Physics 101 – Spring'24

Sect.04_V1

QUIZ 8

Name:	
ID:	
Total Score (out of 10 pts):	

-4/10 points for attending-

Question 1 (6/10 points)

Two solid spheres of masses m_a=10.0 gr, m_b=30.0 gr collide elastically with each other. Velocities of each sphere are given as v_a=2 m/s towards right and v_b=4 m/s towards left before the collision. Find the velocity of each sphere after the collision.

Solution

Since the collusion is elastic, both the kinetic energy and the momentum will be conserved before and after the collusion.

Before

$p_i = m_a v_a - m_b v_b$

$K_i = \frac{1}{2} m_a v_a^2 + \frac{1}{2} m_b v_b^2$

After

$p_f = m_a v_{af} + m_b v_{bf}$

$K_f = \frac{1}{2} m_a v_{af}^2 + \frac{1}{2} m_b v_{bf}^2$

$p_i = 10.0\,gr \times 2\,m/s - 30.0\,gr \times 4\,m/s$

$= -100\,gr\,m/s$

$K_i = 20\,gr\,m^2/s^2 + 240\,gr\,m^2/s^2 = 260\,gr\,m^2/s^2$

$-100\ m/s = 10.0\,v_{af} + 30.0\,v_{bf}$

$-10\,m/s = v_{af} + 3v_{bf}$

$260\,m^2/s^2 = \frac{1}{2} \cdot 10.0\,v_{af}^2 + \frac{1}{2} 30.0\,v_{bf}^2$

$520\,m^2/s^2 = 10.0\,v_{af}^2 + 30.0\,v_{bf}^2$

$* \quad 52\,m^2/s^2 = v_{af}^2 + 3v_{bf}^2$

$v_{af} = -10\,m/s - 3v_{bf}$

$52\,m^2/s^2 = 100\,m^2/s^2 + 60 v_{bf}\,m/s + 9 v_{bf}^2 + 3v_{bf}^2$

$v_{bf}^2 + 60 v_{bf} + 48\,m^2/s^2 = 0$

$v_{bf} = -2\,m/s$ or $-8\,m/s$ (not physical)

$v_{af} = -4\,m/s$