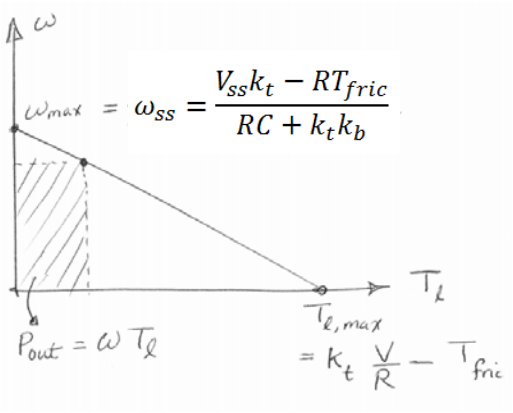
Homework Assignment #7 (ME-190, Fall 2016)

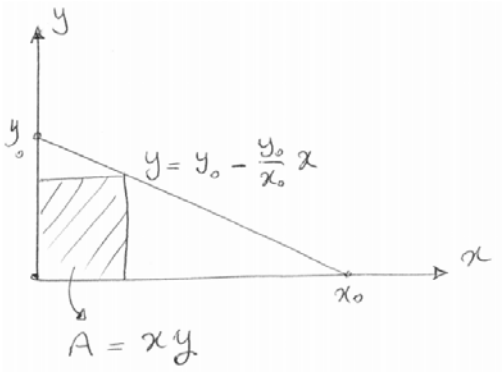
Due date: Thursday, Nov. 10, 2016, 2:00 pm.

Objective: Calculating the maximum power point for DC motor. Inverse Laplace transform using the partial fraction method.

Problem 1. A DC motor's angular speed decreases linearly with the load torque as shown in the diagram. The output power of the motor is calculated from $P_{out} = \omega \times T_l$. There is a particular speed-load point at which the output power is the maximum. Calculate the maximum power of a DC motor as a function of applied voltage, *V*, torque constant, K_t, back-emf constant, K_b, coil resistance, *R*, damping constant *C*, and friction torque T_{fric}.



Hint: Find the value of *x* that maximizes the area (*A* = *xy*), and use it to calculate *A*. You need to use the fact that at the maximum point the derivative of the function is zero.



Problem 2. Use the partial fraction expansion method and inverse Laplace transform to find the <u>unit step response</u> of the following transfer functions (Note: *U*(*s*) = 1/s for the unit step input):

$(a) \quad G(s) = \dfrac{Y(s)}{U(s)} = \dfrac{5}{s+10}$

$(b) \quad G(s) = \dfrac{Y(s)}{U(s)} = \dfrac{5s+2}{s^2+7s+10}$

$(c) \quad G(s) = \dfrac{Y(s)}{U(s)} = \dfrac{5}{s^2+2s+10}$

$(d) \quad G(s) = \dfrac{Y(s)}{U(s)} = \dfrac{5s+2}{s^2+6s+9}$