Your Name: _____

TA's name and Section time: _____

T&AM 203 Make up prelim

Sunday Dec 9, 2008

Draft December 6, 2008

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;

$\underline{\bullet}$ 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 7: ____/25____

Problem 8: ____/25____

Problem 9: ____/25____

7) (25 pt) A mass m has no forces on it but for those due to a system of ideal massless pulleys and cables. A force F is applied at a point P on a cable. Design the system so that P has acceleration

$$a_P = \frac{9F}{m} \ .$$

Neglect gravity. It doesn't matter what direction the acceleration is. Show that your system works. That is, given the system you design, calculate the acceleration of point P.)

8) (25 pt) A uniform block with mass m, width $2w$ and height $2h$ slides down a ramp with slope γ ($\gamma = 0$ would be horizontal) driven by gravity g and slowed by friction μ which acts at the front and back edges (which are the only points where the block touches the ramp).

a) What is the normal component of the reaction on the uphill edge of the block?

b) Assuming $\mu = 0$ what is the range of slopes for which the block will not tip over?

9) (25 pt) A person is running and then trips and falls and hits his head. Model the person as a rigid rod with mass m, COM at height h, head at height ℓ and moment of inertia about the COM of I^G. The person is upright and translating at speed v and then, after tripping, hinges about the curb (modeled as a point on the ground). Under what conditions (what values of m, I^G, h, ℓ, g and v) does the person's head hit the ground with speed greater than v?