5) Calculate the recoil velocity of a 5200g rifle that shoots a 20 g bullet at a speed of 620 m/s.

* Hard Question

For Next Class - Conservation of Momentum 5.3

$m_1 V_1 = m_2 V_2$

$m_B V_B + m_R + V_R = m_B V_B' + m_R V_R'$

$0 + 0 = m_B V_B' + m_R V_R'$

$-m_B V_B' = m_R V_R'$

$m_B = 20g = 0.020kg$

$m_R = 5.2kg$

$V_B = 620\ m/s$

$-\frac{m_B V_B'}{m_R} = V_R'$

$-\frac{(.020kg)(620m/s)}{5.2\ kg} = -2.5\ m/s = V_R$

just means the recoil is in the opposite direction of the bullet

Physics 11 - Practice Questions

Unit: 5.2 Momentum - Impulse

$\vec{p} = m\vec{v}$ $\Delta p = \vec{F}\Delta t = m\Delta\vec{v} = \vec{J}$

1) A 45 g ball is hit and leaves the tee at 40 m/s. Find the impulse imparted by the club to the ball and the change in momentum.

$\Delta p = m\Delta v$

$m = 45g = 0.045kg$

$\Delta\vec{v} = 40m/s$

$\Delta p = (0.045)(40)$

$\boxed{\Delta p = 1.8\ kg \cdot m/s}$

$\vec{J} = \vec{F}\Delta t = \Delta\vec{p} = m\Delta v$

$m = 0.045kg$

$v = 40\ m/s$

$\vec{J} = (0.045)(40\ m/s)$

$\boxed{\vec{J} = 1.8\ N \cdot s}$

2) What is the impulse needed to change the velocity of a 10.0 kg object from 12.6 m/s to 25.5 m/s in a time of 5.0s. How much force is needed?

$\vec{J} = \vec{F}\Delta t = m\Delta\vec{v}$

$m = 10kg$

$\Delta v = 12.9\ m/s$

$\Delta t = 5.0s$

$J = (10)(12.9)$

$J = 129\ N \cdot s$

$F\Delta t = mv$

$F = \frac{mv}{\Delta t}$ $\frac{(10)(12.9)}{5}$

$\boxed{F = 25.8\ N}$

3) What is the impulse of a 55 N force exerted over a time interval of 1.0 ~~m/s~~? ms

$\vec{J} = \vec{F}\Delta t$

$\vec{F} = 55\,N$

$t = 1.0\,ms \times \frac{1\,s}{1000\,ms} = 0.001\,s$

$\vec{J} = (55\,N)(0.001\,s)$

$\boxed{\vec{J} = 0.055\,N\cdot s}$

4) Calculate the impulse experienced when a 70 kg person lands on from ground after jumping from a height of 3.0m.

Kinematics $V_f^2 = V_i^2 + 2a(Y_f - Y_i)$ $\quad a = -g = -9.8\,m/s^2$

$V_i = 0$

$V_f^2 = 2(-9.8)(3.0\,m)$ $\quad Y_f - Y_i = 3.0\,m$

$V_f^2 = 58.8$

$V_f = \sqrt{58.8} = -7.7\,m/s$

$\vec{J} = \vec{F}\Delta t = \Delta p = m\Delta v$

$J = (70\,kg)(-7.7\,m/s) = 540\,N\cdot s$