PHYS 2325 - Dr. Honan - Test 3 - A Name _____

Possibly Useful Information: $g = 9.80 m/s^2$, $G = 6.67\times10^{-11} N\cdot m^2/kg^2$, $\alpha_{steel} = 11\times10^{-6}/C°$, $\beta_{gasoline} = 960\times10^{-6}/C°$

Problem 1 Short answer (2 points each)

A crazed physicist risks his life rotating on a frictionless stool. When he pulls his arms in he spins faster. Give the signs of the changes (as he moves his arms inward) in kinetic energy, angular momentum and angular velocity. Answer +, - or 0.

_____ [i] ΔK _____ [ii] ΔL _____ [iii] $\Delta\omega$

Problem 2 (8 points each)

(a) A 300 g glider moves at 0.3 m/s on an air track toward a 200 g glider moving in the opposite direction at 0.6 m/s. If the collision is elastic then what are both final velocities?

(b) A string is wrapped many times around a frictionless pulley, which is a uniform disk of mass *M*. The string is connected to a hanging mass of mass *m*. What is the speed of the hanging mass after it falls a distance *h* from rest?

(c) A ceiling fan accelerates uniformly at a rate of $3 rad/s^2$ from rest. How long does it take for the acceleration of a point 1.2 m from the center to have a magnitude of $6 m/s^2$.

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Problem 3 (8 points each)

(a) A car moving at 3 m/s hits a truck, with twice the car's mass, moving in *opposite direction* at 2 m/s. If the bumpers lock and the car and truck stick together, then what is their final velocity?

(b) An 78kg man stands on perfectly frictionless ice. If he fires a 0.035kg bullet at an angle of 35° above horizontal at a speed of 250m/s then what is his recoil speed after firing the bullet?

(c) If the two masses m and M are separated by a distance d then how far is the center of mass from M.

(d) A 0.06 kg bullet moving horizontally at 300 m/s collides with and passes through a 2 kg block, initially at rest. The bullet exits the block at 100 m/s. This causes the block to slide along the floor a distance of 12 m before stopping. What is the coefficient of kinetic friction between the block and the floor?

(e) A 0.13 kg rubber ball dropped from a height of 2.1m rebounds to a height of 1.3m. If the ball is in contact with the floor for 0.085s, then what is the average force of the floor on the ball?

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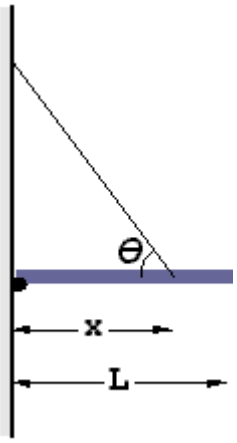
Problem 4 A force of 35 N in the negative *y* direction acts at (2m, 0, 3m). What is the torque about the origin? (8 points)

Problem 5 A uniform horizontal shelf of mass *m* and width *L* is held to a wall by a frictionless hinge and by a rope as shown. (7 points each)



(a) What is the tension in the rope?

(b) Suppose the rope is cut and the shelf swings without friction. What is the shelf's angular acceleration just after the rope is cut?

(c) If the rope is cut as in part (b) what is the speed of the far edge of the shelf just before it hits the wall?