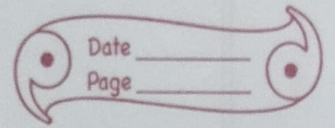


# PHYSICS



1) mass of bullet =  $0.2 \text{ kg} = m_B$

mass of gun =  $20 \text{ kg} = m_G$

muzzle speed of bullet =  $150 \text{ m/s} = v_B$

Let recoil velocity of gun =  $v \text{ m/s} = v_G$

Initial momentum of bullet =  $0 \text{ kg m/s} = P_B$

Initial momentum of gun =  $0 \text{ kg m/s} = P_G$

Let final momentum of bullet be =  $P'_B$

Let final momentum of gun be =  $P'_G$

By law of conservation of momentum:

$$P_B + P_G = P'_B + P'_G$$

$$= 0 + 0 = P'_B + P'_G$$

$$= 0 = P'_B + P'_G$$

$$= 0 = m_B \times v_B + m_G \times v_G$$

$$= 0 = 0.2 \times 150 + 20 \times v_G$$

$$= 0 = 30 + 20 \times v_G$$

$$= -30 = 20v_G$$

$$= v_G = \frac{-30}{20}$$

$$= -1.5 \text{ m/s}$$

Hence recoil velocity is  $-1.5 \text{ m/s}$ .

No. of bullets can be fired by gun per second = 10

Hence Force required to hold the gun

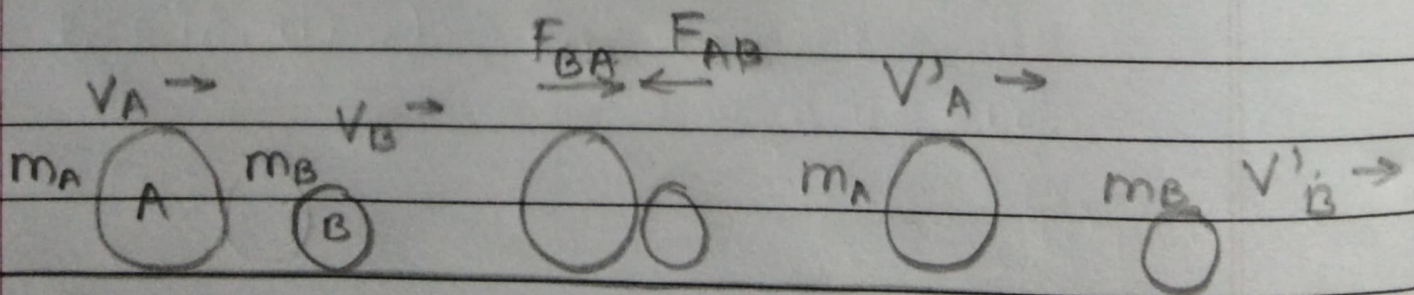
$$= n m_B v_B' = n m_G v_G'$$

$$= 10 \times 0.2 \times 150$$

$$= 300 \text{ N}$$

∴ Force required to hold the gun is 300N.

- 2) If two or more objects apply force on each other with no external force, their final momentum remains same as initial momentum. This is called as law of conservation of momentum.



## PROOF OF LAW OF CONSERVATION OF MOMENTUM

Date \_\_\_\_\_

Page \_\_\_\_\_

Consider two bodies A and B of mass  $m_A$  and  $m_B$  moving with velocities  $v_A$  and  $v_B$ . Their initial momentum are  $P_A$  and  $P_B$ . Let the bodies collide, get apart and move with velocities  $v_A'$  and  $v_B'$  and attain final momentum of  $P_A'$  and  $P_B'$ .

By using Newton's Second law

$$F_{AB} \Delta t = P_A' - P_A, \text{ and}$$

$$F_{BA} \Delta t = P_B' - P_B$$

Now, using Newton's third law,

$$= F_{AB} = -F_{BA}$$

= multiplying  $\Delta t$  to both sides

$$= F_{AB} \Delta t = -F_{BA} \Delta t$$

$$= P_A' - P_A = -(P_B' - P_B)$$

$$= P_A' - P_A = -P_B' + P_B$$

$$= P_A' + P_B' = P_A + P_B$$

Hence the final momentum

Hence, as the sum of final momentums of two bodies is equal to sum of initial momentum of two bodies without presence of any external force, the law of conservation of momentum is proved.

- 3) When a bomb blasts, the chemicals inside the bomb produces a blast of high velocity hot gases. These gases move in all directions with great velocity. To conserve the total momentum of gases the parts break away and fly off in different directions with great velocities.

### Home Assignment - 2

i) 3) 7.5 kg m/s

ii) 3) 1.15 m/s.