Team Force Torque Power Energy Assignment

Team Number: Team Members:

At the beginning of a machine design project it is important to quantify your energy sources. Each quarter the kit varies and each each team must measure Force, Torque, Power, and Energy in your kit.

Potential Energy from Gravity:

Determine the maximum amount of energy available due to gravitational potential. Assume that half the total mass of the kit is free falling from the maximum contest start height.

Mass - ½ of kit (kg):	m_{max}	
Height Change (m):	h_{max}	
Release Time free-fall (s):	$t = \sqrt{2h/g}$	
Potential Energy (J):	$E = mgh$	
Power (watts):	$P = \frac{E}{t}$	

Springs and Rubber Bands:

Experimentally determine the spring constant 'k', then calculate the energy, and power available from the springs/rubber bands. Make sure masses are large enough to overcome the initial spring pretension.

Spring 2020 tutorial

		Small RB	Med RB	Large RB	Small SP	Med SP	Large SP
Load 1 (N):	F_1						
Length (m):	L_1						
Load 2 (N):	F_2						
Length (m):	L_2						
K (N/m):	$k = \frac{F_2 - F_1}{L_2 - L_1}$						
Initial Length (m):	L_o						
Max Length* (m):	L_m						
Max Elongation (m):	$\delta_x = L_m - L_o$						
Max Force (Nm):	$F = k \cdot \delta_x$						
Max Energy (J):	$E = \frac{1}{2} k \cdot \delta_x^{\ 2}$						

$T_{release}$ (s):**	$t_{release}$						
Max Power (watt):	$P = \frac{E}{t}$						

* **Max Length:** Do not damage springs by stretching them beyond their elastic limit
** **Release Time:** a good estimate for the release time is ¼ period of oscillation. See section below.

Spring and Rubber Band Stiffness (oscillation):

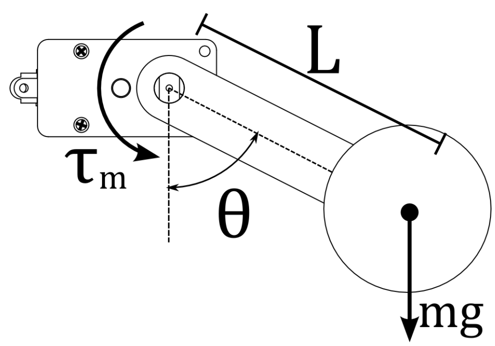
Calculate the stiffness for the small rubber band and medium spring using oscillation. Attach a medium sized mass to the end of the spring, measure the period of oscillation, then calculate the spring stiffness. Compare the results from the ones obtained above.

		Small RB	Med SP
Stiffness from elongation (found in prev. table)	$k_{elon} = See\ above$		
Mass (kg):	m		
Period (sec):	t		
Frequency (rad/s):	$\omega = 2\pi/t$		
Stiffness from oscillation:	$k_{osc} = m \cdot \omega^2$		
% difference:	$\% = \frac{\lvert k_{elong} - k_{osc} \rvert}{k_{osc}}$		

DC Motors:

Using the setup in the lab, measure and calculate the torque, speed, and power of the geared and non geared motors. Using your results, plot the torque-speed motor curves.

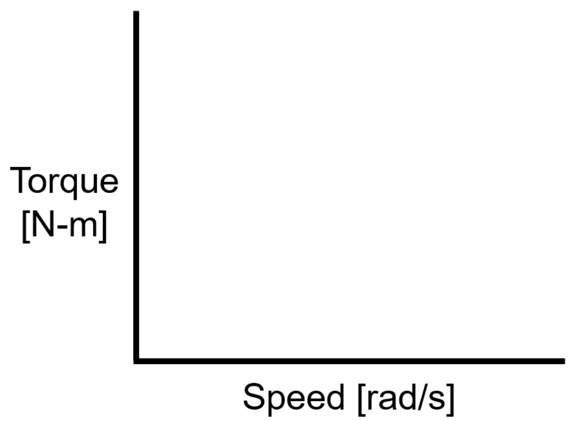
https://www.just4funelectronics.com/product-page/all-metal-gear-motor
https://drive.google.com/drive/u/0/folders/1SP6JQKaI_Ixnw6ODqkiG3rZnPPTTvG09



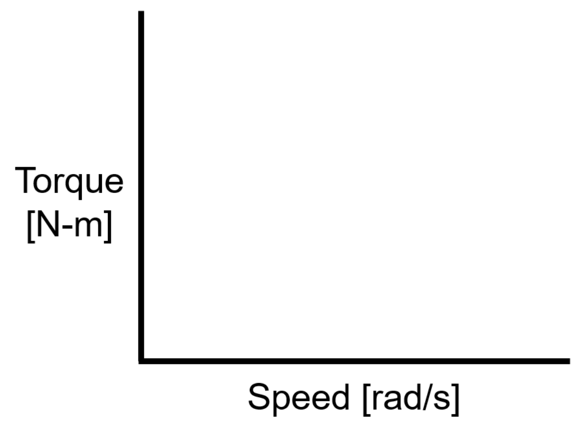
		Geared Motor	Non-Geared Motor
Stall Angle (deg):	θ		

Moment Arm Length (m):	L		
Mass (kg):	m		
Stall Torque (Nm):	$\tau_{stall} = mgL\sin\theta$		
No Load Speed (rad/s):	ω_{noLoad}		
Max Power (watts):	$P = \frac{1}{2}\tau_{stall} * \frac{1}{2}\omega_{noLoad}$		
Max Energy in 60s (J):	$E = P \cdot t$		

Geared Motor:



Non-Geared Motor:



Summary of Energy Sources:

	Max Force/Torque:	Max Energy:	Max Power:
Geared Motor			
Non-Geared Motor			
Small Rubber Band			
Med Rubber Band			
Large Rubber Band			
Small Spring			
Medium Spring			
Large Spring			

Weight (Pot. Energy)			

	Component:	**Value:**
Max Force:		
Max Torque:		
Max Power:		
Max Energy:		