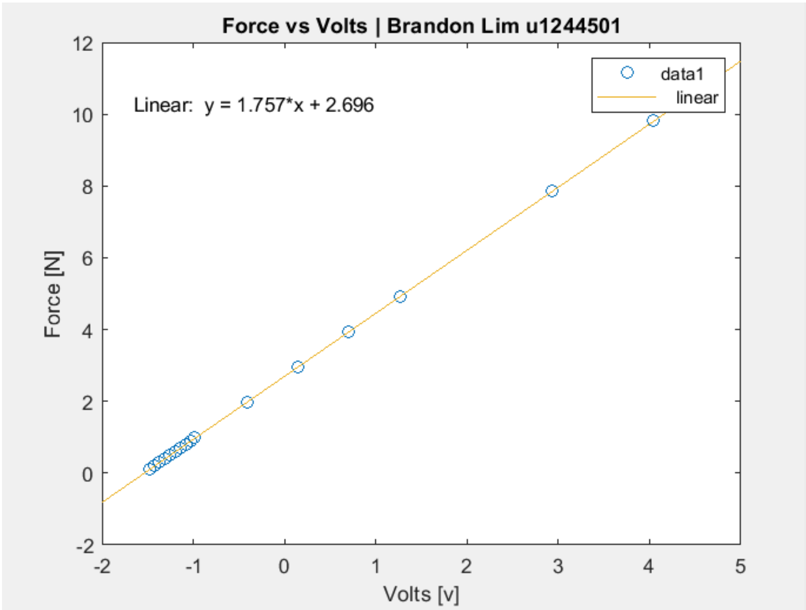
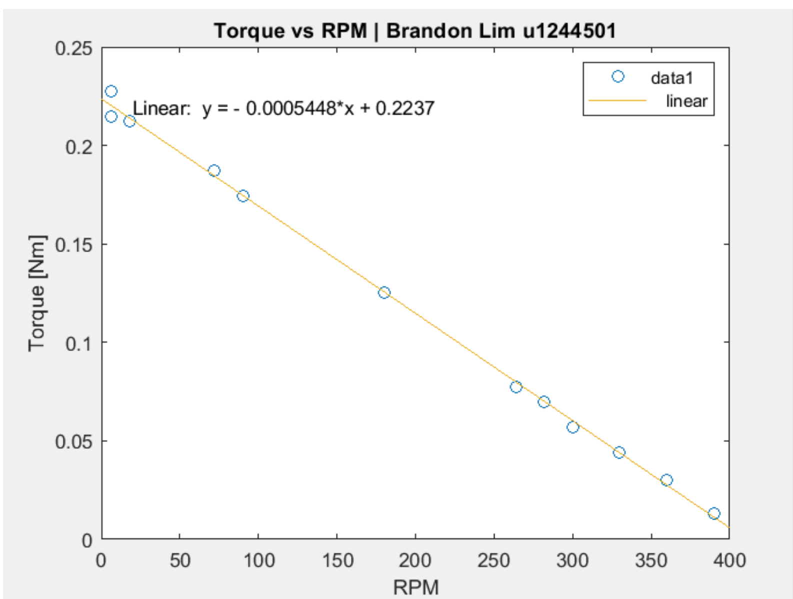
5. Post-Lab Exercises

1. Attach your calibration plot from 4.2.2 with the proper labels, fit line, and equation displayed.



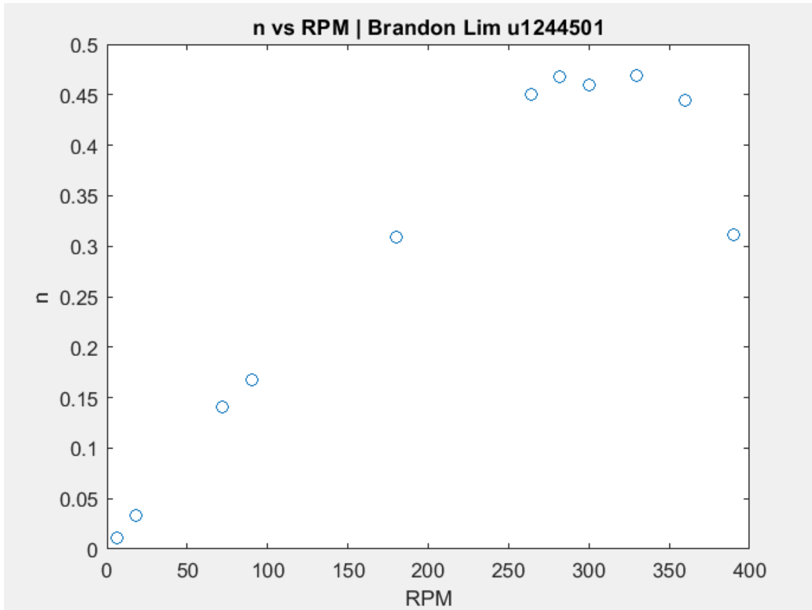
2. Attach your 5V Torque (N*m) vs Speed (RPM) plot with appropriate labels from 4.3. Fit a line to this data. Show the line and equation on the plot. What are the stall torque (in N*m) and no-load speed (in RPM)?



$$T_{stall} = 0.2237Nm$$

$$\Omega_{nl} = \frac{0.2237}{0.0005448} = 407.6RPM$$

3. Using your data from 4.3. Plot the Efficiency vs Speed (RPM). Attach your properly labeled plot to the post lab.



4. Calculate the maximum power output for the motor with the 5 V supply. Show your work.

$$\Omega nl(rad/sec) = \frac{407.6 * 2pi}{60} = 42.68$$

$$P_{max} = \frac{Ts\Omega nl}{4} = \frac{0.2237(42.68)}{4} = 2.38\, watts$$

5. The Mechatronics Lab stocks 37 mm diameter Pololu gear-motors with four different gear ratios: 50:1, 70:1, 100:1, and 131:1. Each motor has two important performance characteristics: the stall torque and the no-load speed. Generally, these two parameters are dependent on the input voltage. Given the stall torque and no-load speed at 12 V for each gear ratio, calculate the stall torque and no-load speed at 10 V (about how much your battery will output). Using the radius of the drive wheels on your robot, and estimating the mass of your robot, calculate the maximum acceleration and maximum speed that your robot could achieve using the different gear ratios.

Mass = 3kg

$$F_{max} = \frac{Tstall}{2} * 2 * g$$

$$Max_{acceleration} = \frac{F_{max}}{m_{robot}}$$

Rw = 3.5cm

$$v = \frac{\Omega nl\ (2pi)}{60}\,(rw)$$

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Pololu Gear ratios	**T_{stall} (kg-cm) @ 12V**	**Ω_{nl} (RPM) @ 12V**	**T_{stall} (kg-cm) @ 10V**	**Ω_{nl} (RPM) @ 10V**	**Max robot acceleration (cm/s^2) @ 10V**	**Max robot speed (cm/s) @ 10V**
50:1	21	200	17.5	166.67	3270	61
70:1	27	150	22.5	125	4204	45.8
100:1	34	100	28.3	83.3	5288	36.7
131:1	45	76	37.5	63.3	7007	23.2

```
clear, clc, close all
Volts = [-1.483 -1.429 -1.37 -1.313 -1.259 -1.198 -1.142 -1.084 -1.03 -0.9818 -0.4057 0.1476 0.7023 1.262 2.9
Force = [.0981 0.1962 0.2943 0.3924 0.4905 0.5886 0.6867 0.7848 0.8829 0.981 1.962 2.943 3.924 4.905 7.848 9.

figure();
plot(Volts,Force,'o');
xlabel('Volts [v]');
ylabel('Force [N]');
title('Force vs Volts | Brandon Lim u1244501');

m = [ 0.01 0.03 0.05 0.07 0.09 0.1 0.2 0.3 0.4 0.5 0.8 1];
V = [-1.233 -0.7963 -0.4176 -0.062 0.292 0.4924 1.957 3.45 4.254 5.289 7.00 8.362];
I = [0.34 0.51 0.65 0.78 0.88 0.95 1.53 1.96 2.01 2.39 2.31 2.5];
g = 9.81;
Hz = [65 60 55 50 47 44 30 15 12 3 1 1];
numStripes = 10;
RPM = (Hz ./numStripes) .* 60;
rad = (RPM .* (2*pi))./(60);
r = .03;
F = 1.757 .* V + 2.696;
T = (F-(m.*g)).*r;
n = (T .* rad)./(5 .* I);
```

```
figure()
plot(RPM,T,'o')
xlabel('RPM');
ylabel('Torque [Nm]');
title('Torque vs RPM | Brandon Lim u1244501');

figure()
plot(RPM,n,'o');
xlabel('RPM')
ylabel('n')
title('n vs RPM | Brandon Lim u1244501')
```