Momentum and Collisions

1. A $0.2\,kg$ tennis ball moving horizontally at $25\,m/s$ hits a wall and rebounds with speed of $15\,m/s$ in the opposite direction. (a) find the impulse from the wall. (b) estimate the average force from the wall if the collision time is $0.1\,s$.

2. Three particles $m_1 = 1\,kg\,,\ m_2 = 2\,kg\,,\ m_3 = 3\,kg$ are located at $(0,1)\,,\ (4,-1)$ and $(5,3)$, respectively. (a) Locate the CM. (b) Where would you place the 4th particle with $m_4 = 3\,kg$ to have the CM at $(0,0)$?

3. A $5\,g$ bullet with speed of $400\,m/s$ gets stuck in a $1\,kg$ wooden block (originally not moving). (a) Classify the collision. (b) Find the new speed of block+bullet.

4. Suppose, in the previous problem the bullet does not get stuck but emerges on the other side of the block with speed of $100\,m/s$ (in the same x-direction). Find the speed of the block.

5. The same bullet-through-block problem, but the bullet emerges from the block at $100\,m/s$ deflected by 60^o from the original x-direction. Find the x and y components of the velocity of the block.

6. Now, originally the block is also moving at $4\,m/s$ but in the y-direction. The bullet hits the block and gets stuck. Find the direction of the resulting motion.