

## 2D Conservation of Momentum Problems

1. A rocket is flying along the  $+x$ -axis with a velocity of 450 m/s. While in flight, the rocket breaks up into two pieces. Piece one has a mass of 555 kg and travels with a velocity of 475 m/s at an angle of  $20^\circ$  above the  $+x$ -axis. The second piece has a mass of 445 kg and travels at an angle of  $24^\circ$  below the  $+x$ -axis. What is the magnitude of the velocity of the second piece?
2. A 900 kg car traveling east at 15 m/s collides with a 750 kg car traveling north at 20 m/s. The cars stick together. What is the magnitude of the velocity of the wreckage just after the collision?
3. An 8.0 kg mass collides elastically with a 5.0 kg mass that is at rest. Initially, the 8.0 kg mass was traveling to the right at 4.5 m/s. After the collision, it is moving with a speed of 3.65 m/s and at an angle of  $27^\circ$  to its original direction. What is the final speed and direction of motion for the 5.0 kg mass?
4. In a rugby game, Player 1 is running with the ball at 5 m/s straight down the field parallel to the edge of the field. Player 2 runs at 8 m/s an angle of  $60^\circ$  to the edge of the field, approaches Player 1 from behind, and tackles Player 1. In the tackle, Player 2 stops completely while Player 1 bounces off Player 2. Calculate the velocity (magnitude and direction) at which Player 1 bounces off Player 2. Both the players have a mass of 90 kg.
5. In a soccer game, Player 1 is running with the ball at 5 m/s across the pitch at an angle of  $75^\circ$  from the horizontal. Player 2 runs towards Player 1 at 6 m/s an angle of  $60^\circ$  to the horizontal and tackles Player 1. In the tackle, the two players bounce off each other. Player 2 moves off with a velocity in the opposite  $x$ -direction of 0.3 m/s and a velocity in the  $y$ -direction of 6 m/s. Both the players have a mass of 80 kg. What is the final total velocity of Player 1?
6. A plate is dropped such that it falls straight down onto the floor. When it hits the floor, it breaks into three pieces. The first piece ( $m = .1$  kg) moves along the  $+y$ -axis with a velocity of 1.23 m/s. The second piece moves at a velocity of .80 m/s at an angle of  $40^\circ$  below the  $+x$ -axis. The third piece moves at a velocity of .87 m/s at an angle of  $39.78^\circ$  below the  $-x$ -axis. Find the masses of the second and third piece.