

NOTE: Use engineering format for problems 1 and 2. Use non-engineering format for problem 3. This is an individual assignment.

1. A pump is powered by a 9V power source for 45 seconds. The outlet tube is placed 1.8 meters above the top of the water source. The mass of the water collected is 0.6kg which was pumped at a velocity of 0.75m/s. The pump has a known efficiency of 0.95%. Find the current drawn while the pump is running. $I = 2.80A$

Tip: Write the equation for efficiency, and circle everything that was given in the problem statement ... what's left? Remember that $W=mg$. Symbolically solve the equation for efficiency for the current (I), and then plug in the values that you know. Be sure to keep track of units since this is the key to catching your mistakes!!

2. Louisiana Tech is planning to place a water fountain at the entrance of the University. The fountain will use a small water pump that sprays the water to an average height of 3.5 meters above the pump. The flow rate of the water will be 4 gallons per minute. For this analysis, the velocity at the peak can be neglected (i.e., assume $v=0$ m/s). Assuming the pump is 55% efficient, how many Joules of electrical energy are consumed by the system when the pump runs for 65 seconds? $W_{it} = 1023.9J$

Useful Equation and Unit Conversions: density = mass/volume, $1L=0.001m^3$, and $1gal=3.785L$

3. The table below shows representative data for student-built pumps along with the resulting efficiencies.

| Pump Head (m) | Flow Rate (L/min) | Efficiency (%) |
|---------------|-------------------|----------------|
| 0.21 | 0.89 | 0.35 |
| 0.45 | 0.78 | 0.58 |
| 0.62 | 0.73 | 0.61 |
| 1.00 | 0.62 | 0.89 |
| 1.43 | 0.44 | 0.83 |

- a. Plot efficiency versus pump head in Excel, showing the best fit trendline and the associated equation and r^2 on your plot. Please consider linear, power, exponential, and polynomial (don't go above quadratic) trendlines. Explain why the trendline chosen is the best fit for the data.
- b. Plot pump head versus flow rate in Excel, showing the best fit trendline and the associated equation and r^2 on your plot. Please consider linear, power, exponential, and polynomial (don't go above quadratic) trendlines. Explain why the trendline chosen is the best fit for the data.

Reminder:

- You should be working on your pump project. Some teams will be able to test their pumps during the next class, but testing can also be performed during helpdesk hours. To test at the helpdesk, you will need to sign up by choosing a time slot on the sheets taped to the helpdesk door. Refer to the pump testing presentation for the requirements of your pump project report which includes a SolidWorks assembly and an exploded view of your pump. The pump report is due on class 18. Additionally, you should be working on the robotics challenge which will be held during class 19.
- 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 helpdek to complete this activity.