

NOTE: Use engineering format for problems 1 and Problem 2a. Use non-engineering format for the remaining problems. This is an individual assignment.

1. A pump is connected to an electric motor. The motor is supplied with 1.5 A of current from a 12 VDC source (VDC = direct current volts). The apparatus is run steadily for 75 seconds, and the following measurements are recorded:
 - mass of fluid collected: 600 grams
 - diameter of exit tube: 0.75 inch
 - density of water: 1000 kg/m³
 - height of fluid exit above reservoir: 32 inches

Find:

- a. the weight of the fluid collected (Newtons) $W = 5.886\text{N}$
- b. fluid velocity at exit in m/s (meters per second) $v = 0.0281\text{m/s}$
- c. flow rate in L/min (1 liter = 0.001 m³) $Q = 0.48\text{L/min}$
- d. system efficiency (express as a percentage) $\eta = 0.354\%$

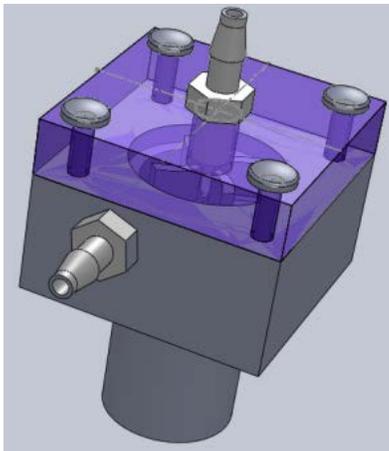
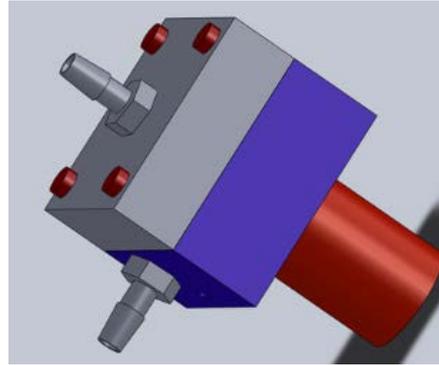
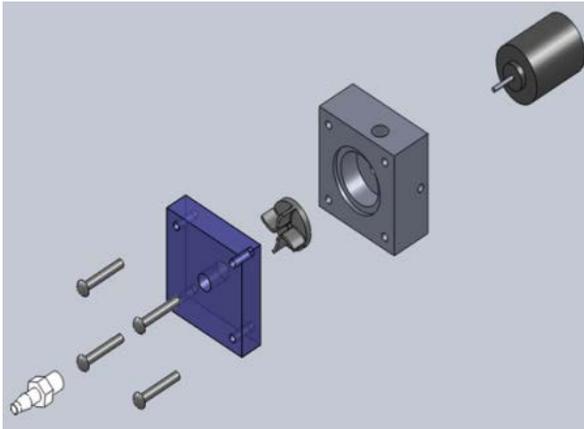
Note: Refer to HW 11 for hints about how to handle unit conversions when working this problem. Remember you should use SI units, and you may need to collapse or expand a group of units to make sense of the physics of the problem (Potential Energy = Weight of Fluid times Distance, etc.).

2. The amount of force exerted to compress or extend a spring is related to the change in length of that spring. Change in length is typically referred to as deflection and is represented with the lower case Greek letter delta, δ . Data was collected on the amount of force (dependent variable) required to deflect a spring a given amount (independent variable).

δ (in)	Force (lb)
1.0	12.9
2.2	26.5
2.5	28.9
3.2	39.4

- a. Find the equation for the line of best fit using least squares linear regression by calculating the values of slope and y-intercept by hand. *Remember you will not have Excel on the test, so it is good to practice the calculations by hand. You can set up a table on your paper just like you would in Excel.* $\text{Force} = 11.8 \cdot \delta + 0.6$
 - b. Enter the data into Excel using proper formatting techniques. Use the symbols feature to put the title for deflection in the table as the Greek letter delta (δ).
 - c. Use Excel to find the slope and y-intercept.
 - d. What are the units for slope? What are the units for y-intercept?
 - e. Plot the data (markers only) and the fit (lines only) on the same graph.
3. Complete the SolidWorks tutorials under "Getting Started" entitled "Lesson 1 – Parts" and "Lesson 2 – Assemblies." Print at least one screen shot as you create the part in "Lesson 1 – Parts" as well as three additional steps of "Lesson 2 – Assemblies," including your final assembly. The main thing here is that you play around with the assembly. Also, you may need to turn on some toolbars when you enter SolidWorks assembly for the first time (such as View > Toolbars > Assembly).

4. **(Due Class 18 with your Pump Project Lab Report)** You have already drawn the pump body, face plate and impeller. Draw the DC motor, a barbed fitting and a screw. You will need to measure these parts with your dial caliper (refer to the presentation about dial calipers for help on how to use them). Combine your parts into an assembly (using what you learned from the assembly tutorial). Provide both assembled and exploded views of your pump (print views like the ones below but from different viewpoints).



Reminder: During the pump fabrication days, you are also asked to solder extensions onto a photoresistor. If you were not able to complete that during class time, please be sure to have it done by Class 16. You may need to go to helpdesk to complete this activity.