Introduction to Solid Mechanics
ME C85/CE C30

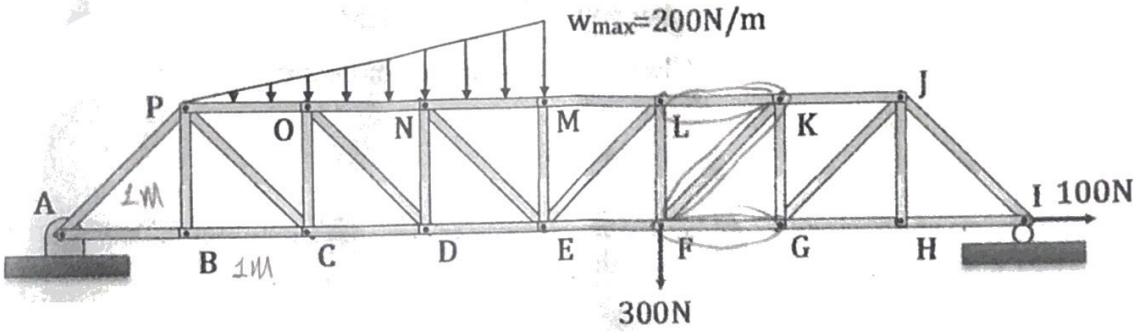
Midterm Exam 1

Fall, 2018

1. Do not open the exam until you are told to begin.
2. Put your name and SID on **every** page of your answer sheets.
3. You may not use a calculator, but you may use a straightedge to help you draw figures.
4. You may use one 8-1/2 x 11 sheet of notes, but not your book or any other notes.
5. Store everything else out of sight.
6. Turn off cell phones.
7. Please read the entire exam before starting work. There is important information in the text of each problem, as well as in the figures.
8. You may solve the problems in any order you choose, of course, but pay attention to the clock so that you have sufficient time to work on all three problems.
9. We will not answer questions during the exam. Write your concerns or interpretations of the problem(s) on your answer sheets.
10. Be concise and write clearly. Identify your answers by putting boxes around them.
11. You may leave the exam room when you are finished, but you may not leave and return during the exam. Please plan accordingly.
12. Time will be strictly enforced. At 3:00, you must put down your pencil or pen and immediately turn in your exam. Failure to do so may result in loss of points.

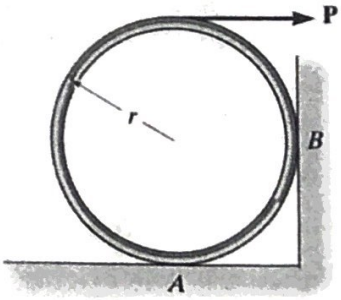
Problem 1. (30 Points) The structure shown below consists of 29 rigid and (assumed) massless members that are connected to one another by ideal pins at the 16 labeled joints. It is loaded by point forces applied at joints F and I, and a distributed force between joints P and M, ramping linearly from 0 to w_{max}=200 N/m. All horizontal and vertical members are 1m in length.

a) Determine the reaction forces at A and I.
b) Determine the forces in members FG, FK and KL. Be sure to identify whether a member is in tension or compression.



Problem 2. (35 Points) A cylinder of weight W is in a corner contacting the floor at point A and the vertical wall at point B. A horizontal force P is applied at the top of the cylinder. Let μ be the coefficient of static friction at both A and B, and let μ be sufficiently large that the cylinder does not slip with respect to the contacting surfaces, but instead begins to roll up the wall when P is large enough.

a) Determine the minimum value of μ that will ensure that the impending motion is rolling about B, not slipping at A and B. Express your answer in terms of W and r.
b) Determine P when this rolling motion is impending. Express your answer in terms of W and r.
c) Determine the normal and frictional forces at both A and B when motion is impending. Again, express your answers in terms of W and r.



Problem 3. (35 Points) The frame shown consists of two massless rigid members AE and BD connected with a pin at C. A double pulley is pinned to the horizontal member at E. This pulley has a smaller radius of r and a larger radius of 2r. The two portions of the pulley are fixed to one another so that it acts as a single unit rotating freely about E. (For reference, a picture of such a pulley with three radii is shown.) Weight W hangs from the cable wrapped around the smaller radius, while the cable wrapped around the larger radius extends horizontally and is attached to the frame at D. Pins A and B, pins A and C, and pins C and E are each separated by a distance L. Member BD makes a 45° angle with the horizontal.

a) Determine the reaction forces at supports A and B. Express your answers in terms of W, r, and L.
b) Determine the force exerted on pin C by member AE. Again, express your answer in terms of W, r, and L.