Physics 11

**Momentum Practise Questions**

1. What momentum would a 250 kg go cart have travelling at 56 km/h?
   \[ p = m \cdot v = 250 \text{ kg} \times 15.56 \text{ m/s} \]
   \[ = 3900 \text{ kg m/s} \]

2. What force would have to be applied in 1.4 s to stop a 240 kg bear travelling at 4.5 m/s?
   \[ F \times t = \Delta p \]
   \[ F = \frac{m_2 v_2 - m_1 v_1}{t} = \frac{0 - 240 \times 4.5}{1.4} \]
   \[ F = -770 \text{ N} \]

3. A 2.3 kg steel ball travelling at 7.8 m/s due east hits a brick wall and rebounds off the wall with a speed of 2.5 m/s. The ball was in contact with the wall for 0.16 s. What force did the wall impart to the ball?
   \[ F \times t = \Delta p = m_2 v_2 - m_1 v_1 \]
   \[ F = \frac{(2.3 \times -2.5) - (2.3 \times 7.8)}{0.16} \]
   \[ = \frac{-5.75 - 17.94}{0.16} \]
   \[ = \frac{-23.69}{0.16} \]
   \[ F = -150 \text{ N} \]

4. A 2.3 kg rifle initially at rest fires a 0.045 kg bullet with an initial speed of 670 m/s. What is the recoil speed of the rifle?
   \[ p_b = p_r \quad \text{(conservation of momentum)} \]
   \[ 0 = m_1 v_1 + m_2 v_2 \]
   \[ (\text{rifle}) \quad (\text{bullet}) \]
   \[ 0 = 2.3 \times v + 0.045 \times 670 \]
   \[ v = \frac{-30.15}{2.3} = -13 \text{ m/s} \]

5. What speed would a 0.0045 kg superfly have to have to stop a 23,000 kg truck travelling in the opposite direction at 9.0 m/s? (Note: The fly and truck are completely stopped ‘Wrecked!’ during this collision)
   \[ p_0 = p_a \]
   \[ m_1 v_1 + m_2 v_2 = 0 \]
\[ m_1v_1 + m_2v_2 = 0 \]
\[ (23000 \times 9.0) + (0.0045 \times v) = 0 \]
\[ - \frac{207000}{0.0045} = v \]
\[ -4.6 \times 10^5 \text{ m/s} = v \]

(\textit{Wow!!!})

6. A 230 kg sled travelling at 3.4 m/s to the right hits a stationary 35 kg girl. The girl ends up on the sled. With what initial speed will the sled move off at?

\[ P_b = P_a \]
\[ m_1v_1 = (m_1 + m_2) v \]
\[ \frac{230 \times 3.4}{(230 + 35)} = v \]
\[ 3.0 \text{ m/s} = v \]

7. A 230 kg miniature train consists of a 150 kg engine and a 80 kg car. The train is travelling at 4.0 m/s due east when a small explosion causes the engine to break away from the car and travel at 7.3 m/s due east. What is the speed and direction of the car?

\[ P_b = P_a \]
\[ (m_1 + m_2) v' = m_1v_1 + m_2v_2 \]
\[ 230 \times 4.0 = 150 \times 7.3 + 80 \times v \]
\[ 920 = 1095 \]
\[ 920 - 1095 = 80 \times v \]
\[ \frac{-175}{80} = v \]
\[ -2.2 \text{ m/s} = v \]

West -!