

1 Mass of gun = 20 kg

Mass of bullet = 0.2 kg.

It can fire 10 bullets per second.

Muzzle speed of bullet = 150 m/s.

Recoil velocity of gun = ?

Force required to hold the gun.

$$F = v \frac{dm}{dt} = \frac{200}{1000} \times 10 = 2 \text{ kg/s}$$

$$F = 150 \times 2 = 300 \text{ N}$$

300 N of force will be required to hold the gun in position.

To prove law of conservation of linear momentum.

According to conservation of linear momentum for an object, the total momentum is conserved until an external force acts on it.

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

If 2 balls collide -

$$P_1 = m_1 u_1$$

$$P_2 = m_2 u_2$$

Total momentum before collision = $m_1 u_1 + m_2 u_2$

$$F_1 = F_2$$

After collision velocity changes

$$P_1 = m_1 v_1$$

$$P_2 = m_2 v_2$$

Total ~~momentum~~ momentum \textcircled{P}

$$m_1 v_1 + m_2 v_2$$

From Newton's 2nd law

$$F_1 = m_2 v_2 - m_2 u_2 / t$$

$$F_2 = m_1 v_1 - m_1 u_1 / t$$

From Newton's 3rd law

$$F_1 = F_2$$

Therefore $m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$

3. When a bomb explodes due to internal forces after collision $m_1 v_1 + m_2 v_2 = 0$
 $m_1 v_1 = -m_2 v_2$ so all the pieces will fly in opposite directions.

4.

1. Mass of Obj = 1.5 kg.

Vel = 5 m/s

Collides with a wooden block of Mass = 5 kg.

$$P_1 = m_1 v_1 = 7.5 \text{ kg m/s}$$

$$m_2 = 5 \text{ kg}$$

$$v_2 = \frac{7.5}{5} = 1.5$$

After collision total momentum = 7.47 kg m/s