Your Name: ______________________________

TA's name and Section time: ______________________________

T&AM 203 Makeup exam

Monday May 7, 2007

Draft May 7, 2007

3 problems, 25^+ points each, and 90^+ minutes.

Please follow these directions to ease grading and to maximize your score.

a) No calculators, books or notes allowed. A blank page for tentative scrap work is provided at the back. Ask for extra scrap paper if you need it. If you want to hand in extra sheets, put your name on each sheet and refer to that sheet in the problem book for the relevant problems.

b) Full credit if

- →free body diagrams← are drawn whenever force, moment, linear momentum, or angular momentum balance are used;
- correct vector notation is used, when appropriate;
- ↑→ any dimensions, coordinates, variables and base vectors that you add are clearly defined;
- ± all signs and directions are well defined with sketches and/or words;
- →| reasonable justification, enough to distinguish an informed answer from a guess, is given;
- you clearly state any reasonable assumptions if a problem seems *poorly defined*;
- work is I.) neat,
  II.) clear, and
  III.) well organized;
- your answers are TIDILY REDUCED (Don't leave simplifiable algebraic expressions.);
- □ your answers are boxed in; and
- ≫ Matlab code, if asked for, is clear and correct. To ease grading and save space, your Matlab code can use shortcut notation like "$\dot{\theta}_7$ `= 18`" instead of, say, "`theta7dot = 18`". You will be penalized, but not heavily, for minor syntax errors.

c) Substantial partial credit if your answer is in terms of well defined variables and you have not substituted in the numerical values. Substantial partial credit if you reduce the problem to a clearly defined set of equations to solve.

Problem 10:	/25
Problem 11:	/25
Problem 12:	/25

10) 25 pt) 2D planar motion. Two equal masses m are connected by a spring k with rest length ℓ_0 and move in a viscous plane. For both masses fluid force resists absolute motion and is proportional to velocity with constant c. Neglect gravity.

a) Write the differential equations governing the motion of this system.

b) Assume $\ell_0 = 0$, and that the system starts from rest with the masses separated by distance d. Under what conditions (values of d, m, c, k) do the masses never touch?

11) 25 pt) A uniform disk (radius R, mass m) rolls without slip down a slope ϕ and accelerates due to gravity g. It is released from rest at $t = 0$. Point P on the disk is on the ground when the disk starts to move. Find the position of the point P as a function of time. Define and use any convenient coordinate systems.

12) 25 pt) A uniform square block (side L, mass m) slides without friction on a plane at speed v_0. It then trips on a small curb which brings the leading bottom corner of the block to an abrupt stop. From that moment on, the corner of the block is essentially hinged to the ground at the point where the small curb is located. Gravity is g. Find (in terms of m, L, g) the minimum value of v_0 so that the block tips over (gets at least up to where its COM is over the corner).