Name:_____

Solve the following problems in the space provided. Use the back of the page if needed. Each problem is worth 20 points. You <u>must</u> show your work in a logical fashion starting with the correctly applied physical principles shown on the last page. Your score will be maximized if your work is easy to follow because partial credit will be awarded.

1. A bug flying northward at 8.00m/s collides with the windshield of a car traveling southward at 20.0m/s. Answer the following questions. For full credit, you must explain your thinking. Be sure to cite any relevant principles of physics. Which object, the bug or the car:

(a)feels the greater force during the collision?

(b)has the greater acceleration during the collision?

(c)has the greater impulse on it during the collision?

(d)has the greater change in momentum during the collision?

(e)has the greater momentum after the collision?

2. A railroad car traveling east at a speed of 4.00m/s collides and couples with three identical cars traveling in the opposite direction at 2.00m/s. Find the velocity of the fours coupled cars just after the collision. Is the collision elastic? Explain you answer quantitatively.

3. A 4.00m diameter merry-go-round is sped up from rest to 10.0rpm in 8.00s by a force of 120N exerted tangentially on its edge. Assuming that there is no friction, find the rotational inertia of the merry-go-round.

4. Two astronauts each have a mass of 75.0kg are initially connected by a 10.0m long rope of negligible mass. They are isolated in space and orbit their center of mass with a speed of 5.00m/s. They then begin to pull in on the rope until they are only 5.00m apart. Find (a)their initial kinetic energy (b)their final speed, (c)their final kinetic energy and (d)the work they have done.
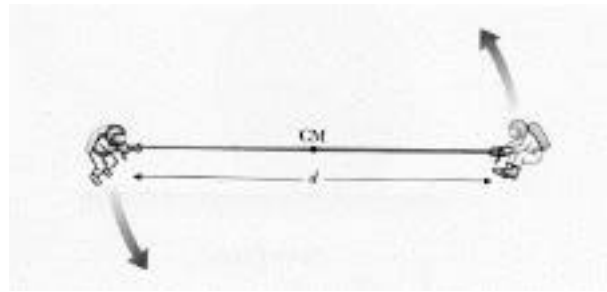
5. A person bends over and lifts a 200N weight as shown with his back in a horizontal position.   The back muscle is attached two-thirds of the way up the spine and makes a 12° angle with the spine. Assuming the weight of the upper part of the body is 350N and acts at the center of the spine, find the tension in the back muscle and the horizontal and vertical components of the force exerted by the base of the spine.