1. Completely describe the product so that you become thoroughly familiar with it at the part and function level
tell where you bought the product and how much it cost
carefully take the product apart, making notes or even taking digital photos
draw all the parts freehand or 2D or 3D computer (except fasteners)
number all the parts for easy reference and make a parts list, including fasteners
make an assembly drawing showing all the parts, including fasteners; make cross-section drawings of important subassemblies

**note: an assembly drawing shows all the parts in their final assembled positions**
make an exploded view showing all the parts, including fasteners; name and number each part
make a bill of materials (BOM) listing the part names and numbers from your exploded view

Include the BOM and exploded view in every project report

determine what materials the parts are made of and how they are made
explain what each part does to help the product deliver its functions
identify any "mystery" parts or features
list and discuss all the mates between parts
note important dimensions on the drawings of the parts, including clearances
measure clearances
estimate difficulty of assembly using clearance ratios and your personal observations
if possible, determine differences between different but similar versions of the product
contact the company or talk to retailers about the product and find out or estimate

where it is made, what is the production volume, how many versions are made, etc

2. Perform a datum flow chain analysis of part of your product in order to understand how one important function is realized
Make a liaison diagram of the product
select a significant set of parts that does an identifiable function
describe and explain that function (report #1 will be helpful here)
identify the KC or KCs associated with that function and identify the DFC or DFCs involved
guess or surmise a root for the DFC
draw the DFC and explain all its elements: features, constraint, important KCs
on each KC, write the degrees of freedom that are important for its delivery
explain why your DFC looks as it does, paying particular attention to which parts
locate which other parts
determine if there are any over-constraints or risk of over-constraints
suggest redesigns that improve constraint or KC delivery

3. Completely choreograph each assembly step in any convenient assembly sequence and do a DFA analysis

so that you understand all your product's assembly operations and problems

generate some feasible assembly sequences, choose one, say why

Note: there is no need to generate all assembly sequences

List all the:

- required gross motions including reorientations
- required fine motions
- features on parts where they can be gripped
- features on parts where they can be mated to a fixture
- all chamfers and lead-ins or indicate where there are none
- the types of fasteners, how many, how many of each kind or size
- auxiliary operations such as lubrication, test, and inspection
- possible problems and risk areas:
  - feeding, fixturing, presenting, orienting
  - gripping
  - inserting
  - damage to parts or people
suggest design improvements to deal with these risks
sketch the fixtures and grippers that are needed for assembling this product
perform a DFA analysis (report #2 will be helpful here)
try assembling the product yourself several times and compare your time to that predicted by DFA
calculate assembly efficiency
if feasible, implement some of the design changes on an example part or parts

4. Create a floor layout for this product's assembly
   draw an assembly tree for your assembly sequence, identifying subassemblies
   Note: this tree is simply a diagram of main and subassemblies in assembly sequence order
   assume a production rate or annual volume
   calculate required system capacity and takt time
   assume workstations or people with given realistic assembly speeds and assign assembly operations to them
   data from report #3 will be useful here
   make a Gantt chart for the entire process and indicate on it which stations do which tasks
   draw or sketch the floor layout, showing where each workstation is and what steps it does
   this should be an actual floor plan, not just a schematic drawing
   show how parts will flow across the floor to feeding points
   provide space for any people who work on the line, keeping them clear of machinery, and provide space for material handling
   determine how many direct workers, supervisors, inspectors, material handlers and other people will be needed
   if software is available, use it to design the concept line

5. Design a workstation
   select a group of operations, say for making a small subassembly, and assume they will be done at one workstation
   determine the time needed to complete the operation or operations involved based on data from report #3
   lay out the station, including in- and out-flows of assemblies and parts
   plan required motions of equipment or people
   show how necessary inspections or tests will be carried out
   allocate required time of each required activity and draw a Gantt chart for a complete cycle
   estimate the purchase and installation cost of this station, using actual costs that you may be able to find on the Web or in standard catalogs
   Note: McMaster-Carr and other catalogs have benches, chairs, power screwdrivers, conveyors, etc.
   estimate the labor cost of doing the work at this station based on where you think the product is made

6a. Perform an economic analysis of your assembly layout
   estimate or obtain approximate costs of equipment and labor rates with OH and benefits
   estimate engineering and installation costs
   establish a payback period or required rate of return
   determine unit assembly cost including equipment and labor
   determine ROI by comparing two assembly methods
      or by assuming manufacturing costs and sales revenues

6b. Perform a discrete event simulation of your line
   diagram the line with activities and queues
   write program and make several runs
   identify any operating problems and improve the design