Physics 1303 Professor Olness
EXAM 3 November 16, 1999

NAME:_____

Signature:_____

Suggestion:
1) Show all work. Explain if it might help with partial credit.
2) Use symbols as much as possible. It makes it easier to allocate partial credit.
3) Do not waste an excessive amount of time on any one problem or individual part. Note the point allocation, and budget your time accordingly.
4) Write clearly so that we can try and reconstruct your steps. Make figures of reasonable size.
5) In case of emergency, you may use the back of a page. (This must be indicated on the original problem page, or no credit will be given.)
6) Make sure that you have all problems.

Instructions:
1) Fill in your name clearly.
2) Show all your steps. No work, no credit!
3) Do not use a red pen or red pencil.
4) Cheating is an offense that will lead to disciplinary action.
5) You are not allowed to share calculators, rulers, pencils, or any other material.
6) No notes or scratch paper of any kind is allow. You should never have any paper on your desk except for the exam paper.
7) Any books or notes are to placed on the floor, and closed so that the material is not visible.
8) Violation of the above rules will result in a FAILING grade for the ENITRE course.
9) Violations will be refereed to the coordinator of student conduct according the procedure established in the university code. A summary can be found in the student handbook.

1) _____

2) _____

3) _____

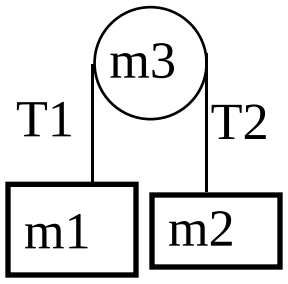
4) _____

5) _____

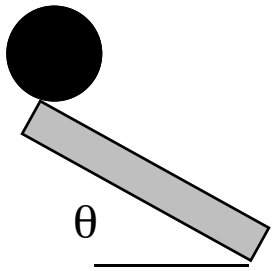
6) _____

TOT) _____

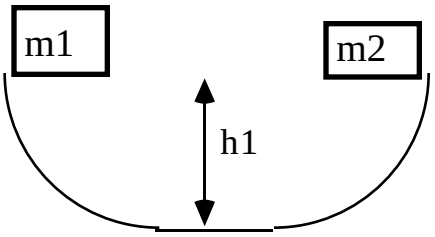
1a) (10 Points) Two masses m_1=10kg and m_2=20kg are suspended from a pulley of radius r=20cm, and mass m_3=30kg. (For the pulley, $I = 1/2\ m_3\ r^2$.)
a) Compute the linear acceleration of mass m_1.
b) Compute the tension T_1 in the cord supporting mass m_1.



1b) (10 Points) A disk of mass m=10kg and radius r=2m and $I=3/5\ m\ r^2$ starts from rest on an incline of length L=4m, and angle of incline θ =30 degrees.
a) Compute moment of inertia of the disk about the contact point with the incline.
b) Compute the torque of the disk about the contact point with the incline.
c) Compute the α of the disk.



2) (20 Points) Two masses m_1=10kg and m_2=20kg start from rest as shown at a height of h_1=10m. They collide, and stick together, and slide up the hill to a new height h_2.
Find the final height h_2. (Ignore friction with the surface.)



3a) (10 Points) A turntable of m=20kg r=0.5m ($I=1/2\ mr^2$) is spinning at ω_0=20 rad/sec. A torque of τ=2 N-m^2 is applied to <u>slow</u> the turntable.

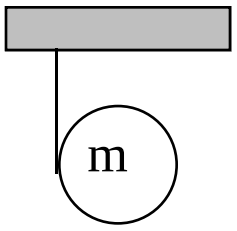
i) Find the angular deceleration α.

ii) Find the number of <u>revolutions</u> necessary to stop the turntable.

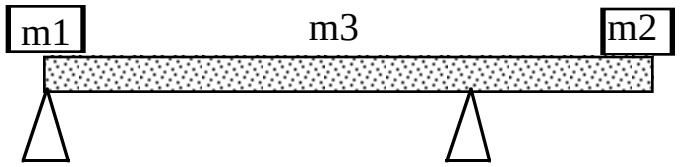
3b) (10 Points) A string is wound around a disk of m=20kg r=0.5m ($I=1/2\ mr^2$). The disk starts from rest.

i) Find the angular acceleration α.

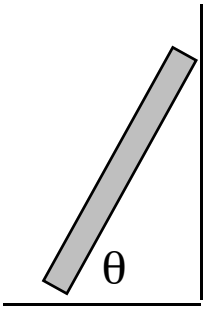
ii) Find tension in the string.



4a) (10 Points) m1=10kg, m2=20kg, and the board has m3=30kg and L=100m. Supports are placed at the 0m and 60m mark. Compute the normal force $\{N_1, N_2\}$ on each support.



4b) (10 Points) A ladder having uniform density and mass m rests against a frictionless vertical wall at an angle of 60 degrees. The lower end rests on a flat surface where μ_s=0.4. A student with mass M=2m climbs the ladder. What fraction of the length L of the ladder with the student have reached when the ladder begins to slip.



5a) (6 Points) A m=200 kg load is hung on a wire of L=4.0m and cross sectional area $A=0.2\times10^{-4}\ m^2$, and Young's modulus $Y=8.0\times10^{10}\ N/m^2$. What is the increase in length.

5b) (6 Points) Calculate $\Delta V/V$ for water at a depth of 1km where the pressure is approximately $P=F/A=1.0\times10^{7} N/m^2$. Take $B=0.21\times10^{10}$.

5c) (8 Points) When water freezes, it expands about 9%. What would be the pressure increase inside your automobile engine block if the water in it froze. Take $B=2.0\times10^{9}$ for ice.

6) (20 Points)

1) If the total energy of a particle is zero, its linear momentum necessarily zero.

TRUE or FALSE

2) If the kinetic energy of a particle is zero, its linear momentum necessarily zero.

TRUE or FALSE

3) If two particles have equal kinetic energies, their momenta are necessarily equal.

TRUE or FALSE

4) The center of mass of an object can never lie outside of the body.

TRUE or FALSE

5) A wheel rotates clockwise in the x-y plane. The direction of ω is along the positive z-axis.

TRUE or FALSE

6) An object at rest can have non-zero moment of inertia.

TRUE or FALSE

7) If an object has zero ω, then α must be zero.

TRUE or FALSE

8) It is impossible to calculate the torque acting on a rigid body without specifying a center of rotation.

TRUE or FALSE

9) A body can be in equilibrium if there is only one non-zero external force acting on it.

TRUE or FALSE

10) If the net torque acting on a body is zero, the net force must also be zero.

TRUE or FALSE