Physics 1303 Professor Olness
EXAM 2 March 16, 1999

1) (20 Points)

a) (4 points) Find the tension in the string. M=5kg.

b) (4 points) Find the tension in the string. M=5kg, masses are at rest.

c) (4 points) The tension in a string from which a 4.0 kg object is suspended in an elevator is equal to 44 N. What is the acceleration of the elevator?

d) (4 points) What is the magnitude of the total force on a driver by the dragster he operates as it accelerates horizontally along a straight line from rest to 60 m/s in 8.0s? (mass of driver = 80 kg)

e) (4 points) The force an ideal spring exerts on an object is given by $F_x = -kx$, where x measures the displacement of the object from its equilibrium (x = 0) position. If k = 60 N/m, how much work is done by this force as the object moves from x = -0.20 m to x = 0?

2) (20 Points) *(Hint: Make your calculations carefully---errors propagate!!!)*

a) (3 Points) I Stand on the top of Fondren Hall at a height of h_0=30m, holding a ball of mass M=4kg. Find the potential energy (PE) (relative to the ground), the kinetic energy (KE), and the total energy (E) of the ball. (You may use g=10 m/s^2.)

b) (5 Points) I now throw the ball up with a velocity of 20m/s. Just after I release the ball (h_0=30m), find the potential energy (PE) (relative to the ground), the kinetic energy (KE), and the total energy (E) of the ball.

c) (5 Points) When the ball reaches its maximum height above the ground, find the potential energy (PE) (relative to the ground), the kinetic energy (KE), and the total energy (E) of the ball. Also find the height of the ball (relative to the ground).
(Hint: find the height using energy considerations.)

d) (5 Points) When the ball reaches the ground, find the potential energy (PE) (relative to the ground), the kinetic energy (KE), and the total energy (E) of the ball.
Also find the velocity of the ball. (Hint: find the velocity using energy considerations.)

e) (2 Points) At what height above the ground will the kinetic energy (KE) of the ball be half of the total energy. (Hint: This is simple. No calculation necessary.)

3) (20 Points)

a) (5 Points) A 3.0-kg block slides on a frictionless 20 degree inclined plane. A force of 16 N acting <u>parallel</u> to the incline and up the incline is applied to the block. What is the acceleration of the block?

b) (5 Points) An astronaut who weighs 800 N on the surface of the earth lifts off from planet Zuton in a space ship. The free-fall acceleration on Zuton is 3.0 m/s^2 (down). At the moment of liftoff the acceleration of the space ship is 0.50 m/s^2 (up).
What is the magnitude of the force of the space ship on the astronaut?

c) (5 Points) An airplane travels 80 m/s as it makes a horizontal circular turn which has a 0.80-km radius.
What is the magnitude of the resultant force on the 75-kg pilot of this airplane?

d) (5 Points) A 0.30-kg ball attached to the end of a string swings in a vertical circle having a radius of 1.4 m. At an instant when the string makes an angle of 30 degrees above the horizontal, the tension in the string is 3.0 N.
What is the speed of the ball at this instant?

4) (20 Points)

a) (8 Points) A space station in the form of a large wheel, 120 m in diameter, rotates to provide an ``artificial gravity'' of 3 m/s^2 for persons located at the outer rim. Find the rotational frequency of the wheel (in revolutions per minute) that will produce this effect.

b) (6 Points) A 70-kg high jumper leaves the ground with a vertical velocity of 6m/s. How high can he jump?

c) (6 Points) Water flows over a section of Niagara Falls at the rate of 1.2×10^6 kg/s and falls 50 m. What is the power wasted by the waterfall?

5) (20 Points)

a) (5 Points) A pendulum is made by letting a 2.0-kg object swing at the end of a string that has a length of 1.5 m. The maximum angle the string makes with the vertical as the pendulum swings is 30°. What is the speed of the object as it goes through the lowest point in its trajectory?

b) (5 Points) A 2.0-kg mass is projected from the edge of the top of a 20-m tall building with a velocity of 24 m/s at some unknown angle above the horizontal. Disregard air resistance and assume the ground is level. What is the kinetic energy of the mass just before it strikes the ground?

c) (5 Points) A block (mass = 4.0 kg) sliding on a horizontal frictionless surface is attached to one end of a horizontal spring (k = 100 N/m) which has its other end fixed. If the maximum distance the block slides from the equilibrium position is equal to 20 cm, what is the speed of the block at an instant when it is a distance of 16 cm from the equilibrium position?

d) (5 Points) A 10-kg object is dropped from rest. After falling a distance of 50 m, it has a speed of 26 m/s. How much work is done by the dissipative (air) resistive force on the object during this descent?

6) (20 Points)

a) (10 Points) A block of mass 6kg slides 6m down a frictionless ramp inclined at 30° to the horizontal. It then travels on a rough horizontal surface where μ=0.5.

i) What is the speed of the block at the end of the incline.

ii) What is the spped after traveling 1m on the rough surface.

b) (10 Points) A bead slides without friction around a loop-the-loop. The bead is released from a height h=10m, and the radius of the loop is R=1m.

i) Find the speed of the bead at the top of the loop.

ii) Find the normal force of the track on the bead at the top of the loop.