

Use the direct solution format for all questions on this assignment. Refer to the lecture slides on data reduction for pump performance measurement.

- Given the following raw data from a pump measurement

Height of exit tube above reservoir	$h = 75 \text{ cm}$
Mass of water collected	$\Delta m = 350 \text{ g}$
Time during mass collection	$\Delta t = 24 \text{ s}$
Motor voltage	$V_m = 11.98 \text{ V}$
Motor current	$I_m = 0.42 \text{ A}$

- Using the symbols in the preceding table, write down the formulas (using symbols, not numbers!) for computing the volumetric flow rate in L/min and the efficiency of the pump. Define symbols for any additional data (e.g. physical constants) necessary to complete the calculations.
  - Substitute the numerical values from the table into the equations from part (a) to obtain values for the flow rate and the efficiency.
- Download the `sample_pump_data.xlsx` from the class web site.
    - Expand the *rows* at the top of the spreadsheet to include
      - The class (ME 120) and the assignment (Sample Pump Data Reduction) and the due date of the assignment
      - Your name
      - Extra rows with constants needed in the data reduction. Include text labels and units of any constants needed in the calculations.

Refer to Figure 1 on the next page to see the recommended layout of the spreadsheet, including section for constants and the columns for the reduced data described in part (b).

- Create columns in the spreadsheet for the flow rate in L/min, head in m, and efficiency of the pump. See Figure 1 on the next page. It will be helpful to create additional columns for intermediate results like the mass flow rate.
- Using the columns defined in part (b), write out sample spreadsheet formulas necessary to compute the volumetric flow rate and efficiency of the pump for the first row of data. The formulas should use the same math as you used in question 1, but instead refer to quantities by spreadsheet cell notation. Include those formulas in the document you turn in for the assignment.
- Use the formulas for flow rate and efficiency to fill out the reduced data columns in the spreadsheet. Make a plot of head (m) versus flow rate (L/min) and a plot of efficiency versus flow rate on the spreadsheet. Add labels for the axes. Add curve fits to each plot.

(Continued on next page)

- e. Arrange the plots and tables so that the spreadsheet prints on a single sheet of paper. Attach the printed spreadsheet page to your completed assignment.

ME 120    **Sample Pump Data Reduction**    28-Nov-18  
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**Constants**

rho    xxxx    kg/m<sup>3</sup>    Density of water  
Tube ID    yyyy    cm    Inside diameter of tubing using to measure pump performance  
... add more constants

**Measured Data**

<u>h (inch)</u>	<u>Vp (Volts)</u>	<u>Ip (mA)</u>	<u>dm (g)</u>	<u>dt (s)</u>	
14	11.98	370	145	15	
28	11.98	380	92	15	

... more data rows

**Reduced Data**

<u>mdot (kg/s)</u>	<u>Q (L/min)</u>	<u>h (m)</u>	<u>Exit velocity (m/s)</u>	<u>eta (%)</u>	
your formulas and computed data go here					

Figure 1    Sample spreadsheet layout for HW2 on Problem Set 6