Cornell TAM 2020

Catch-all makeup prelim

Dec 4, 2010

3 Problems, 90 minutes (+ up to 90 minutes overtime)

Directions. To ease your TA’s grading and to maximize your score, please:

- Draw **Free body diagrams** whenever force, moment, linear momentum, or angular momentum balance are used.
- Use correct **vector notation**.
- Be (I) **neat**, (II) **clear** and (III) **well organized**.
- **TIDILY REDUCE** and **box in** your answers (Don’t leave simplifiable algebraic expressions).
- Make appropriate **Matlab code** clear and correct.
  You can use shortcut notation like “\( T_7 = 18 \)” instead of, say, “\( T(7) = 18 \)”.
  Small syntax errors will have small penalties.
- **Clearly define** any needed dimensions (\( \ell, h, d, \ldots \)), coordinates (\( x, y, r, \theta \ldots \)), variables (\( v, m, t, \ldots \)), base vectors (\( i, j, \hat{e}_r, \hat{e}_\theta, \hat{\lambda}, \hat{\eta} \ldots \)) and signs (\( \pm \)) with sketches, equations or words.
- **Justify** your results so a grader can distinguish an informed answer from a guess.
- If a problem seems **poorly defined**, clearly state any reasonable assumptions (that do not oversimplify the problem).
- **Work for partial credit** (from 60–100%, depending on the problem)
  - Put your answer is in terms of well defined variables even if you have not substituted in the numerical values.
  - Reduce the problem to a clearly defined set of equations to solve.
  - Provide Matlab code which would generate the desired answer (and explain the nature of the output).
- **Extra sheets.** Put your name on each extra sheet, fold it in, and refer to it at the relevant problem.
  Note the last page is **blank** for your use. Ask for more extra paper if you need it.

Problem 7: \( \_\_\_ /25 \)

Problem 8: \( \_\_\_ /25 \)

Problem 9: \( \_\_\_ /25 \)
7) A uniform ladder with mass $m$ and length $L$ leans against a wall. There is friction $\mu$ against the wall and a frictionless roller on the floor. Depending on the values of $m$, $L$, $g$, $\mu$, and $\theta$ static equilibrium might not even be possible. If $m > 0$, $L > 0$, $g > 0$ and $\pi / 2 > \theta > 0$ either find the minimum value of $\mu$ for equilibrium or prove that equilibrium is not possible.
8) Given $F$ and $L$ find the reactions at A and E and any other force of interaction in the structure (you choose).
9) The beam shown has given $M$, $L$, $b$, $h$, $E$, $G$, and $v$. Find the maximum values of tension and shear stress in the beam and clearly describe the location(s) where they occur (where along the length and where in the cross section)?