ENGR 120   Homework 14

NOTE: Use engineering format for problems 1-3. 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 45 seconds, and the following measurements are recorded:
    *   mass of fluid collected: 800 grams
    *   diameter of exit tube: 0.5 inch
    *   density of water: 1000 kg/m^3
    *   height of fluid exit above reservoir: 38 inches

    Find:
    a. the weight of the fluid collected W = 7.848N
    b. fluid velocity at exit in m/s (meters per second) v = 0.14m/s
    c. flow rate in L/min (1 liter = 0.001 m^3) Q = 1.067L/min
    d. system efficiency (express as a percentage) η=0.94%

2. A pump is powered by a 5V power course for 15 seconds. The outlet tube is placed at 1.4 meters above the water source. The mass of the water collected is 230g which was pumped at a velocity of 0.5m/s. The pump has a known efficiency of 0.9%. Find the current drawn while the pump is running. I=4.7A

    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!!*

3. A pump requires 1.2kW to raise 4500L of gasoline 12 meters in a half-hour. The velocity of the gasoline is 5m/s, and the density of gasoline is 670 kg/m^3. Find:
    a. Weight of gasoline (Remember density = mass/volume and 1L=0.001m^3) W=29577.15N
    b. Flow rate in L/min   Q=150L/min
    c. System efficiency   η=18.18%

4. There are ongoing efforts across STEM (science, technology, engineering and mathematics) disciplines to increase the number of females and underrepresented groups in the workforce. A study published through the American Society of Engineering Education highlights the number of engineering bachelor's degree awarded to females over the past 10 years (www.asee.org/colleges). Some of the data from the study are provided below.

Year	Degrees Awarded to Females (%)
2007	18.1
2009	17.8
2011	18.4
2013	19.1
2015	19.9

    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 exam, 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. % Degrees Awarded to Females = 0.245 * Time - 474.03

    b.   Enter the given data into Excel using proper formatting techniques.

    c.   Use Excel to find the slope and y-intercept.

    d.   Plot the data (markers only) and the fit (lines only) on the same graph.

5.   There are many suppliers that carry engineering parts and supplies. Using the "parts and materials required for pump" slide on the pump fabrication presentation, find the nylon barbed tube fittings (3/16″ tube ID and 1/8″ pipe size) and the PVC gray bar (the 2″ x 2″ bar). Print out the specifications provided on the web site regarding these parts, and provide the cost and the method sold (in a package quantity for the fittings and in a certain length for the PVC bar). Go to www.mcmaster.com, and search for "barbed fittings" and "PVC" to get started; it is helpful to use the tools provided on the McMaster-Carr website to narrow your search.

6.   **(Due Class 18 with your Pump Project Lab Report)** Work towards finishing the SolidWorks drawings of the pump parts. 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 shown in HW 12).

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.