Hw
9/8/21

ODM CONNECT APP HOMEWORK

Q1. A 20 Kg ~~bullet~~ gun can fire 10 bullets per second. Mass of each bullet is 0.2 kg. The muzzle speed of the bullet is 150 m/s. What is the recoil velocity of the gun? How much force is required to hold the gun?

Ans) $F = nmu = nMv$

1 sec = 10 bullets

1 bullet = $\frac{1}{10}$ secs

Given:- $M = 20\ kg$, $m = 0.2\ kg$, $u = 150\ m/s$, $v = ?$

Mass of the gun = $M = 20kg$

Mass of the bullet = $m = 0.2kg$

Now,

we know $Mv + mu = 0$

$\Rightarrow v = \frac{-mu}{M}$

$\Rightarrow |v| = \left|\frac{mu}{M}\right|$

$\Rightarrow v = \frac{0.2 \times 150}{20}$

$\Rightarrow \boxed{v = 1.5\ m/s}$

$F = nMv = 10 \times 20 \times 1.5 = \boxed{300\ N}$

∴ The recoil velocity of the gun is 1.5 m/s and 300N force is required to hold the gun.

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Q2. State & prove law of conservation of linear momentum.

CONSERVATION OF MOMENTUM :-

Example : Bullet fired from a Rifle,

Initially, total momentum = 0

Later, the trigger is pulled, bullet gains momentum in a direction, but this is cancelled by rifle's momentum.

Therefore, total momentum = 0

During the process, the chemical energy in gunpowder gets converted into heat, sound and chemical energy.

Let after firing; the velocity of bullet (of mass m) = u

The recoil velocity of the gun (of mass M) = v

By conservation of linear momentum; $Mv + mu = 0$

$\Rightarrow \boxed{v = \frac{-mu}{M}}$ = recoil velocity of gun

Before firing	After firing
$m \times 0 + M \times 0$	$mu + Mv$

$\Rightarrow mu + Mv = m \times 0 + M \times 0$

$\Rightarrow mu + Mv = 0$

$\Rightarrow Mv = -mu$

$\Rightarrow \boxed{v = \frac{-mu}{M}}$

If n bullets are fired per second,

then interaction time between gun and each bullet =

$= (1/n)s$

So magnitude of force between gun and each bullet =

$= \left[\frac{mu}{\frac{1}{n}}\right] = [nmu] = [nMv]$

$mu - 0$

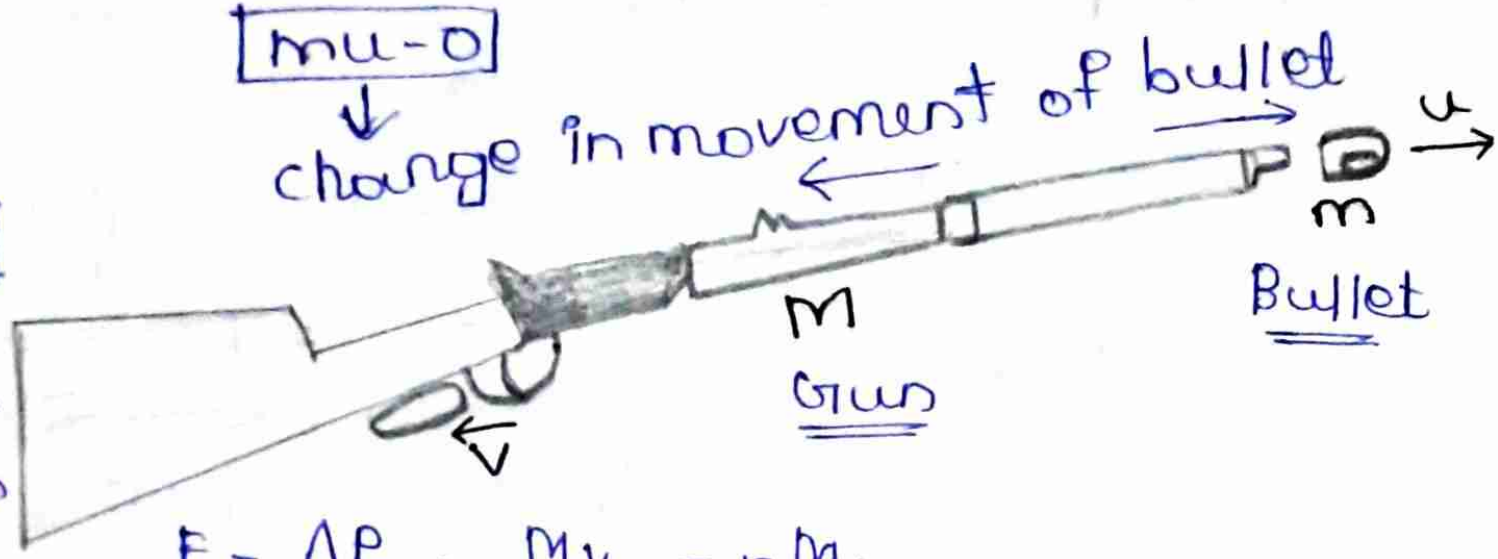
↓

change in movement of bullet

$M_v - 0$

↓

change in momentum of gun



$$F = \frac{\Delta P}{\Delta t} = \frac{Mv}{1/n} = nMv$$

1 sec = n bullets fired

1 bullet = $\frac{1}{n}$ secs

time taken

Q3. A bomb explodes into several parts. why these parts fly off in different directions?

Ans) Exploding of bomb is due to the internal force. As there is no role of the internal forces, so the momentum is conserved. Hence, when a bomb explodes into several parts, the parts fly off in different directions as no external force is acting on it.

Q4. An object of mass 1.5 kg travelling in a straight line with a velocity of 5 m/s collides with a wooden block of mass 5 kg resting on the floor. This object sticks with wooden block after collison and both move together in a straight line.

(a) The total momentum after collision is -

i) 3.5 kg m/s

ii) 1.5 kg m/s

iii) 7.5 kg m/s ✓

iv) 2 kg m/s

(b) The velocity of the combination of these objects after collision is -

i) 8.5 m/s ii) 9.5 m/s iii) 1.15 m/s iv) 1.5 m/s