Physics 180

Term Test #2 **November 16, 2006**

***Aids permitted**: Writing/drawing aids and non-programmable calculators.*

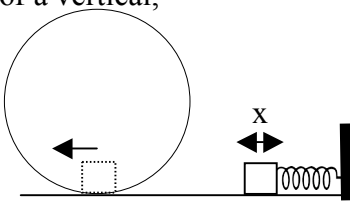
PUT YOUR NAME, TUTORIAL SECTION AND STUDENT NUMBER ON ALL BOOKS
Do all 3 questions. Provide appropriate reasoning for your answers.
S.I. (m-k-s) units are used throughout with $g = 9.8\ m/s^2$.

1) a) In 3 sentences or less, discuss each of the following (WITHOUT symbols, equations or graphs).

i) What is the parallel axis theorem for moment of inertia?
ii) What is meant by power and efficiency of a mechanical system?
iii) What is the condition for unstable equilibrium for a particle?
iv) What is the difference between an elastic and a perfectly inelastic collision?
v) What determines the thrust of a rocket? *(5 marks for each part)*

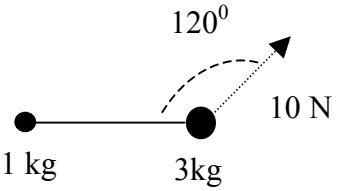
b) Show that the work done by all vector forces on a system is equal to the change in its translational kinetic energy and that the total work done by a conservative force around a closed path is zero. *(15 marks)*

2) A block of mass 0.5 kg is pushed against a horizontal spring of negligible mass until the spring is compressed a distance *x* (see figure). The spring constant is 450 N/m. When released the block travels along a frictionless, horizontal surface to the bottom of a vertical, circular track of radius 1.0 m and continues to move up the track. The speed at the bottom of the track is 12 m/s and the block experiences an average frictional force of 7.0 N while sliding up the track.



i) What is x?
ii) What speed do you predict for the block at its maximum height?
iii) Does the block reach the top of the track? (*10 marks for each part*)

3) A barbell consists of a 1 kg point mass and a 3 kg point mass separated by a massless rigid rod of length 1 m. They rest on a frictionless table. A force of 10 N is applied to the 3 kg mass as in the diagram.



i) What is the moment of inertia of the barbell about the centre of mass?
ii) What are the torque about the center of mass and the angular acceleration of the barbell about the centre of mass immediately after the force is applied?
iii) What is the initial linear acceleration of each mass relative to the table?
iv) Is there a point that experiences no initial linear acceleration relative to the table? If so where is it?
v) What is the ratio of total barbell kinetic energy to rotational kinetic energy about the centre of mass immediately after the force is applied? *(6 marks for each part)*

Total marks: 100