Your Name: ____________________

Your TA name: ____________________

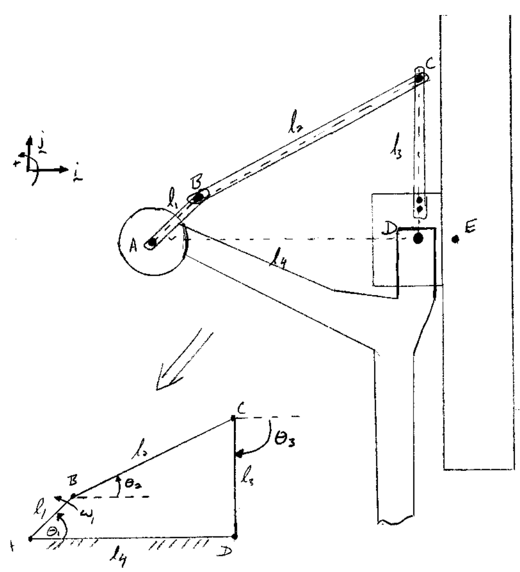
Section day: ____________________

MAE325, Homework 7

(Due Wednesday, October 20, 1999, 9:04 AM)

Please follow the homework directions from the course WWW pages, the directions of the first homework, and the advice marked on your previously graded homework.

1. Norton 4-1a
2. Norton 4-1f
3. Norton 4-1j
4. Same as above but with simple tension of σ_x
5. Same as above but with hydrostatic compress $\sigma_x = \sigma_y = \sigma_z = -p$.
6. Write a Matlab function that runs by typing `>stress(sigma)` where previously `sigma` was assigned values as a 3 by 3 symmetric matrix and types out the value of the three principal stresses and the maximum shear. For hints about how to do the output, see the grade statistics on the WWW page for prelim 1. You will probably want to use the matlab function `EIG`. Demonstrate your program for problems 1-5 above (you will have to pick numbers you like for problems (4) and (5).
7. It is hot and your roommate is hogging the only fan that you have – an industrial strength 10 kg job. Having recently taken MAE325, and having a motor and other parts handy, you decide to rig the fan so that it oscillates up and down, blowing air alternately on the upper and lower bunks of your bed. You rig up a linkage as shown below, but aren't sure whether or not the motor that you have is sufficient for the job. The motor is rated for 6 Newton-meters of torque. Ultimately you will want to figure out whether or not it is strong enough to make the fan oscillate.



Assume:

- $\omega_{AB} = 2\pi$ rad/s counterclockwise
- $AB = 10$ cm, $BC = 40$ cm, $CD = 30$ cm, $AD = 40$ cm, $DE = 10\sqrt{3}$ cm

- mass of the fan is 10 kg and the center of mass is at E
- the links are attached to the fan so that lines CD and DE remain perpendicular
- the moment of inertia of the fan is $\frac{md^2}{16}$ and the diameter of the fan, d, is 1 meter
- the gyroscopic effects from rotating the spinning fan apply forces to the pins at D, but these forces do not contribute to the torque necessary at the motor (this can be shown, by a fun experiment or by considering how the forces act at D); do not ignore the forces from gravity or accelerating the fan!
- all links are massless
- initially, $\theta_3 = \arctan(3/4)$

This problem with be completed over the course of several weeks and is meant to illustrate a method for solving a four-bar linkage problem beginning to end. Please follow the notation in the figure in your own solutions.

For the first part of the problem, this week, write a `matlab` function to evaluate the angular velocities and numerically integrate to the the positions on the links over a full cycle. Plot the positions of the pins in the linkage over the cycle (A, B, C, and D). Note that you will have to solve a geometry problem to get the initial values of angles. Also find approximately the greatest angle that the fan blades are tilted away from vertical over the course of a cycle.