PART A: MULTIPLE CHOICE (8 MARKS)

Choose the best response in each case and place your answer in the appropriate space on your answer sheet.

1. Using L, M, and T for the dimensions of length, mass, and time, the dimensions of impulse are:
   (a) $\frac{ML}{T}$ (b) $\frac{LT}{M}$
   (c) $\frac{ML}{T^2}$ (d) $\frac{L}{TM}$

2. The area under the line on a force-time graph indicates:
   (a) the impulse.
   (b) the change in momentum.
   (c) neither (a) or (b).
   (d) both (a) and (b).

3. When you catch a fast-moving baseball, your hand hurts less if you move it in the same direction as the ball because:
   (a) the change in the momentum in the ball is less.
   (b) the change in kinetic energy of the ball is less.
   (c) the time interval of the interaction is greater.
   (d) the time interval of the interaction is less.

4. The force applied by an apple hitting the ground depends on:
   (a) whether or not the apple bounces.
   (b) the time interval of the impact with the ground.
   (c) the apple's maximum speed just before impact.
   (d) all of the above.

5. If an arrow's speed is doubled, then its momentum and kinetic energy are respectively increased by factors of:
   (a) 2 and 4 (b) 4 and 4
   (c) 4 and 8 (d) 8 and 8

6. When you are jogging and you increase your kinetic energy by a factor of 4, then your momentum increases by a factor of:
   (a) $\sqrt{2}$ (b) 2 (c) 4 (d) 8

7. A firecracker is placed in the midst of a motionless cluster of billiard balls on a table. When the firecracker explodes, the balls scatter in all directions. The total momentum of the balls immediately after the explosion is:
   (a) less than before the explosion.
   (b) more than before the explosion.
   (c) the same as before the explosion.
   (d) cannot tell from this information.

8. A baseball of mass "m" leaves a pitching machine of mass "M" (where "M" includes the mass of the ball "m") with a speed "v". The recoil speed of the machine after shooting the baseball is:
   (a) $\frac{mv}{(M - m)}$ (b) $\frac{2mv}{(M - m)}$
   (c) $\frac{mv}{(M + m)}$ (d) $\frac{mv}{M}$

PART B: MATCH (5 MARKS)

Match the definition from the 1st column to the best term in the 2nd column and place the matching letter in the appropriate space on your answer sheet.

1. Car design that can expand the duration of a crash.
2. System which can exchange both matter and energy with its surroundings.
3. Collision in which kinetic energy is not conserved.
4. System which can exchange energy with its surroundings but not matter.
5. Product of an object's mass and its velocity.

A) closed system
B) conservation of momentum
C) crumple zone
D) elastic collision
E) impulse
F) inelastic collision
G) isolated system
H) momentum
I) open system
J) recoil

SPH4U-2 ENERGY & MOMENTUM: E&M (PART 1) QUIZ#2

PART A: MULTIPLE CHOICE (8 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (5 MARKS)

1	2	3	4	5

PART C: SHORT ANSWER (13 MARKS)

Answer the following questions in the space provided.

{5} 1. Determine the momentum of the following objects.

(a) an electron of mass 9.11×10^{-31} kg travelling north at 6.45×10^{6} m/s

(b) a 4.0×10^{5} kg jet travelling south at 755 km/h

{4} 2. A boat of mass 1.3×10^{2} kg has a velocity of 9.8 m/s[E44°N]. Determine the northward and eastward components of its momentum.

North ☞

East ☞

{4} 3. What impulse is exerted in each case?

(a) a force of 35 N[W] on a dynamics cart for 2.3 s

(b) the Earth pulling down on a 16 kg rock during the 4.0 s it takes to fall from a cliff

PART D: PROBLEMS (29 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

1. A student practises his batting at a local batting cage.

{4} (a) A 0.350 kg baseball is travelling at 46 m/s toward the batter. After the batter hits the ball, the ball is travelling at 62 m/s in the opposite direction. What is the impulse of the interaction?

{3} (b) If the duration of the interaction is 25 ms, what is the average force exerted on the ball by the batter?

2. A bullet with a mass of 0.012 kg, moving at 400 m/s, goes through a stationary block of wood in 4.0×10^{-4} s, emerging at a speed of 100 m/s.

{4} (a) What is the change in momentum of the bullet?

{2} (b) What impulse does the wood exert on the bullet?

{3} (c) What average frictional force does the wood exert on the bullet?

{5} 3. A 80 kg girl running at 3.5 m/s jumps onto a sled that has a mass of 10 kg and that is moving in the opposite direction to the girl, at 2.0 m/s. What will be the final velocity of the girl and the sled, assuming that she manages to hang on, that the sled is on level snow and that there is no friction?

4. A 125 kg astronaut pushes off from his 2500 kg space capsule, quickly acquiring a constant velocity of 4.0 m/s. (Assume that both the astronaut and spacecraft are at rest to begin with.)

{5} (a) What is the velocity of the space capsule, after he pushes off?

{3} (b) If he is tethered to the space capsule by a 20 m line, what time will elapse before the line becomes taut? (Hint: think relative velocities!)