Name: _____

PHY 105 Test 3 December 3, 2004 50 minutes

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Do all work in the blue book! All answers must be in MKS units unless otherwise specified.

1. A 2.2 kg block slides at 4.1 m/s along a frictionless table from left to right. It collides with a 1.4 kg block also moving to the right at 2.9 m/s. **[20 pts]**
   a) If the collision is totally inelastic, calculate the final velocity of the masses. Also calculate the percentage of kinetic energy lost in the collision.
   b) If the collision is perfectly elastic, calculate the velocities of both masses after the collision.
   c) If the collision time is 0.18 s, calculate the average force on the smaller mass due to the larger mass during the collision for both types of collision.
   d) Based on your answers in (c), discuss whether it is safer to be in a totally inelastic or perfectly elastic collision. (Assume that initial velocities are the same in both cases.).

2. Explain what happens to the speed of a fighter aircraft chasing another when it opens fire. What happens to the speed of the pursued aircraft when it returns the fire from a rear-mounted gun? Assuming both pilots do not change their throttle settings, what happens to the spacing between the planes as guns from both are fired? [**6 pts**]

3. A block of mass 4.5 kg is moving in the *x*-direction with a speed of 7.5 m/s. It is acted upon by a time-varying force that starts at t = 0 and ends at t = 4 s, where $F(t) = 4t^2 - 16t$ N and *t* is in seconds. [**8 pts**]
   a) Calculate the total impulse on the block.
   b) Calculate the velocity of the block at t = 4 s.

4. A 4 kw motor runs a winch at the top of a long crane. It is used to lift large objects at a constant speed. [**8 pts**]
   a) How fast can a 500-kg object be lifted with this motor?
   b) What is the tension in the winch cable while the object is lifted?

5. Pluto travels around the sun at an average distance of 5.916×10^9 km. If Pluto were somehow stopped short in its orbit, it would fall into rather than orbit around the sun. How fast would it be moving when it hit the sun? (M_{sun}=1.99 x 10^{30} kg; R_{sun}= 6.96 x 10^8 m, G = 6.673 x 10^{-11} m^3/kg-s^2) [**8 pts**]

EC The Marianas Trench's depth is about 10,924 m. If a submarine could go to the bottom of the Trench, what total inward force would be present on a round porthole window of radius 15.0 cm? Assume that the pressure inside the sub is 1 atmosphere (1.013 x 10^5 Pa).) [5 **pts**]