PART A: MULTIPLE CHOICE (9 MARKS)

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

1. Unit wise, momentum could also be expressed as
   (a) J/s (b) J·m
   (c) N·m (d) N·s

2. A hockey puck and a curling stone are at rest on a sheet of ice (mass of puck << mass of stone). If you apply equal impulses to each of them with a hockey stick:
   (a) they will have the same acceleration.
   (b) the forces applied were equal.
   (c) they will have the same velocity, but different momenta.
   (d) they will have the same momentum but different velocities.

3. A rubber bullet R and a metal bullet M of equal mass strike a test target T with the same speed. The metal bullet penetrates the target and comes to rest inside it, while the rubber bullet bounces off the target. Which statement is true?
   (a) M and R exert the same impulse on T.
   (b) M exerts a greater impulse on T than R does.
   (c) R exerts a greater impulse on T than M does.
   (d) none of the above.

4. A 3.0 kg object moving right at 12 m/s collides head-on with a 6.0 kg object at rest. What is the velocity of the 6.0 kg object after the collision, if the 3.0 kg object rebounds to the left at 4.0 m/s? (Assume right as positive.)
   (a) +4.0 m/s (b) +8.0 m/s
   (c) -4.0 m/s (d) -8.0 m/s

5. A billiard ball, moving with speed "v", collides head-on with a stationary ball of the same mass. After the collision, the billiard ball that was initially moving is at rest. The speed of the other ball in terms of "v" is:
   (a) 0 (b) v/2
   (c) v (d) 2v

6. Consider the following statements about a collision between two bodies.
   ① The total kinetic energy remains constant throughout the collision.
   ② The total momentum remains constant throughout the collision.
   ③ The total energy remains constant throughout the collision.

   Which of the statements apply to an <u>elastic</u> collision?
   (a) ① and ② only (b) ② and ③ only
   (c) ① and ③ only (d) ①, ② and ③

7. A child rolls a superball of mass 0.025 kg (A) along a table at a speed of 2.3 m/s to collide head-on with a smaller stationary superball of mass 0.020 kg (B). If the collision is perfectly elastic, what is the velocity of each ball after the collision?
   (a) v_A = 0.26 m/s v_B = 2.6 m/s
   (b) v_A = 2.6 m/s v_B = 0.26 m/s
   (c) v_A = 0.256 m/s v_B = 2.56 m/s
   (d) v_A = 2.56 m/s v_B = 0.256 m/s

8. In an <u>inelastic</u> collision involving two interacting objects, the final kinetic energy of the system:
   (a) is always less than the initial kinetic energy of the system.
   (b) is always less than or equal to the initial kinetic energy of the system.
   (c) is always equal to or greater than the initial kinetic energy of the system.
   (d) is always greater than the initial kinetic energy of the system.

9. A glider of mass "m" travels leftward on a frictionless air track with a speed "v". It collides head-on in a completely inelastic collision with a glider that has twice its mass and half its speed moving to the right. After the collision, the combined speed of the glider system is:
   (a) 0 (b) v/3
   (c) v/2 (d) v

10. Consider the following statements about a collision between two bodies.
    ① The total momentum remains constant throughout the collision.
    ② The total kinetic energy remains constant throughout the collision.
    ③ The total energy remains constant throughout the collision.

    Which of the statements above apply to an elastic collision?
    (a) ① and ② only (b) ① and ③ only
    (c) ② and ③ only (d) ③ only

11. When there is a loss of kinetic energy during an inelastic collision, the most likely form of energy conversion is from kinetic energy to:
    (a) electricity (b) chemical
    (c) light (d) heat

PART A: MULTIPLE CHOICE (9 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (0 MARKS)

1	2	3	4	5

PART C: PROBLEMS (41 MARKS)

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

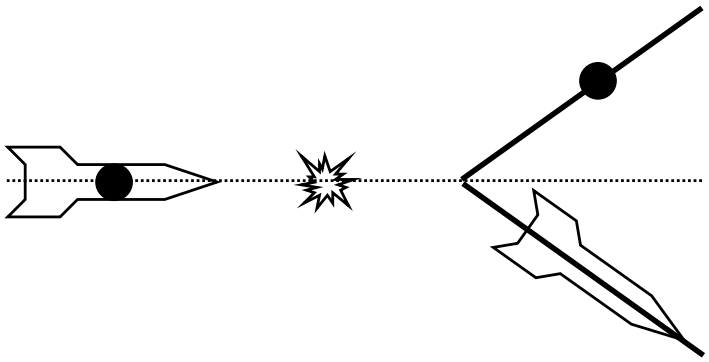
{5} 1. A 3600 kg truck travelling east at 10 m/s enters an icy intersection and collides with a 2000 kg car travelling south at 24 m/s. They become coupled together in the collision. Draw a diagram showing the initial and final situations. Be sure to include vectors to represent the velocities and their components.

2. A 0.0520 kg golf ball is moving east with a velocity of 2.10 m/s when it collides head on with a stationary 0.155 kg billiard ball. The golf ball rolls directly backward with a velocity of -1.04 m/s.

{5} (a) What was the velocity of the billiard ball after the collision?

{5} (b) Was the collision elastic? Be sure to prove your answer using energies!

3. A 2500 kg space capsule (<u>including projectile</u>) is travelling in outer space with a velocity of 250 m/s[E]. In an effort to alter its course, it fires a 250 kg projectile at a speed of 1500 m/s[N].



{3} (a) After firing it is found that the horizontal component of each object's velocity is still 250 m/s[E]. Explain why.

{5} (b) Complete the diagram showing the initial and final situations. Be sure to include vectors to represent the known and unknown velocities and their components.

{7} (c) What is the (i) new speed and (ii) direction of the space capsule?

4. A 24.0 g bullet is fired horizontally, embedding itself in a 10.0 kg block initially at rest on a horizontal ice surface. The block (with the bullet embedded) slides along the ice, coming to rest in 2.00 s at a distance of 60.0 cm from its original position. Assume that the frictional force stopping the block is constant.

{5} (a) Calculate the initial velocity of the bullet-block combination.

{4} (b) Calculate the initial velocity of the bullet.

{2} (c) Is this an elastic or inelastic collision? How do you know?