PHYS-1800 **Homework 6** **Due: Fri 26 February, 2010**

Name:_____ **Show all workings, use g = 9.8 m/s²**

1. By re-arranging Newton's 2nd law of motion we showed that the _____ acting on an object equals the **change in momentum** of the object. (1 point)

2. A large truck and a compact car have a head-on collision. The average force experienced by each vehicle during impact is: (1 point)
   A. Greater for the truck
   B. Greater for the car
   C. Zero for both
   D. The same for both.

3. A cannon fires a shell and recoils. After firing, which of the following statements is NOT true? (1 point)
   A. The shell and cannon have equal magnitudes of momentum.
   B. The shell and cannon have equal kinetic energies.
   C. The force given to the shell is equal in magnitude to the force given to the cannon.
   D. The impulse imparted to the shell is equal to the impulse given the cannon.

4. A bowling ball has a mass of 7 kg and a speed of 1.5 m/s. A baseball has a mass of 0.12 kg and a speed of 30 m/s. Which has the largest momentum? (2 points)

5. A 0.15 kg ball traveling with a speed of 40 m/s is brought to rest in a catcher's mitt. What is the size of the impulse exerted by the mitt on the ball? (2 points)

6. A 5.0-kg cat travels to the left at 10 m/s and a 10-kg dog travels to the right at 5.0 m/s. The total momentum of this system is: (2 points)
   A. 125 kg m/s to the left.
   B. zero.
   C. 50 kg m/s to the right.
   D. 100 kg m/s to the right.

7. The average force required to accelerate a 0.20-kg ball from rest to 30 m/s in 0.001 s is: (2 points)
   A. 0.006 N
   B. 6000 N.
   C. 30000 N.
   D. 150000 N.

Name:_____ **Show all workings, use g = 9.8 m/s²**

8. A child runs at 4.0 m/s and jumps onto a sled, initially at rest. If the child's mass is 36 kg, and if the child and sled slide off together at 3.0 m/s after the collision, the sled's mass is: (2 points)
   A. 12 kg.
   B. 27 kg.
   C. 36 kg.
   D. 48 kg.

9. An ice skater with a mass of 75 kg pushes off against a second skater with a mass of 25 kg. Both skaters are initially at rest. Determine (a) the total momentum of the system after they push off, and (b) If the larger skater moves off with a speed of 3 m/s to the left, what is the corresponding velocity (speed and direction) of the smaller skater? (3 points)

10. A 0.15 kg baseball traveling at 28 m/s due south approaches a waiting batter. The ball is hit and momentarily crushed; it then springs back flying away with a velocity of 46 m/s due north. Determine (a) the magnitude of the initial and final momenta of the ball, and (b) the change in the balls momentum. (4 points)

PTO for additional (optional) questions…….

Name:_____ **Show all workings, use g = 9.8 m/s^2**

Two additional (optional) questions worth up to 5 points each:

A. A 2,200 kg car traveling due East with a speed of 45 m/s collides head-on with an 8,500 kg truck traveling due West with a speed of 15 m/s. The two vehicles become locked together in the impact. Determine:

(i) The total momentum of the system prior to impact.
(ii) The velocity of the two vehicles just after impact.
(iii) The total kinetic energy of the two vehicles before impact.
(iv) The amount of energy lost during the impact.
(v) Is the collision elastic? Explain your answer.

PTO for question B….

Name:_____ **Show all workings, use g = 9.8 m/s^2**

B. During the early days of the NASA space program a Gemini spacecraft (total mass 40 x 10^2 kg) with two astronauts onboard was launched into a circular orbit of 200 km altitude from Cape Canaveral. Their task was to test docking procedures by joining together with an unmanned Agena launce vehicle previously launched into the same orbit.

(i) While the two spacecraft were coupled together Gemini's motors were accidentally fired exerting a brief thrust of 1500 N for 4.5 sec. As a result of this "nudge" the joined spacecraft increase their orbital velocity by 0.9 m/s. Determine the mass of the Agena spacecraft.

(ii) Later on in the mission one of the astronauts (mass 200 kg) was on a space walk when his tether accidentally snagged and broke leaving him floating helpless in space 15 m behind the spacecraft. All he had with him was a waist band containing 4 tools each of mass 2 kg. Is he doomed or can you think of a way for him to get safely back to the Gemini spacecraft. Explain your answer using a drawing and the appropriate physical law.