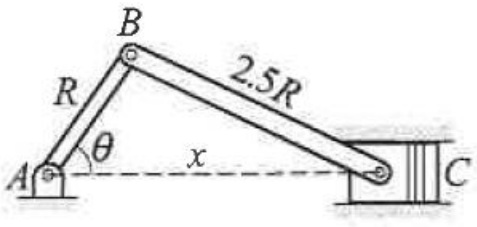
ME 8213 – Fall 2023
Exam #2

- Exam will be available for 36 hours before it is due.
- You may consult online resources but **NOT** other students
- Recommended format is 1 or more files of raw code for each problem + 1 word document containing a brief report of your results and comments. Code may be in any language/software.

Problem 1:

The crank AB of length R = 80 mm is rotating at a constant angular speed of $\frac{d\theta}{dt} = 6000\ rpm$. The position of the piston C, is constrained to move along the horizontal axis. Determine the position of the piston, x, as a function of angle and find the acceleration of the piston, $\ddot{x}$, for angles from 0 to 180 using numerical differentiation. Plot the acceleration as a function of angle.



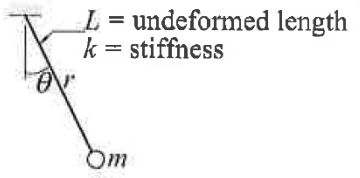
Problem 2:

Use Gauss-Chebyshev quadrature to evaluate the following integral. Compare to the "exact" answer of 2.622057554. You will need to use a variable transformation. If you answer differs from this value, explain why.

$$\int_0^{\frac{\pi}{2}} \frac{dx}{\sqrt{\sin x}}$$

Problem 3:

A mass, m, is suspended from an elastic cord with stiffness, k, and undeformed length, L. If the mass is released from rest at $\theta(0) = 45°$ with the cord unstretched, find the length, r, of the cord when the mass first crosses the vertical ($\theta = 0°$). The equations of motion are as follows:



$$\ddot{r} = r\dot{\theta} + g\cos\theta - \frac{k}{m}(r - L)$$

$$\ddot{\theta} = \frac{-2\dot{r}\dot{\theta} - g\sin\theta}{r}$$

Use g = 9.80665m/s2, k = 30 N/m, L = 0.4 m, and m = 0.2 kg.