Ph 205 1st Mid Term Exam

DUE IN CLASS, 10:30 AM, TUESDAY, OCT. 20, 1981

THIS IS A TAKE-HOME EXAM

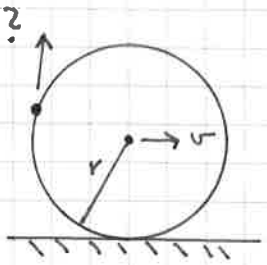
TIME LIMIT = 90 MINUTES IN ONE CONTINUOUS SITTING

THE EXAM IS CLOSED BOOK, CLOSED NOTES ETC.

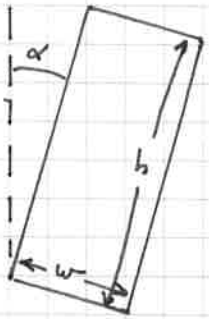
THE EXAM CONSISTS OF 3 PROBLEMS, EACH WORTH 10 POINTS. PARTIAL CREDIT WILL BE LIBERALLY AWARDED. THE PROBLEMS ARE (HOPEFULLY) EASIER THAN THOSE ON THE HOMEWORK SETS. THE EXAM COVERS THE MATERIAL OF THE 1ST 4 WEEKS OF THE COURSE. THE METHOD OF LAGRANGE MULTIPLIERS IS NOT NEEDED.

PLEASE DO ALL WORK YOU WISH GRADED IN THE EXAM BOOKLET PROVIDED.

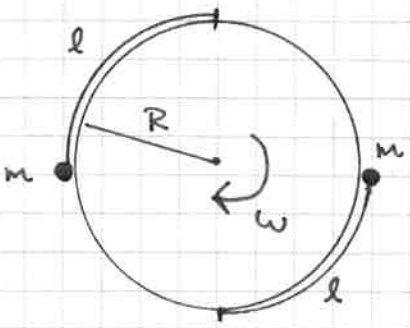
① A WHEEL OF RADIUS r ROLLS WITHOUT SLIPPING WITH VELOCITY v ON A FLAT ROAD. PARTICLES OF MUD ARE THROWN OFF THE WHEEL AS IT ROTATES. WHAT IS THE GREATEST HEIGHT TO WHICH THE MUD CAN RISE?



② A DOOR OF HEIGHT h AND WIDTH w IS HUNG POORLY SO THAT THE HINGES ARE ON A LINE WHICH MAKES ANGLE α TO THE VERTICAL. WHAT IS THE FREQUENCY OF SMALL OSCILLATIONS OF THE DOOR?



③ A UNIFORM DISC OF MASS M AND RADIUS R IS ROTATING WITH CONSTANT ANGULAR VELOCITY ABOUT AN AXIS PERPENDICULAR TO THE DISC, THROUGH ITS CENTER. IGNORE GRAVITY. TWO MASSES, m, ARE ATTACHED TO THE RIM OF THE DISC BY MASSLESS STRINGS OF LENGTH l. INITIALLY THE STRINGS LIE ALONG THE RIM AS SHOWN, AND THE MASSES ARE PINNED TO THE RIM. HENCE THE MASSES ARE ALSO ROTATING WITH ANGULAR VELOCITY ω.



AT SOME MOMENT THE PINS ARE RELEASED AND THE MASSES FLY OUTWARDS. WHEN THE STRINGS ARE ALIGNED RADIALLY THEY ARE CUT AND THE MASSES GO FREE. WHAT SHOULD THE LENGTH OF THE STRINGS BE SUCH THAT THE DISC WILL STOP ROTATING DUE TO THIS ACTION?