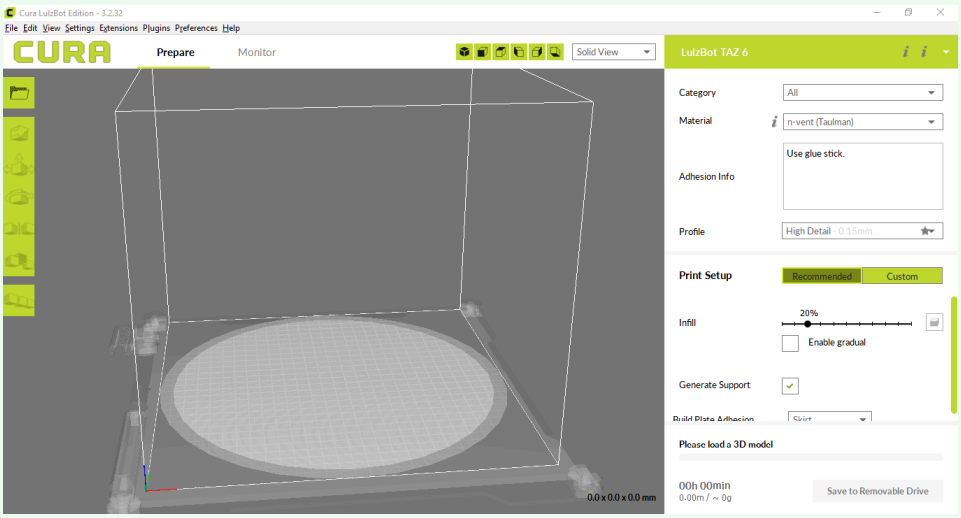
an external program to convert this into a `.gcode` file.

Select the body in the **Model** tab. Click on **File**, then click on **Export**. In the **Files of type** drop-down menu, select the `.stl` option. Give your model a name, then click on **Save**.



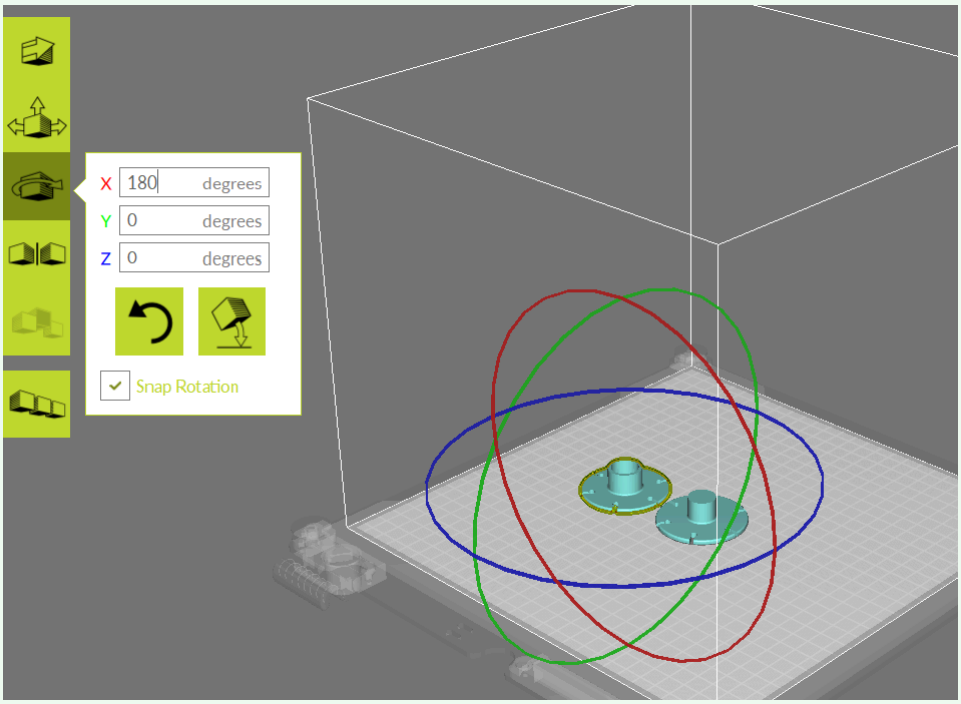
If your 3D printer requires `.gcode` files, use an external application to convert the `.stl` file into a `.gcode` file. The instructions below are for the software **Cura** (https://ultimaker.com/en/products/ultimaker-cura-software).

Open Cura from your **Applications** menu.



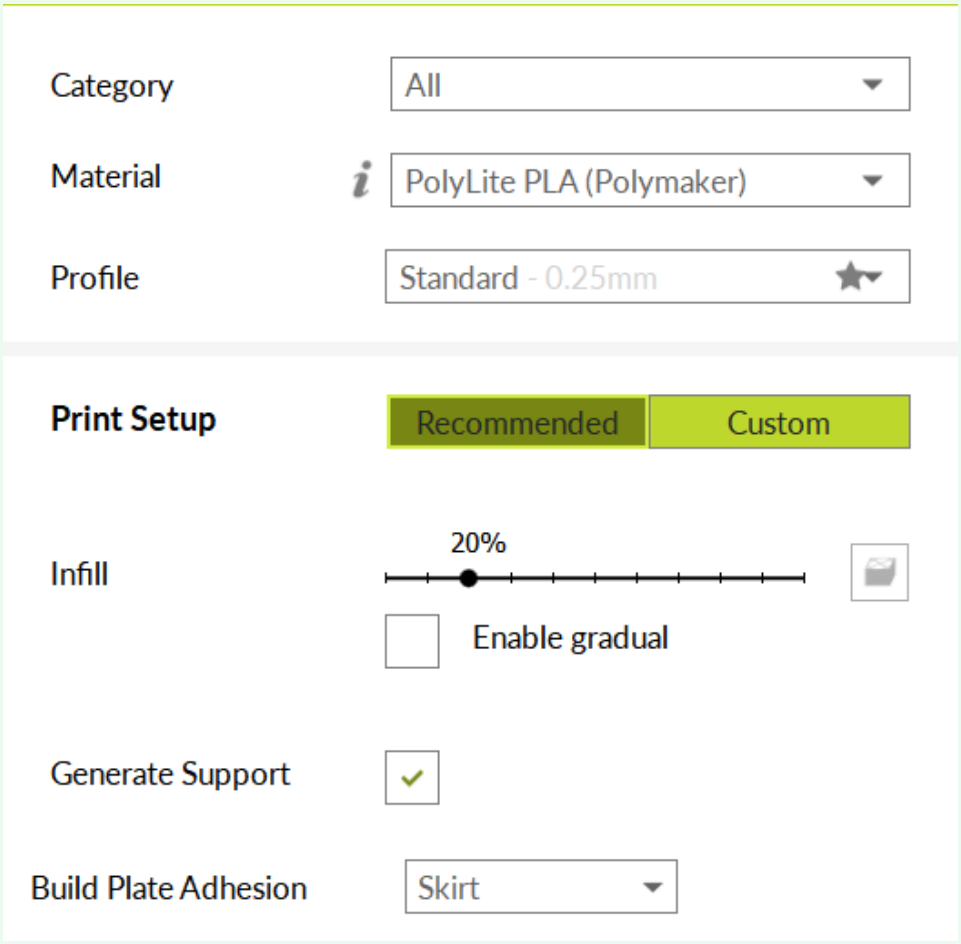
Go to the **File** menu and open your `upper.stl` and `lower.stl` files.

Position the two models side by side and rotate them so that they lie flat on the bed.



Use the settings on the right-hand side to choose your **material**, **profile**, **infill**, and any **support** you might need.
In this example:

- The material is **PLA**
- The profile is set to **Standard** detail
- The infill is set to **20%**

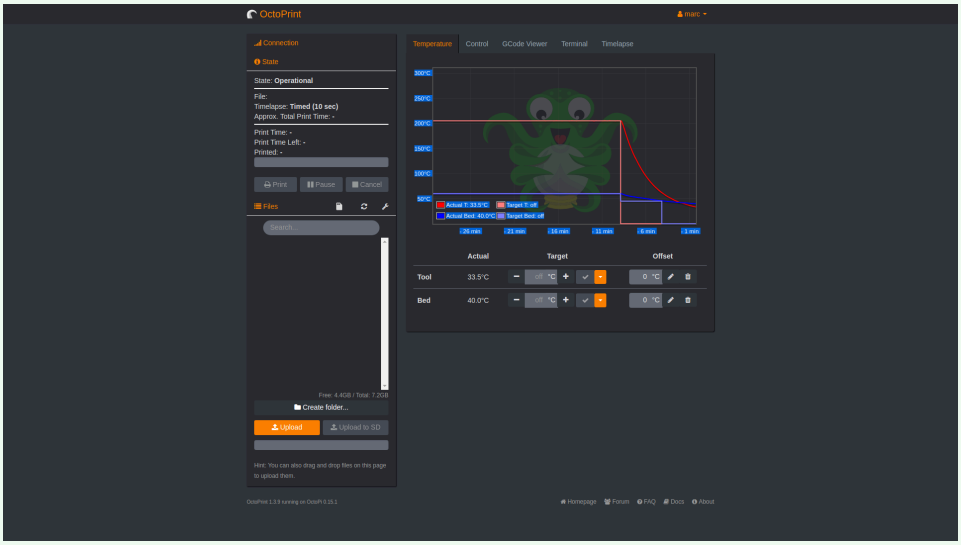


Once you are happy with the settings for your 3D printer, use the menu in the bottom left-hand corner to save your `.gcode` file.

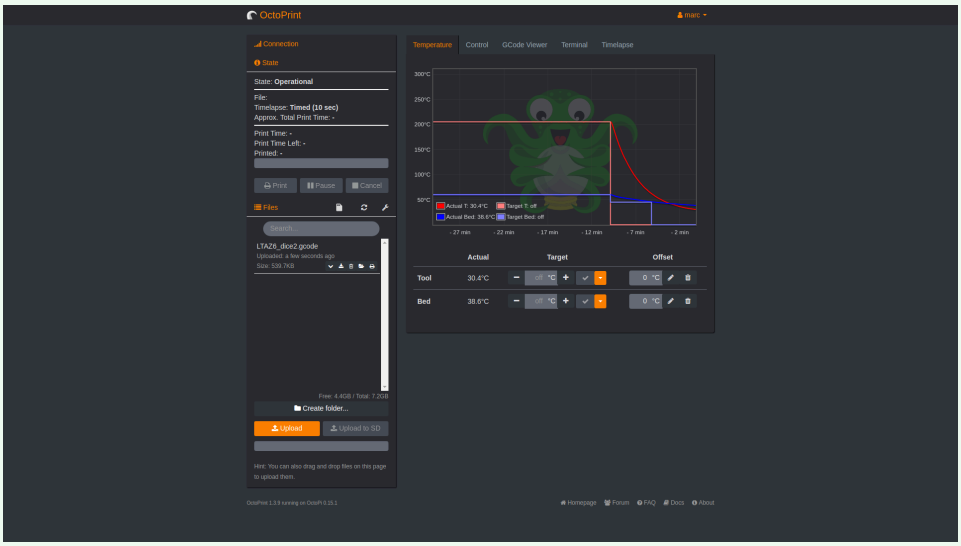
Step 9 Print your headphone tidy

Instructions can't be provided for all 3D printer models. The example here uses the Octoprint (https://octoprint.org/) software to print the headphone tidy on a Lulzbot TAZ 6.

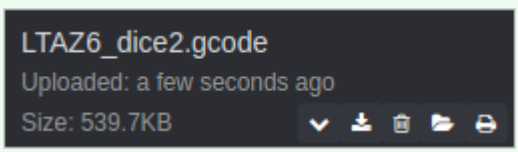
Turn on the 3D printer and load the Octoprint software.



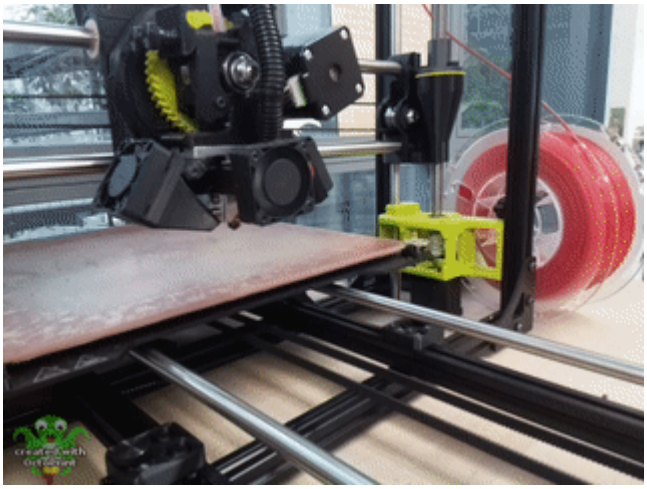
Load your `.gcode` file so that it appears in the file list.



Then, load and print the file.



As soon as the printer has warmed up, it should start printing the headphone tidy.



Push the upper and lower sections together. Your headphone tidy is now complete.