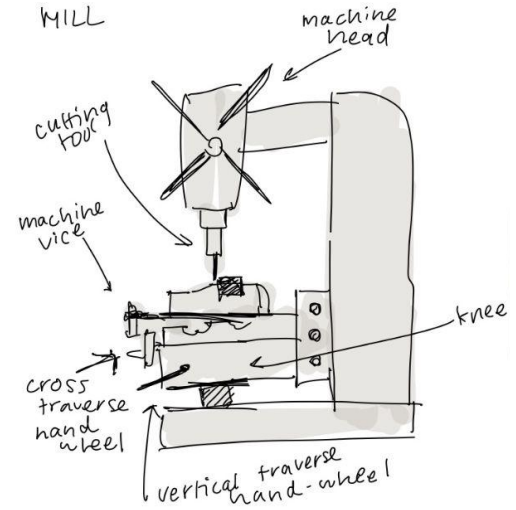
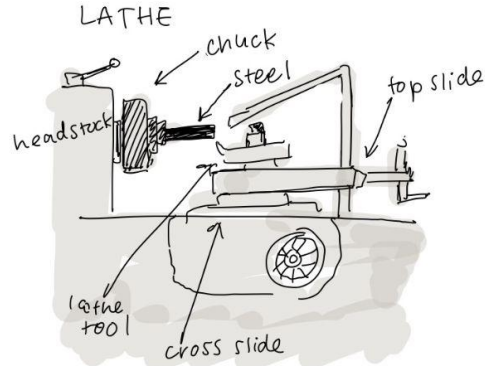
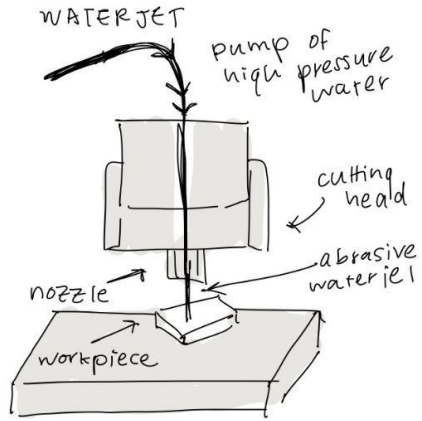


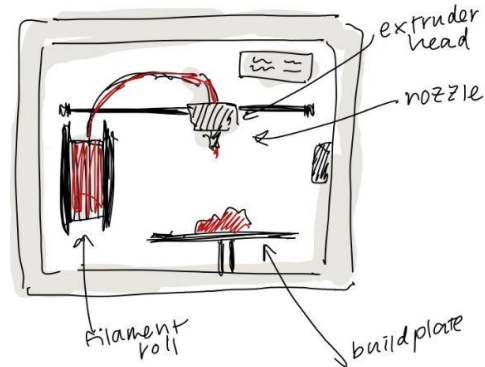
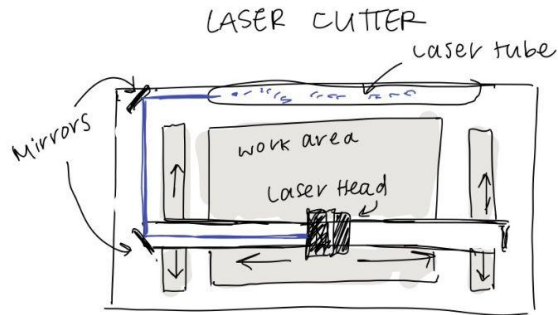
set #2

natalie wolf

question 1



3D PRINTER



question 2

Box tube construction:

When box tubes are assembled to form a strong backbone for mounting other mechanisms. The box tubes are attached using gussets, welding, or connecting blocks.

It is one of the easier methods for design and implementation. Many teams build a box tube structure and attach sheet metal parts. Three ways to attach box tubes together are:

- Gussets w/ fasteners (usually rivets)
- Welding
- 3D milled blocks, such as the chassis connecting blocks

question 3

Chassis:

The supporting frame of a structure (such as an automobile or television).

[Versatube chassis](#)

question 4

Round tube construction is when round tubes are used to construct a chassis, as opposed to the traditional square/rectangular tubing

It can be beneficial in some aspects. For example, it is typically 20% lighter than square tubing of the same size and thickness. It can also be bent into complex geometric shapes that prove to be strong.

A con with round tubing is that it is difficult to manufacture and interact with. It is also difficult to effectively use without previous experience.

question 5

Welding is used to fasten components together securely and in a permanent manner. When welding, parts are prone to warping and burning of material. Lots of experience is needed to properly weld. Sometimes teams bolt their frame together before welding. Usually teams just pay for welding services, though.

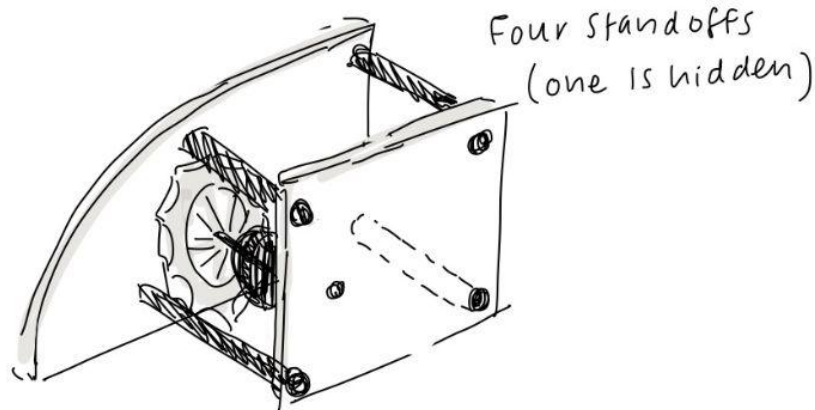
MIG welding is generally most used on steel. It uses a wire to act as a filler which adds material to the weld. It spreads a greater area when compared to TIG welding. MIG welding often has small imperfections and air bubbles.

TIG welding is used on aluminum and stainless steel. It is a harder process, more costly, and slower, but produces higher quality welds. A filler material is optional for this method, but using one makes this method more difficult. As the TIG welding area is more narrow, it heats up the material more and causes warping.

question 6

Plate and standoff construction:

A simple and common method used in FRC. Most commonly used in gearboxes to support end of shafts. This method uses a standoff to support a plate a distance away from another plate. It is often confused with spacers, but standoffs are threaded and have bolts on either end. Spacers are meant to have a bolt go through them.



question 7

Standoffs are used for gearboxes and structures to hold gears in place permanently. They are threaded and contain bolts on either side.

On the other hand, spacers are not threaded, but instead have a bolt going through them. This method allows for preloading assemblies, and the added strength of the steel bolt.

question 8

The bend radius is important to keep in mind when designing for sheet metal because manufacturability needs to be ensured. Sometimes after bending a material, it may turn out poorly with the wrong tools: like crash into the die without the proper measurements or create cracks in the material. Accounting the stretching and shrinking of the newly bent part is also important.

question 9

After a part is bent, the inside of the new bend shrinks the material, while the outer edge of the material stretches. Sometimes cracks will appear if the part has a too small radius bend, or if its not bent with the grain of the material. The line between where the material stretches and shrinks is the neutral axis.

The K-Factor helps determine the new length of a part after its been bent. It is important as calculating the lengths of your part allows for a correctly fitting assembly. It can be calculated by dividing the distance between the neutral axis by the sheet thickness.

$$\text{K-Factor} = t/T$$

question 10

3D printing is useful for creating 3D parts with complex geometry that may be seen as impractical or impossible to recreate on a mill. Using supports in your prints make overhangs of a part possible. It can recreate small or large parts, depending on the size restriction a 3D printer build plate might have. They can print in multiple materials, and are fed this material through a nozzle in the form of filament.

question 11

When threaded holes are needed in a 3D printed part, it is best to use heat set inserts. These are brass threaded inserts that are pressed into plastic parts using a soldering iron.

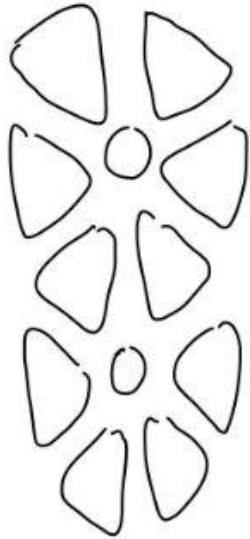
In lower load applications, you can use press-in/threaded inserts that do not require soldering. Tapping 3D printed parts is not recommended.

[Inserts from McMaster](#)

question 12

Lightening patterns:

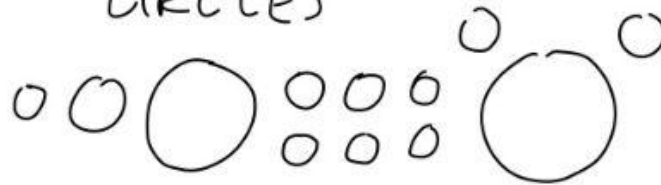
ISO GRID



TRIANGLES



CIRCLES



question 13

[Drivetrain tube w/ lightning](#)

question 14

[Dog shifter shaft drawing](#)