Introduction

**NOTE**: This guide is to improve your skills **NOT** to test your knowledge, feel free to search or ask anyone in the Mechanical subteam for any information.

This guide is built to simulate the environments you will work in in this team. To achieve this, all the tasks will be without instructions (some hints) and will be hands-on.

This is designed to give you proficiency in CAD and NOT MASTERY. You will achieve mastery as you progress through the team and life (if you continue engineering) and progress will depend on time and dedication given to the team.

## Reference Websites

#### *Our material providers:*

**Vex**: [https://www.vexrobotics.com/](https://www.vexrobotics.com/pro?___store=vexroboticsau&___from_store=vexrobotics)

**Rev**: <https://www.revrobotics.com/frc/>

**Andymark**: <https://www.andymark.com/>

**West Coast Products**: <https://wcproducts.com/>

**The Thrifty Bot**: <https://www.thethriftybot.com/>   
**Grapple**: <https://grapplerobotics.au/>

#### Design guide:

**[Link]**

#### Onshape Tutorials:

<https://cad.onshape.com/help/Content/EnterpriseHelp/Content/home.htm>

# Account Creation & Recommended Settings

## Step 1:

Use your Education Email to create an Onshape Account. If you have any questions feel free to ask us.

## Step 2:

Select the dropdown on the top right of the screen next to your name. Select “My Account” and head to the preferences section, and then the units heading.

Please enter the following units of measurement, which are both our team’s and Australia’s standards:

A screenshot of a computer

Description automatically generatedPlease note that while these will be the default units when no unit is specified and will be displayed with the dimension tool, Onshape is easily able to convert between units of measurement, which is extremely helpful when dealing with imperial measurements. Simply type the magnitude and then “in” for inch, or any other symbol, such as “cm” for centimetres or “rad” for radians. This will allow for easy workflow and you will need to use this **a lot**.

# Basic CAD

NOTE: This section will not necessarily teach good CAD habits. This section is designed to teach basic CAD usage and skills. In our solution presentation, we will teach you how to have good CAD habits.

## Task 1: Battery

Using callipers in the workshop and their website, model a dimension-accurate battery that we use on the robot.

A blue rectangular object with three shelves

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## Task 2: Tubes

### 2.1 – Drivebase Frame

Design half a drivebase frame with M5 clearance holes 12.5mm apart on a RHS tube

Use your decision-making skills and the 2024 rules to decide on suitable dimensions.

Hint: Check out shortcuts to do this faster (do not individually sketch and extrude 100s of holes).

A blue square with holes

Description automatically generated with medium confidence

### 2.2 – Standardised L Gusset

Design a simple L gusset to connect the drivebase tubes. When manufacturing parts, we cannot CNC sharp corners, so make sure to fillet your corners!

A grey rectangular object with black dots

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### 2.3 – Drivebase Assembly

Using the assembly tab, connect the L gussets to the tubes so they are fastened at the corners.

Hint: Think about how they would be connected in real life, mate!

A blue square frame with black corners

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## Task 3: Swerve Drivebase

### 3.1 – Introduction to Mkcad

Download the MkCAD library into Onshape. If you have any questions do not hesitate to ask us, we will go through its functionality when we return to school. Import one SDS MK4i Swerve Module into the assembly with two NEOs, below the frame with a size of 10-32, and an SDS Billet wheel. We use CANcoders to control the wheels. We will cover the function of swerve modules when we go through the solutions next session.

A mechanical device with gears

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### 3.2 – Drivebase tubes

Using the formula:

Tube Length = Drivebase Length - 214.6 (Size of the swerve modules)

Design a 4-sided, square drivebase to mount the swerve modules at each corner. Refer to the real robot or others online. For this tutorial, we will be investigating the 2022 game, so please refer to R104 in the [2022 FIRST® Robotics Competition Game Manual](https://firstfrc.blob.core.windows.net/frc2022/Manual/2022FRCGameManual.pdf) for the maximum frame perimeter.

Hint: Use the circular pattern tool to save time and reduce effort!

A blue and black machine

Description automatically generated with medium confidence

### 3.3 – Bumpers

Taking the context of the drivebase and the tubes, design a bumper for the drivebase. Refer to rules R401 and beyond for bumper restrictions for Rapid React. For bumpers, we use 63.5 mm diameter pool noodles stacked upon one another tied to 127 mm tall by 19.05 mm wide radiata pine wood. They are then covered with cloth.

Hint: Don’t try to extrude 4 different sides of the bumper, there is a handy tool that can extrude along a line, called the sweep tool!

A blue square object with a white surface

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## Task 4: Extension Battery Holder

For this, you are tasked with designing a battery holder for the battery you designed in Task 1.

The battery holder must:

* Hold the battery firmly
* Allow the battery to be quickly removable and changed
* Attach to the drivebase you have already designed
* Use the materials we have available

You are encouraged to look at both our and other teams’ designs but note that many other teams mount batteries in strange places or have materials and manufacturing processes we don’t have available.

Please also be aware that mentors will be asking you questions about your design choices, so try to think about them before you make it. However, it should be stressed that we do not expect this to be perfect and that you should not get hung over on any one step.