Onshape is an online CAD tool that is completely free to use. To follow along with these tutorials, you will need to create an Onshape account. You can do so here:

These tutorials will walk you through the creation of two simple scale models of some FRC robots from the 2020 game animation, but Onshape also provides general tutorials for using their program.

The completed CADs of these tutorials can be found here:
https://cad.onshape.com/documents/02199b4f408bddec65b32c2b/w/15523aa323f73f2bf6d56efa/e/83240f3b2c4933aa376f7df2

Quick Tips:

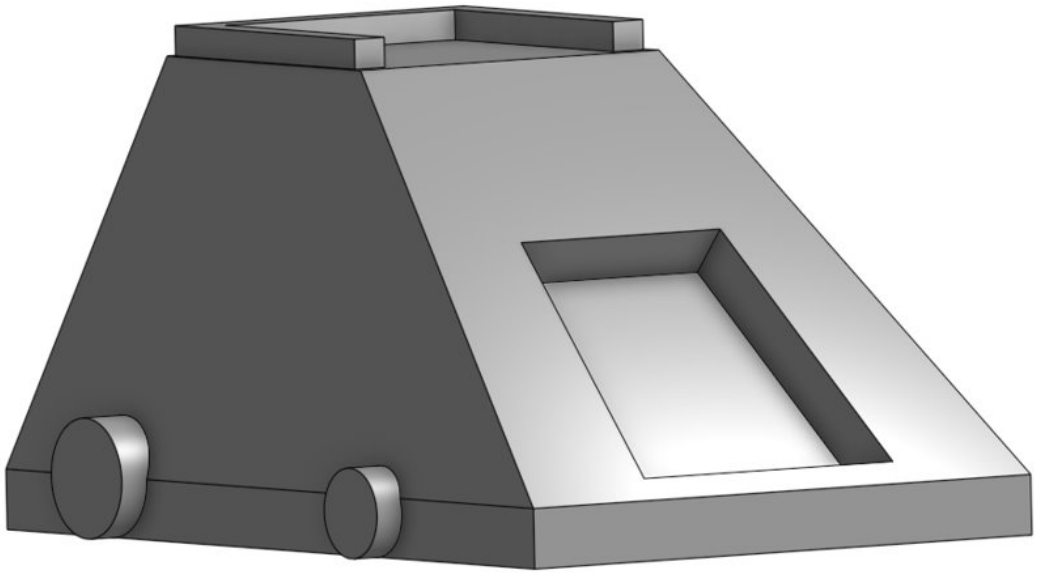
You can change your viewing orientation by holding down the right mouse button and dragging. You can zoom in and out by scrolling.

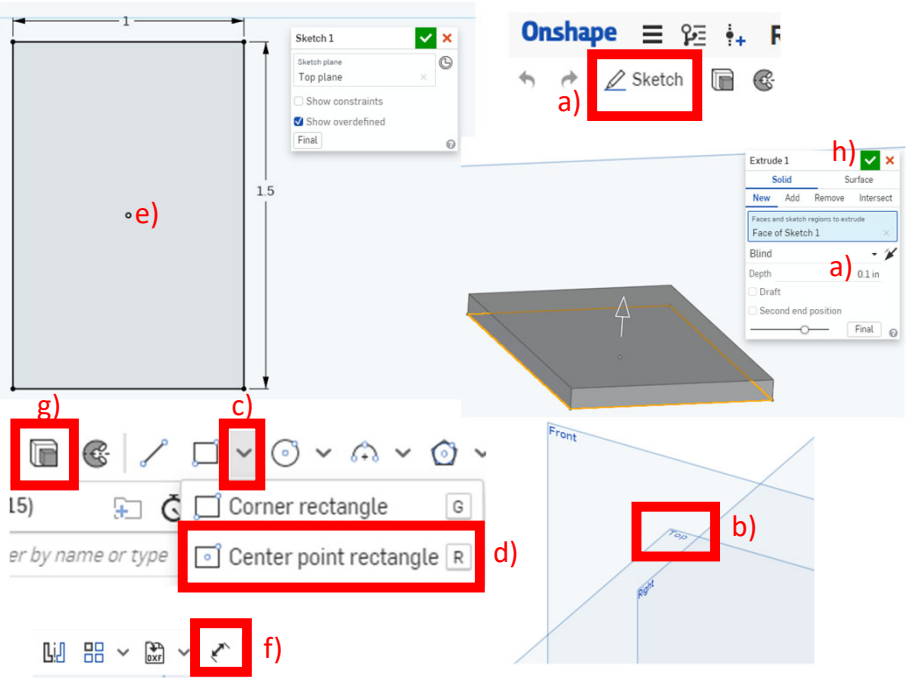
The lines of your sketches will turn black once they are fully defined. While you can complete a sketch even when it is not fully defined, you should try to make it as defined as possible.

If you're in a sketch, you can right click the screen and select "View normal to sketch plane" to face the plane head-on.

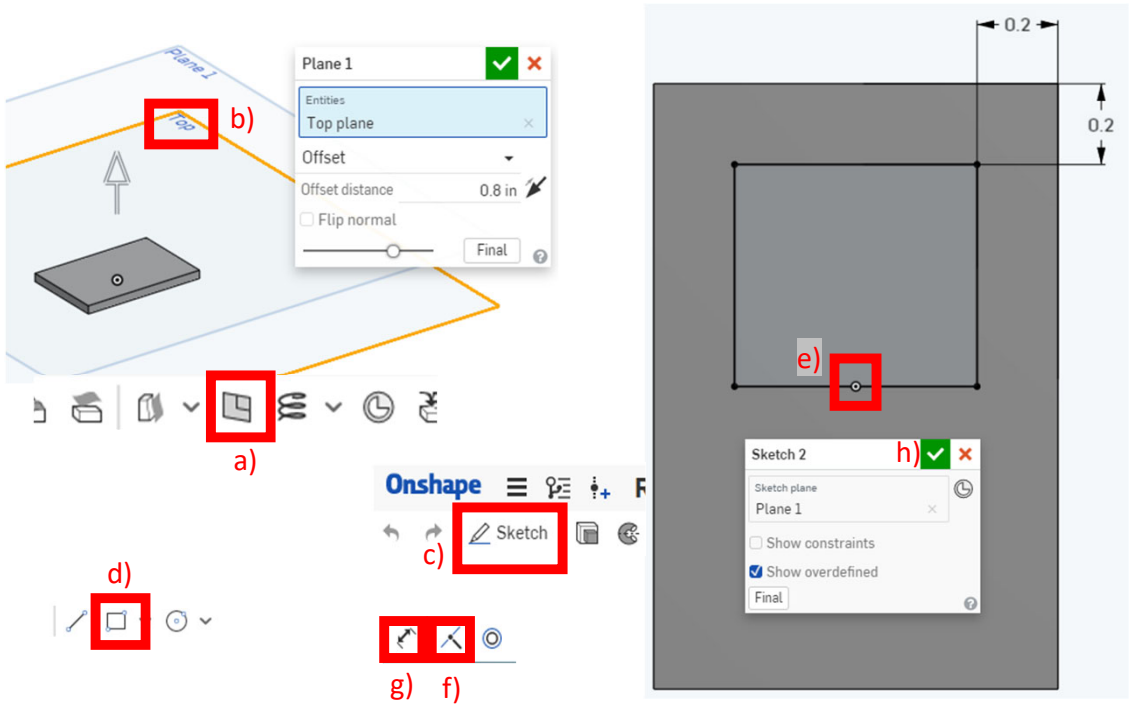
In these tutorials, the dimensions we give the robots are the dimensions of the scaled down models, but when making your own models in CAD, feel free to use the actual, 1:1 dimensions of your robot. You can scale the whole model down when you 3D print it, or you can use the Transform tool to scale it down in Onshape.

Instructions for Robot 1

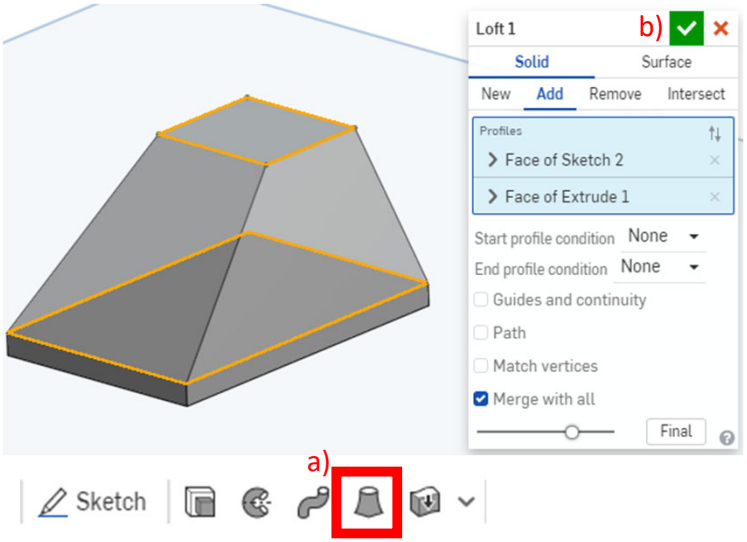




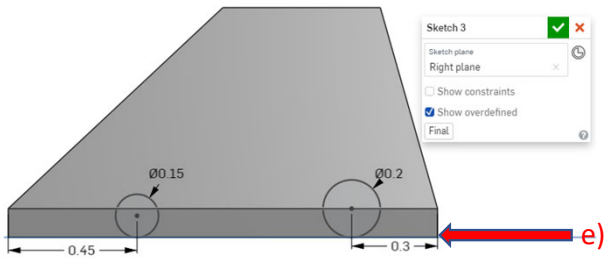
Step 1: Click the sketch tool a) and click the Top Plane b). Click the dropdown arrow on the Rectangle tool c) and select the Center point rectangle tool d). Start at the origin point e) and left click your mouse to make the diagonal points of your rectangle. Click the Dimension tool f) and click on a line to give it a dimension. Put 1 inch for the top line and 1.5 inches for the right line of your rectangle. Click the extrude tool g) and input a depth of 0.1 inches, then click the green check h).

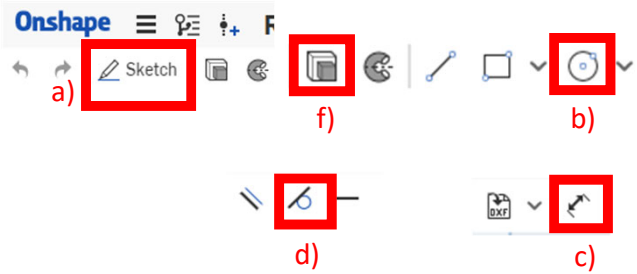


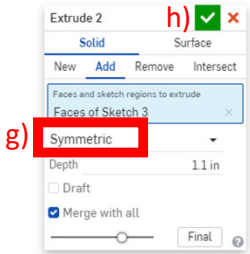
Step 2: Click the Plane tool a) to make a reference plane. Select the Top Plane b) and input an offset of 0.8 inches. Click the Sketch tool c), select your reference plane, and click on the rectangle tool d). Create a rectangle by left clicking, moving your mouse diagonally, and left clicking again. Move your rectangle so that it is in a similar position to the one in the picture above. Click the origin point e) and the bottom line of your rectangle, then click the intersect tool f). Click the dimension tool g), then click the top rectangle edge and the top edge of the bottom rectangle, and input a distance of 0.2 inches. Do the same dimension for the sides of the rectangle. Click the green check h).

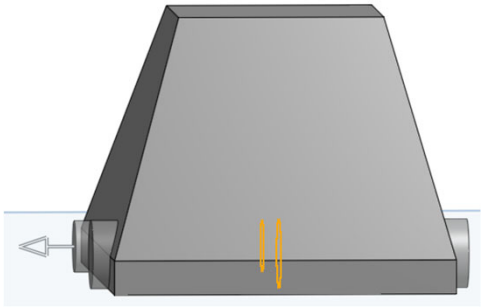


Step 3: Click the Loft tool a). Select the top surface of your bottom rectangular prism, and the top rectangle. Click the green check b).

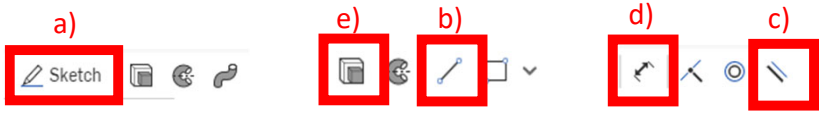






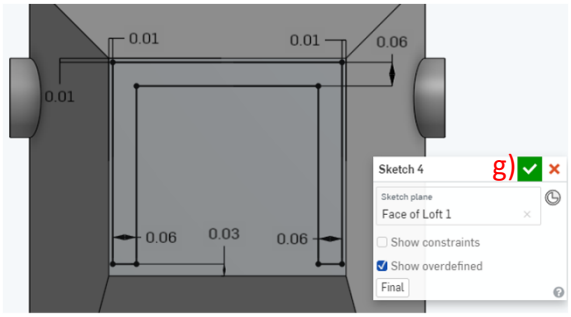


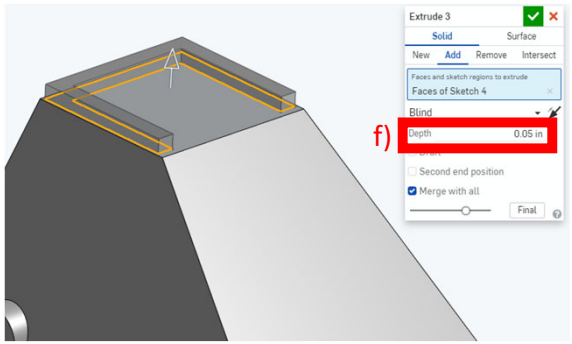
Step 4: Click the Sketch tool a) to make a sketch and select the Right Plane. On the right plane, click the circle tool b) and make two circles. To make a circle, left-click the screen to place the circle's origin, move your mouse to where the circle's edge should be, and left click again. Click the dimension tool c) and give the circles a 0.2" and 0.15" diameter. Make the origin of the circles 0.3" and 0.45" from the edge, respectively. Click the tangent tool d) , select the origin of one circle and the bottom edge e) of the robot's main body. Do this with the origin of the other circle as well. Click the extrude tool f), select the circles, select a symmetric extrusion g), and input a 1.1 inch depth. Click the green check h).



Step 5: Click the sketch tool a) and select the top face of the main body. Using the line tool b), make a general sketch of shape in the picture on the left. Use the parallel tool c) to make the edges parallel to the edges of the top surface. Use the dimension tool d) to put dimensions on the sketch, as shown below.

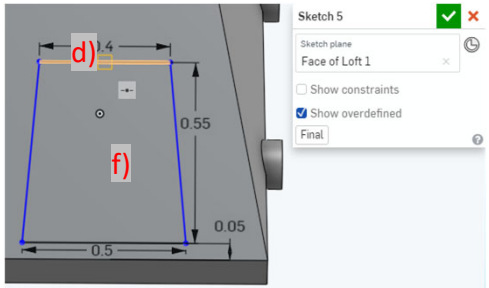
Click the extrude tool e), click on the sketch, and input a depth f) of 0.05 inches high. Click the green check g) to finish.

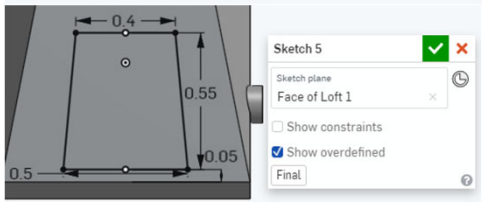


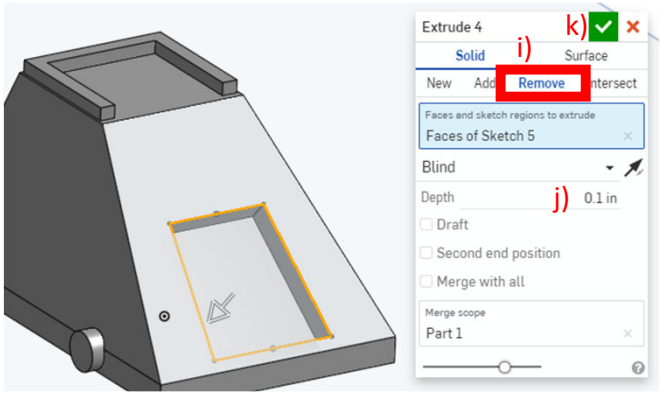


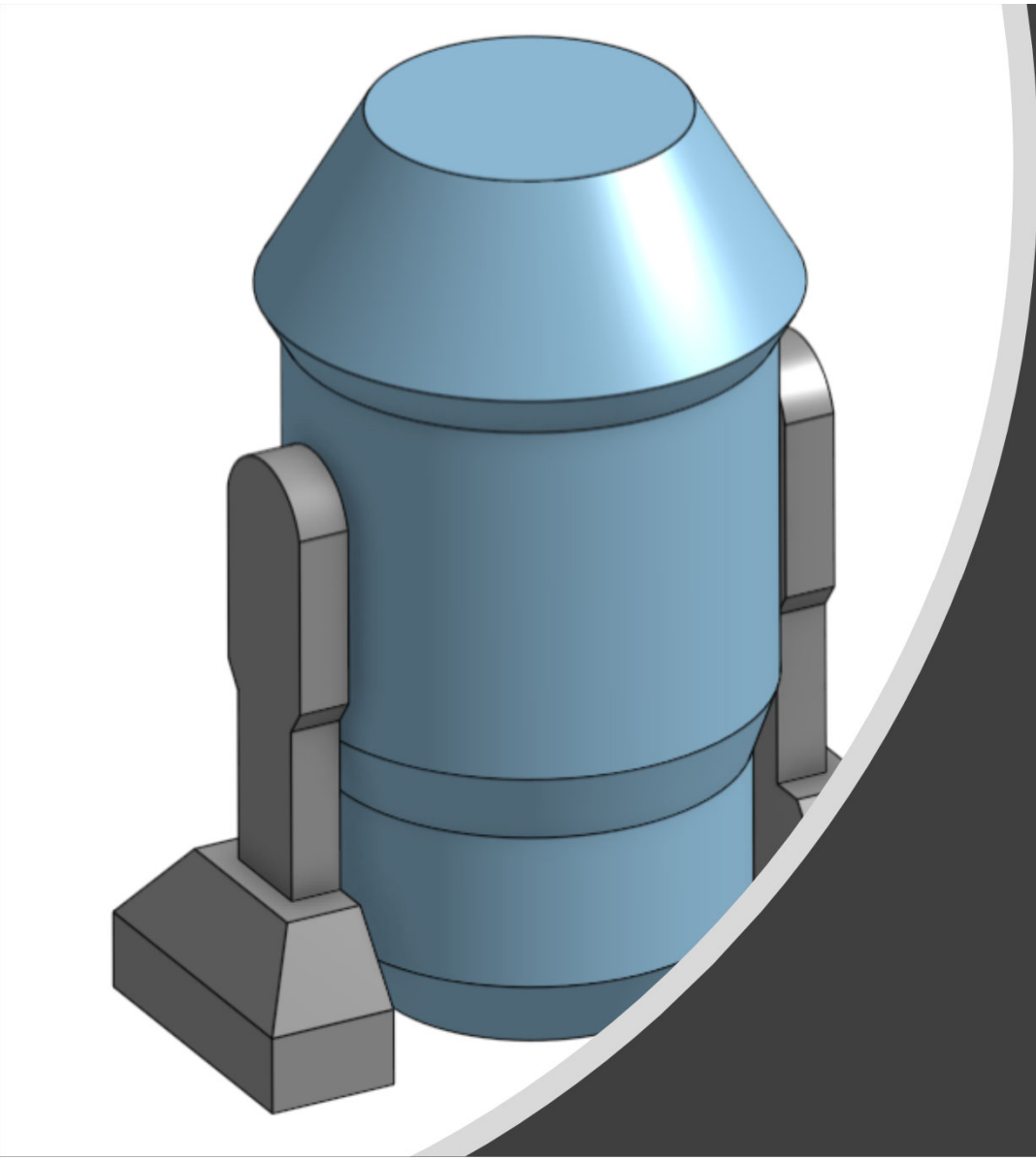
Step 6: Click the sketch tool a) and click on the slated front plane of the main body. Using the line tool b), create a trapezoid as shown below. Click on the point tool c), and put a point in the center of the top and bottom line. Only click to place the point once there is a yellow box indicating the center of the line, as seen below d). Click on the Vertical tool e), and click on the points of the top and bottom line, then click on the origin f) and one of the center points to make the trapezoid's points centered with the origin. The trapezoid should be all black, indicating that it is completely defined. Click the dimension tool g) and give each line the dimension shown below.

Click on the extrude tool h), select "Remove" i) and input a depth of 0.1 inches j). Click on the green check to finish k).

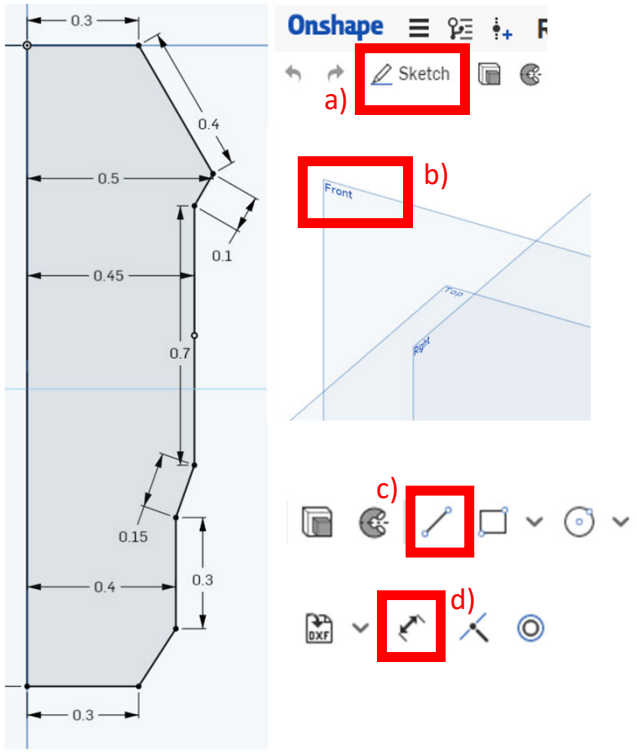




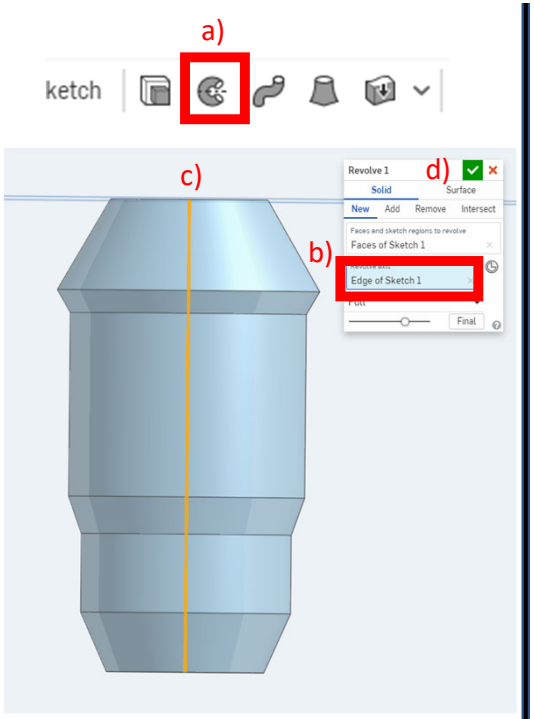




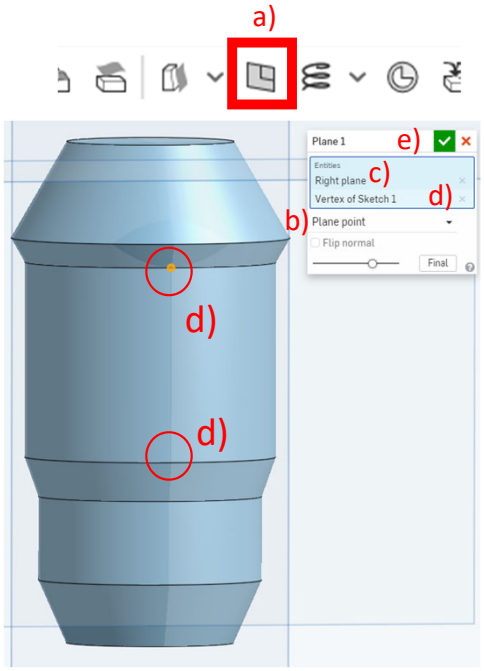
Instructions for Robot 2



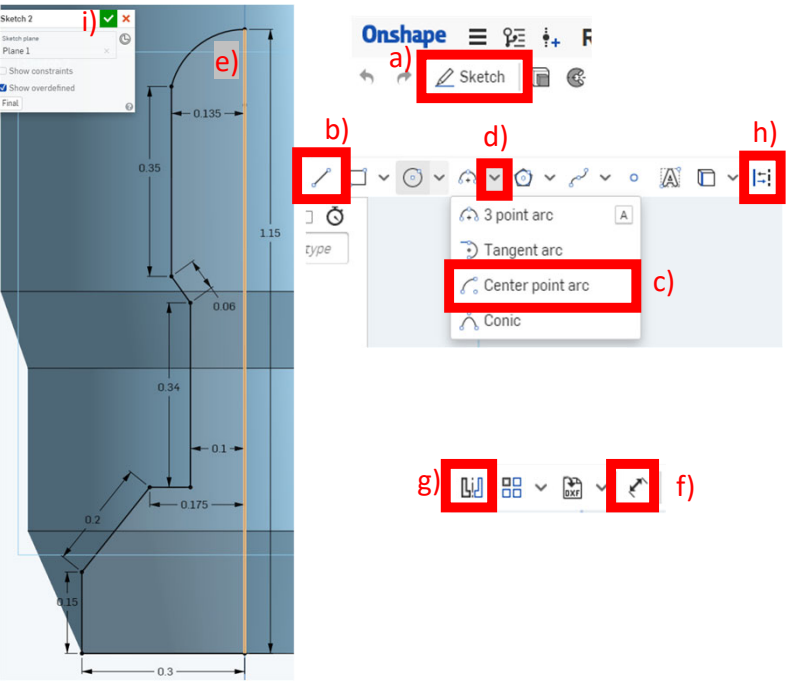
Step 1: Make a sketch a) (Click "Sketch") on the Front Plane b) (Click the plane labelled "Front Plane"). Select the "Line" tool c). Draw lines in the general shape you see in the picture on the left. Once all the lines are drawn, select the "Dimension" tool d). Click on each line and input the dimension you see in the picture above.



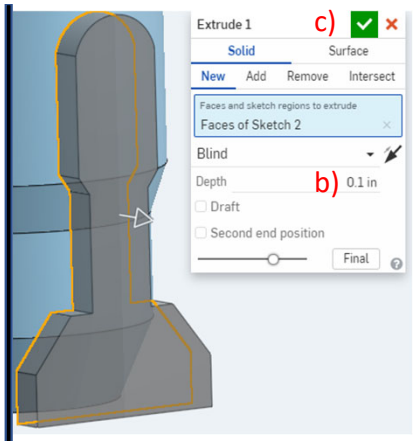
Step 2: Revolve the sketch. Click on the Revolve feature a). Click on "Revolve axis" b) and then click on the long line of your sketch c). Click the green check mark d).



Step 3: Create a reference plane for one of the arms.
Select a) Plane, b) Plane Point, then click on the c) Right Plane, and d) selecting one of the points from your sketch on the middle cylinder. Finish by clicking the green check mark e).

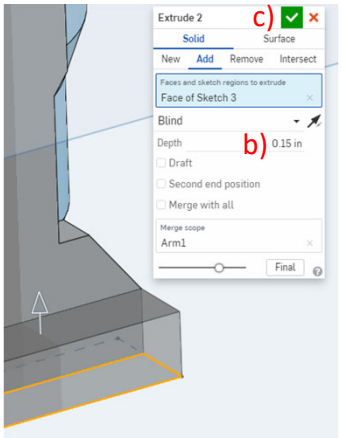


Step 4: Click the sketch tool a) and click on your reference plane from Step 3. Using the Line tool b), sketch the general shape of the arm as shown above. Use the Center point arc tool c) (found by clicking the arrow of the Arc tool d)) for the top arc, making sure that the center point and top point are on the centerline e). Click the Dimension tool f) and give each line the dimensions shown above. Then, click the Mirror tool g), select the centerline, and click every line and arc that is left of the centerline. Click the Construction tool h) and click the centerline. Click the green check mark i).



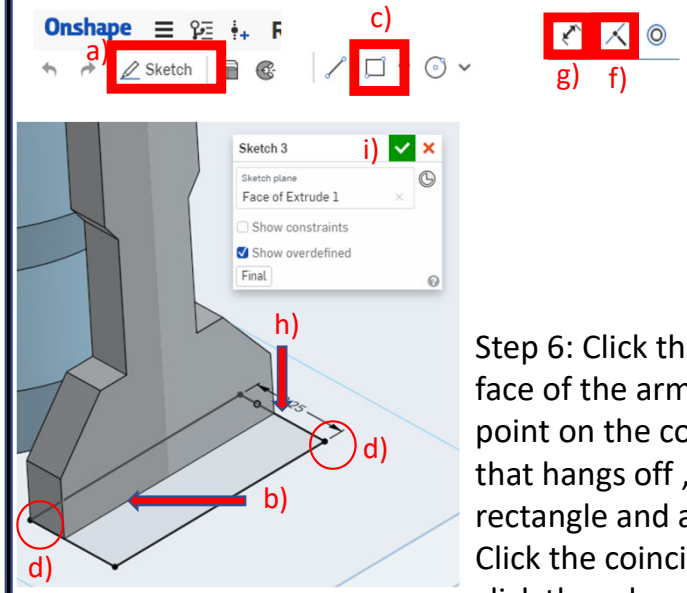
Step 5: Click on the extrude feature a) and input 0.1 inches for the depth b). Click the green check mark c).

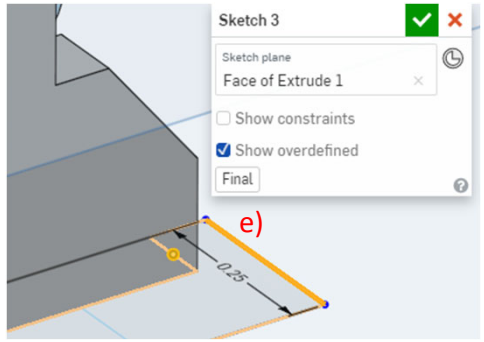
a)



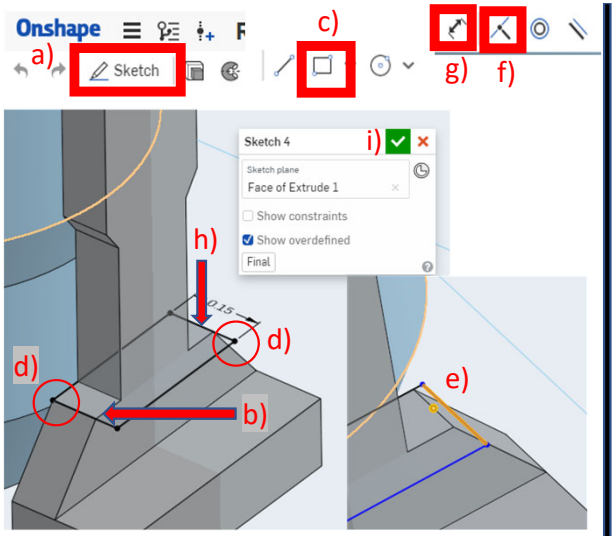
Step 7: Extrude the sketch from Step 6 by clicking on the Extrude tool a), clicking on the sketch, and inputting a depth of 0.15 inches b). Click the green check mark c).

a)

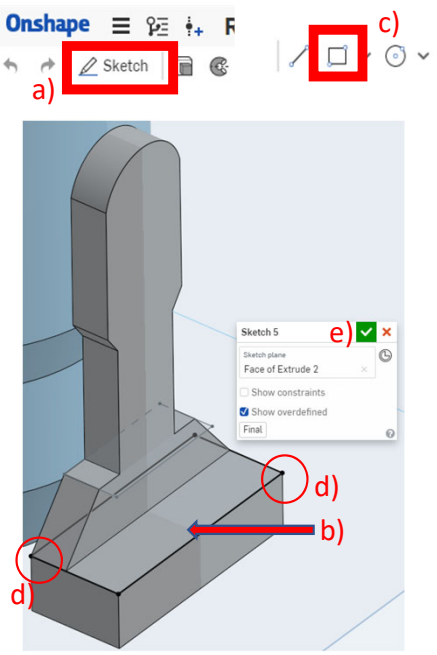




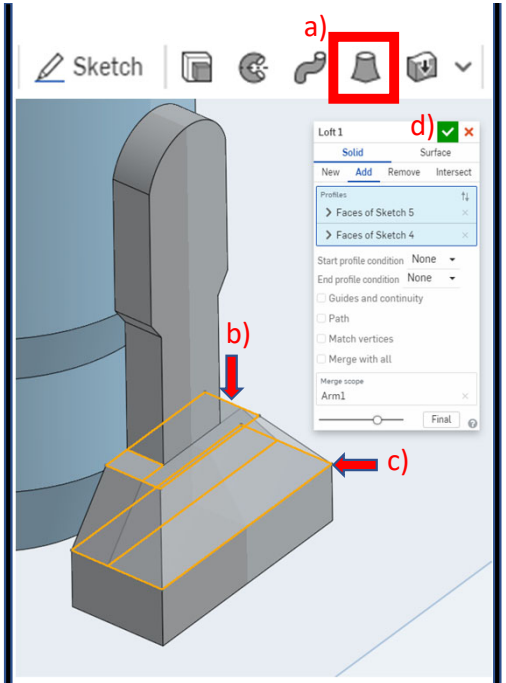
Step 6: Click the sketch tool a) and clicking the bottom face of the arm b). Click the rectangle tool c) and click one point on the corner of the bottom surface, and another that hangs off , as shown in d). Click the edge of the rectangle and a point on the bottom surface's edge e). Click the coincident tool f). Click the dimension tool g), click the edge of the rectangle h) and input a dimension of 0.25 inches. Click the green check mark i).



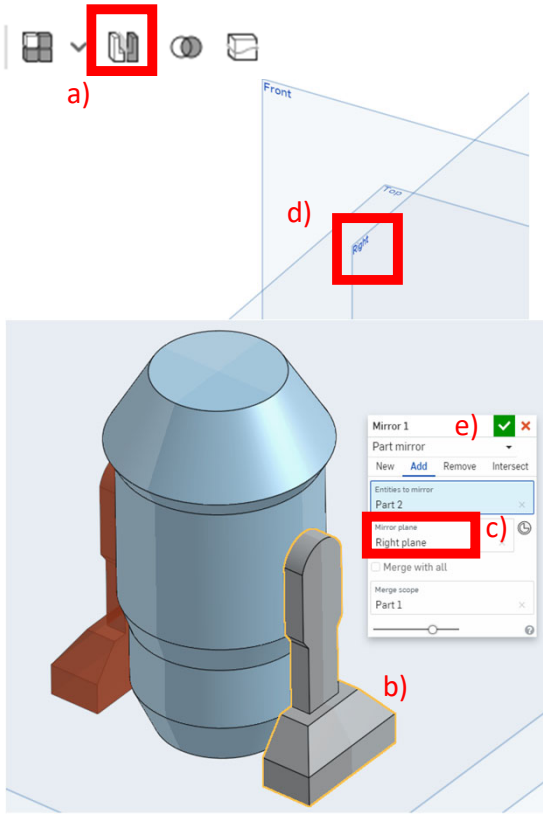
Step 8: Click the sketch tool a) and clicking the upper flat surface of the arm b). Click the rectangle tool c) and click one point on the corner of the upper flat surface, and another that hangs off , as shown in d). Click the edge of the rectangle and a point on the upper flat surface's edge e). Click the coincident tool f). Click the dimension tool g), click the edge of the rectangle h) and input a dimension of 0.15 inches. Click the green check mark i).



Step 9: Click the sketch tool a) and clicking the lower flat surface of the arm b). Click the rectangle tool c) and click two diagonal points on the lower flat surface, as shown in d), in order to create a rectangle that aligns with the entire lower flat surface. Click the green check mark e).



Step 10: Create a loft between the two flat sketches.
Click the Loft tool a) and click both the top sketch b) and bottom sketch c) from steps 8 and 9. Click the green check mark d).



Step 11: Make a second arm.
Select the "Mirror" tool a) and select the arm b) as the "Entity to mirror." Click "Mirror Plane" c) and click on the Right Plane d). Click the green check mark e).