WS-9 → Inelastic collision

8th foundation

Thakle

(1)

Given $m_{man} = 64 kg$; $u_{man} = 5.4$ kmph.

$M_{cart} = 32$ kg ; $u_{cart} = -1.8$ kmph.

After jumping into the cart both man + cart move with same velocity $V_{cart} = V_{man} = V_{com}$.

According to law of conservation of linear momentum

$$M_{man} u_{man} + M_{cart} u_{cart} = M_{man} V_{man} + M_{cart} V_{cart}$$

$$\Rightarrow 64 \times 5.4 + 32(-1.8) = 64 V_{com} + 32 V_{com}$$

$$\Rightarrow \cancel{32} \times \overset{0.6}{\cancel{1.8}} [2 \times 3 - 1] = \overset{3}{\cancel{96}} V_{com}$$

$$\Rightarrow 0.6 [6-1] = V_{com} \quad \Rightarrow V_{com} = 0.6 \times 5 = 3 \text{ kmph}$$

(2)

let m_1, m_2 are the masses of bullet and block.

Here $u_1 \to$ initial velocity of bullet $u_1 = 120$ m/s

$u_2 \to$ initial velocity of block $u_2 = 0$

Given $m_2 = 11 m_1$.

After collision both move with same velocity

$V_1 = V_2 = V_{com}$

According to law of conservation of linear momentum

$$m_1 u_1 + m_2 u_2 = m_1 V_1 + m_2 V_2.$$

$\Rightarrow m_1(120) + m_2(0) = m_1 V_{com} + 11 m_1 V_{com}$

$\Rightarrow 120\, m_1 = 12\, m_1 V_{com}$

$\Rightarrow V_{com} = \frac{120}{12} = 10\ m/s \rightarrow D$

(3)

let $m_1 = 10\ kg$; $m_2 = 4\ kg$; $u_2 = 0$

let $u_1 = u$ be the initial velocity of I^{st} body.

$k = k \cdot E_1 =$ kinetic Energy of I^{st} body $= \frac{1}{2} m_1 u_1^2 = E$

$\Rightarrow \frac{1}{2} 10 (u)^2 = E$

$\Rightarrow 5u^2 = E$

we know during collision loss of k.E of m_1

is $= k\left[\frac{m_2}{m_1+m_2}\right] = E\left[\frac{4}{10+4}\right] = \frac{4E}{14} = \frac{2E}{7}$

Final velocity of I^{st} body

$$V_1 = \frac{2m_2u_2 + (m_1 - m_2)u_1}{(m_1+m_2)}$$

$$\Rightarrow u_1 = \frac{2m_2(0) + (10-4)u_1}{10+4}$$

$$\Rightarrow V_1 = \frac{6}{14} u_1 = \frac{3}{7} u_1$$

$\therefore$ k.E left with first body $= \frac{1}{2} m_1 V_1^2 - \frac{1}{2} m_1 u_1^2$

$$\Rightarrow \frac{1}{2} m_1 (V_1^2 - u_1^2) = \frac{1}{2} \times 10 \left[\frac{9}{49} u_1^2 - u_1^2\right]$$

$$= \frac{1}{2} \times 10 u_1^2 \left(\frac{9}{49} - 1\right)$$

$$= \boxed{E \times \frac{40}{49}} \rightarrow D$$

(4)

we know that mass $\propto$ volume

$\Rightarrow m \propto \frac{4\pi}{3} r^3$ For sphere

$\Rightarrow m \propto r^3$.

let $r_1 = r$; $r_2 = 2r$.

& mass of first sphere $m_1 \propto r_1^3 \Rightarrow m_1 = k r_1^3$

$\Rightarrow m_1 = k r^3$ and it is

at rest $\therefore u_1 = 0$.

mass of 2nd sphere $m_2 \propto r_2^3 \Rightarrow m_2 = k r_2^3$

$\Rightarrow m_2 = k(2r)^3$

$\Rightarrow m_2 = 8kr^3$; $u_2 = 36$ m/s

After collision both bodies move with same velocity

(ie) $v_1 = v_2 = v_{com}$.

According to law of conservation of linear momentum

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

$\Rightarrow kr^3(0) + 8kr^3(36) = kr^3 v_{com} + 8kr^3 v_{com}$

$\Rightarrow 8\cancel{kr^3}(\overset{4}{\cancel{36}}) = \cancel{9}\cancel{kr^3} v_{com}$

$\Rightarrow v_{com} = 8 \times 4 = 32$ m/s

(5)

let $m_1 = m_2 = 0.06$ kg ; $u_2 = -8$ m/s ; $u_1 = 8$ m/s

Here two bodies are identical so after collision they simply exchange their velocities (ie) $v_1 = -8$ m/s ; $v_2 = 8$ m/s

change in momentum $= m(v - u)$

$= 0.06[-8-8] = -0.96$ kg m/s

-ve sign shows direction of change in momentum

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(3)

(6)

velocity of neutron $u_1 = 10^6$ m/s

mass of nucleus $m_2 = 80m \rightarrow u_2 = 0$

mass of neutron $m_1 = m$

According to law of conservation of linear momentum

$\Rightarrow m_1 u_1 + m_2 u_2 = m_1 V_1 + m_2 V_2$

$\Rightarrow m \times 10^6 + 80(0) = -mV_1 + 80m V_2$

$\Rightarrow m \times 10^6 = 80m V_2 - mV_1$ After collision neutron

$\Rightarrow 10^6 = 80V_2 - V_1 \rightarrow (1)$ reflected back so

V_1 is $-ve$

For elastic coefficient of restitution $e = 1$

$e = \frac{V_2 - V_1}{u_1 - u_2} \Rightarrow 1 = \frac{V_2 + V_1}{u_1}$

$\Rightarrow V_1 + V_2 = u_1 \Rightarrow V_1 + V_2 = 10^6 \rightarrow (2)$

By solving (1) and (2) we get

$$\cancel{V_1} + V_2 = 10^6$$
$$-\cancel{V_1} + 80V_2 = 10^6$$
$$81V_2 = 2 \times 10^6 \Rightarrow \boxed{V_2 = \frac{2}{81} \times 10^6 \text{ m/s}}$$

By sub V_2 in (2) we get

$\Rightarrow V_1 + \frac{2}{81} \times 10^6 = 10^6 \Rightarrow V_1 = 10^6 - \frac{2 \times 10^6}{81}$

$\Rightarrow \boxed{V_1 = \frac{79}{81} \times 10^6 \text{ m/s}}$

Fraction of Energy retained $= \left[\frac{V_1}{u_1}\right]^2 = \left(\frac{\frac{79}{81} \times 10^6}{10^6}\right)^2$

$= \left[\frac{79}{81}\right]^2$ (or) we can use $\left[\frac{m_2 - m_1}{m_2 + m_1}\right]^2$

(7)

Given mass of bag $m_1 = m$

mass of bullet $m_2 = \frac{m}{40}$

Initial velocity of bullet $u_2 = v$.

Initial velocity of bag $u_1 = 0$

After collision both move with same velocity

i.e. $v_1 = v_2 = v_{com}$

According to law of conservation of linear momentum

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

$$\Rightarrow m(0) + \frac{m}{40} v = m v_{com} + \frac{m}{40} v_{com}$$

$$\Rightarrow \frac{\cancel{m} v}{\cancel{40}} = \frac{41 \cancel{m} v_{com}}{\cancel{40}} \Rightarrow 41 v_{com} = v$$

$$\Rightarrow \boxed{v_{com} = \frac{v}{41}}$$

(8)

let $m_1 = 10^5$ kg $\rightarrow$ $u_1 = 0.5$ m/s

$m_2 = 2\times10^5$ kg $\rightarrow$ $u_2 = 0$

After dumping velocity of railway wagon + coal is same. $v_1 = v_2 = v_{com}$

According to law of conservation of linear momentum

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

$$\Rightarrow 10^5 \times 0.5 + 2\times10^5 (0) = 10^5 v_{com} + 2\times10^5 v_{com}$$

$$\Rightarrow \cancel{10^5} \times 0.5 = 3\times\cancel{10^5} v_{com}$$

$$\Rightarrow v_{com} = \frac{0.5}{3} = \underline{0.167 \text{ m/s}}$$

(9)

let mass of shot $m_1 = m$

mass of block $m_2 = 13m$

Initial velocity of shot $u_1 = 140$ m/s

Initial velocity of wooden $u_2 = 0$.

After collision both block + shot move with same velocity $v_1 = v_2 = v_{com}$

According to law of conservation of linear momentum

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

$$\Rightarrow m(140) + 13m(0) = m\, v_{com} + 13m\, v_{com}$$

$$\Rightarrow \cancel{m} \times \cancel{140}^{10} = \cancel{14}\cancel{m}\, v_{com}$$

$$\Rightarrow v_{com} = 10 \text{ m/s}$$

(10)

According to law of conservation linear momentum

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2 \text{ --(1)} \Rightarrow m_1(u_1 - v_1) = m_2(v_2 - u_2) \text{ --(1)}$$

$$K.E_{Before} = \frac{1}{2} m_1 u_1^2 + \frac{1}{2} m_2 u_2^2$$

After collision $K.E_{After} = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m v_2^2$

loss of kinetic energy for $m_1 = \frac{1}{2} m_1 u_1^2 - \frac{1}{2} m_1 v_1^2 = \Delta K.E_1$

for $m_2 = \frac{1}{2} m_2 u_2^2 - \frac{1}{2} m_2 v_2^2 = \Delta K.E_2$

Since both bodies lose same amount of energy

$$\Delta K.E_1 = \Delta K.E_2$$

$$\Rightarrow \frac{1}{2} m_1 u_1^2 - \frac{1}{2} m_1 v_1^2 = \frac{1}{2} m_2 u_2^2 - \frac{1}{2} m_2 v_2^2$$

$$\Rightarrow m_1(u_1^2 - v_1^2) = m_2(u_2^2 - v_2^2)$$

10th continuation

$$\Rightarrow m_1(u_1-v_1)(u_1+v_1) = m_2(u_2-v_2)(u_2+v_2) \rightarrow (2)$$

By $\frac{(2)}{(1)}$ $$\frac{\cancel{m_1}\cancel{(u_1-v_1)}(u_1+v_1)}{\cancel{m_1}\cancel{(u_1-v_1)}} = \frac{\cancel{m_2}(u_2-v_2)(u_2+v_2)}{\cancel{m_2}(v_2-u_2)}$$

$$\Rightarrow v_1+u_1 = \frac{\cancel{(u_2-v_2)}}{-(u_2-v_2)}(u_2+v_2)$$

$$\Rightarrow v_1+u_1 = -(u_2+v_2)$$

$$\Rightarrow v_1+u_1+u_2+v_2 = 0$$

(19)

let 'M' be the mass of bomb. which is initially at rest $u=0$

After explosion, $m_1 = m_2 = m_3 = \frac{M}{3}$

$v_1 = 9$ m/s, $v_2 = 12$ m/s.

momentum of third particle $= \sqrt{P_1^2 + P_2^2}$

$$\Rightarrow P_3 = \sqrt{(m_1v_1)^2 + (m_2v_2)^2}$$

$$\Rightarrow P_3 = \sqrt{\left[\frac{m \times 9}{3}\right]^2 + \left[\frac{12m}{3}\right]^2}$$

$$\Rightarrow P_3 = \frac{M}{3}\sqrt{9^2+12^2} = \frac{M}{3}\sqrt{81+144}$$

$$= \frac{M}{3}\sqrt{225} = \frac{M}{\cancel{3}} \times \cancel{15}\,5$$

$$\Rightarrow \frac{M}{3}v_3 = 5m$$

$$v_3 = 15 \text{ m/s}$$

(20)

Total momentum After collision $= m_1V_1 + m_2V_2 + m_3V_3$

$\Rightarrow \frac{M}{3}(9) + \frac{M}{3}(12) + \frac{M}{3}(15)$

$\Rightarrow \frac{M}{3}[9 + 12 + 15]$

$\Rightarrow \frac{M}{3} \times 36 = 12M$ NS

(11)

let 'M' be the original mass of bomb at rest i.e $u = 0$

$\therefore$ It's momentum $p = Mu = M(0) = 0$

If it is break up into two pieces of masses m_1 & m_2 flies with velocities V_1 & V_2 respectively.

According to law of conservation of linear momentum

momentum Before explosion = momentum after explosion

$\Rightarrow M(0) = m_1V_1 + m_2V_2$

$\Rightarrow 0 = m_1V_1 + m_2V_2$

$\Rightarrow m_1V_1 = -m_2V_2$

$\Rightarrow m \propto \frac{1}{V}$

(12)

At the time of collision of two billiard balls, the K.E of the balls is not conserved and will get converted into P.E.

$\therefore$ Total K.E of the billiard balls before collision will always be greater than that after collision.

(13)

let $m_1 = m$; $m_2 = nm$; $u_2 = 0$.

$u_1 \rightarrow$ initial velocity of I^{st} ball.

In collision, the energy transferred to the 2^{nd} body is

$$\frac{4m_1m_2}{(m_1+m_2)^2} \Rightarrow \frac{4m(nm)}{(nm+m)^2} = \frac{4n\cancel{m^2}}{(n+1)^2\cancel{m^2}}$$

$$= \frac{4n}{(n+1)^2}$$

(14)

In any collision, the system's momentum is maintained, but the momentum of individual objects is lost due to the force of impact.

when two identical balls travelling at the same speed in opposite directions collide elastically, no energy is transferred from one body to the other.

$\rightarrow$ Any collision must involve impulsive force acting on the bodies.

(15)

As the velocity of approach and velocity of seperation is equal in the case of ball hitting the wall it is elastic collision. The collision between ball and bus is perfectly inelastic because in perfect inelastic collision bodies move together.

$$\Rightarrow \quad v_1 + v_2 = 0 \quad \Rightarrow \quad v_1 = -v_2 .$$

(18)

we know that in an inelastic collision $[e=1]$

velocities of the bodies after collision

$$v_1 = \left[\frac{(m_1 - e m_2) u_1 + m_2 (1+e) u_2}{m_1 + m_2} \right]$$

$$v_2 = \left[\frac{(m_2 - e m_1) u_2 + m_1 (1+e) u_1}{m_1 + m_2} \right]$$

For $m_1 = m_2$; $\cancel{u_2 = 0}$

$$v_1 = \frac{[(m_1 - m_1) u_1 + m_1 (1+1) u_2]}{m_1 + m_1} = 0 + \frac{2 m_1}{2 m_1} u_2$$

$v_1 = u_2 \rightarrow$ initial velocity of 2nd body

$$\& \quad v_2 = \frac{[(m_1 - m_1) u_2 + m_1 (1+1) u_1]}{m_1 + m_1} = \frac{2 m_1 u_1}{2 m_1} = u_1$$

$v_2 = u_1 \rightarrow$ initial velocity of Ist body

so two bodies exchange their velocities

If $u_1 = 0$; $u_2 = U$. $m_2 >> m_1$

So m_1 can be neglected

$$v_1 = \left[\frac{(m_1 - m_2)(0) + m_2(1+1)U}{m_1 + m_2} \right]$$

$$v_1 = \frac{2m_2 U}{m_2} = 2U \rightarrow$$

velocity of smaller body after collision.

If $u_2 = 0$ $m_2 >> m_1$; m_1 can be neglected

$$v_1 = \left[\frac{(m_1 - m_2) u_1 + m_2 (1+1)(0)}{m_1 + m_2} \right]$$

$$v_1 = \frac{-m_2 u_1}{m_2} \Rightarrow v_1 = -u_1$$

smaller body rebounds with same velocity

<u>LTask</u> [CUQ's]

① It's a fact that in an oblique elastic collision of two bodies of equal masses, the velocity along the common normal gets exchanged and velocity along the direction perpendicular to the common normal remains unchanged. So the 1st particle will give its velocity along common normal to the 2nd particle and will start moving in the direction of common normal, whereas the velocity of the 1st particle remains unchanged along the direction perpendicular to common normal. Thus they move in mutually perpendicular directions

(2)

Since the velocity before and after collision change hence momentum of the ball will change.

In inelastic collision a part of the mechanical energy is lost.

Taking earth and the ball as a system there is no external force on the system. hence the total momentum of the ball and the earth is conserved.

(3)

After bullet is embedded in a solid block. After collision both bullet + block move with same velocity

So the collision is inelastic

So only momentum is conserved.

(7)

As per question, the rubber ball rebounds while the metal ball does not. So if m and v be the mass and velocity respectively, the change in momentum of rubber ball $= m(v-u)$

$= m(-u-u)$

$= -2mu$

The change in momentum of metal ball $= m(v-u)$

$[\because v=0]$

$= mv.$

The rubber ball suffers almost twice the change in momentum as experienced by the metal ball.

(10)

A neutron collides elastically head on with the nucleus of an atom.

$u_1 = u ; u_2 = -u . , V_1 = V_2 = V.$

According to law of conservation of linear momentum

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

$$\Rightarrow m_1 u + m_2 (-u) = m_1 V + m_2 V$$

$$\Rightarrow u(m_1 - m_2) = V(m_1 + m_2)$$

we know $\cancel{v_1 = \frac{(m_1 - m_2)u_1 + 2m_2 u_2}{m_1 + m_2}}$

$$v = \frac{u(m_1 - m_2)}{m_1 + m_2} = u\left(\frac{1-A}{1+A}\right)$$

Now the fraction of K.E retained is $= \frac{\frac{1}{2}m_1 v_1^2}{\frac{1}{2}m_1 u_1^2}$

$$= \frac{v_1^2}{u_1^2} = \frac{u^2\left[\frac{1-A}{1+A}\right]^2}{u^2}$$

$$= \left[\frac{A-1}{A+1}\right]^2$$

Jee mains level

(11)

let $m_1 = 3\,kg$; $u_1 = 4\,m/s$; $m_2 = 2\,kg$ $u_2 = 0$

$v_1 = 4.5\,m/s$

According to law of conservation of linear momentum

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

$$\Rightarrow 3 \times 4 + 2(0) = 3 \times \cancel{4.5}\, v_1 + 2(4.5)$$

$$\Rightarrow 12 = \cancel{13.5}\; 3v_1 + 9 \Rightarrow 3v_1 = 3$$

$$\Rightarrow v_1 = 1\,m/s$$

(12)

let $m_1 = 1\,kg \rightarrow u_1 = 50\,m/s$

$m_2 = 2\,kg \rightarrow u_2 = -40\,m/s$

we know

$$u_2 = \frac{2 m_1 u_1 + (m_1 - m_2) u_2}{m_1 + m_2}$$

$$\Rightarrow V_2 = \frac{2 \times 1 \times 50 + (2-1) \times (-40)}{1+2}$$

$$\Rightarrow \frac{100 - 40}{3} = \frac{60}{3} = 20\,m/s$$

change in momentum of 2 kg mass

$$= m_2 (V_2 - u_2)$$

$$= 2\,[20 - (-40)]$$

$$= 120\ kg\,m/s$$

(13)

Given $M_{gun} = 10\,kg$; $m_{bullet} = 10\,gm = 10 \times 10^{-3}\,kg = 10^{-2}\,kg$

$V_{recoil} = ?$ $\quad u_{bullet} = 200\,m/s$

$$\therefore V_{recoil} = -\frac{M_{bullet}\, u_{bullet}}{M_{gun}}$$

$$= \frac{10^{-2}}{10} \times 200 = 0.2\,m/s$$

(14)

Given $m_A = 60\,kg$; $m_B = 40\,kg$

$V_B = -4.5\,m/s$ [-ve' for South]

According to law of conservation of linear momentum

$$m_A u_A = -m_B V_B$$

$$\Rightarrow \overset{3}{\cancel{60}} \times V_A = -\overset{2}{\cancel{40}} \times (-\overset{1.5}{\cancel{4.5}})$$

$$\Rightarrow V_A = 3\,m/s \text{ towards North.}$$

(15)

let $m_1 = 5 kg$, $u_1 = -10 m/s$

$m_2 = 6 kg$ $u_2 = 12 m/s$.

After collision both move with same velocity

$v_1 = v_2 = V_{com}$

According to law of conservation of linear momentum

$$m_1 u_1 + m_2 u_2 = m_1 V_1 + m_2 V_2$$

$$\Rightarrow 5 \times (-10) + 6(12) = 5 V_{com} + 6 V_{com}$$

$$\Rightarrow -50 + 72 = 11 V_{com}$$

$$\Rightarrow \cancel{11} V_{com} = \cancel{22}\ 2 \quad \Rightarrow V_{com} = 2 m/s.$$

(16)

Given $m_n = 1.67 \times 10^{-27} kg$, $u_n = 3 \times 10^6 m/s$

$m_D = 3.34 \times 10^{-27} kg$, $u_D = 0$

After collision both move with same velocity

$V_1 = V_2 = V_{com}$

According to law of conservation of linear momentum

$$\Rightarrow m_n u_n + m_D u_D = m_n V_{com} + m_D V_{com}$$

$$\Rightarrow 1.67 \times 10^{-27} \times 3 \times 10^6 + 3.34 \times 10^{-27} (0) = 1.67 \times 10^{-27} V_{com} + 3.34 \times 10^{-27} V_{com}$$

$$\Rightarrow 1.67 \times \cancel{10^{-27}} \times 3 \times 10^6 = 5 \times \cancel{10^{-27}} V_{com}$$

$$\Rightarrow V_{com} = \frac{1.67 \times 3}{5} \times 10^6 m/s$$

$$V_{com} \simeq 10^6 m/s \rightarrow A.$$

(17)

No. of bullets $n = 5$; $m_{bullet} = 200\ gm = 200 \times 10^{-3}\ kg$

$u_{bullet} = 10\ m/s$

$M_{block} = 30\ kg$; $u_2 = 0$.

After collision both bullet + block move with same velocity $v_1 = v_2 = v_{com}$.

According to law of conservation of linear momentum

$$n\, m_{bullet} u_{bullet} + m_{block} u_{block} = n m_{bullet} v_1 + m_{block} v_2$$

$$\Rightarrow 5 \times 200 \times 10^{-3} \times 10 + 3(0) = 5(200 \times 10^{-3}) v_{com} + 3 v_{com}.$$

$$\Rightarrow 10 = v_{com} + 3 v_{com} \Rightarrow 4 v_{com} = 10$$

$$\Rightarrow v_{com} = \frac{10}{4} = 2.5\ m/s$$

(18)

Let $m_1 = m$; $m_2 = 2m$; $m_3 = 3m$; $m_4 = 4m$; $m_5 = 5m$

$u_1 = u$; $u_2 = 2u$; $u_3 = 3u$; $u_4 = 4u$; $u_5 = 5u$

After collision both move with same velocity

$$v_1 = v_2 = v_3 = v_4 = v_5 = v_{com}$$

According to law of conservation of linear momentum

$$m_1 u_1 + m_2 u_2 + m_3 u_3 + m_4 u_4 + m_5 u_5 = m_1 v_1 + m_2 v_2 + m_3 v_3 + m_4 v_4 + m_5 v_5$$

$$\Rightarrow mu + (2m)(2u) + (3m)(3u) + (4m)(4u) + (5m)(5u) = m v_{com} + 2m v_{com}$$
$$+ 3m v_{com} + 4m v_{com} + 5m v_{com}$$

$$\Rightarrow mu + 4mu + 9mu + 16mu + 25mu = 15 m v_{com}$$

$$\Rightarrow \cancel{55}^{11} \cancel{m} u = \cancel{15}_{3} \cancel{m} v_{com}$$

$$\Rightarrow v_{com} = \frac{11u}{3}\ m/s$$

(19)

$u_p = 7\times10^6$ m/s ; $u_n = -4\times10^6$ m/s.

After collision both move with same velocity

$u_1 = v_2 = v_{com}$

let $m_1 = m_p = m$; $m_2 = m_n = m$.

According to law of conservation of linear momentum

$m_1 u_p + m_2 u_n = m_1 v_1 + m_2 v_2$

$\Rightarrow m\times7\times10^6 - m\times4\times10^6 = m v_{com} + m v_{com}$

$\Rightarrow 3m\times10^6 = 2m\, v_{com}$

$\Rightarrow v_{com} = \frac{3}{2}\times10^6$ m/s $= 1.5\times10^6$ m/s

(22)

During an oblique collision of ball with floor, the only force considered is normal reaction force which is always perpendicular to surface until clearly given rough surface no force parallel to surface is taken into account

(23)

when external forces are acting momentum is not conserved $F_{ext} = \frac{dP}{dt}$ when P = constant
$F_{ext} = 0$.

when bomb is exploded → Energy released, that Energy given to fragments in the form of k.E

The collision of rubber ball with the wall is inelastic so k.E is not conserved.

(25)

(a) when a bullet is fired into wooden block after firing both move with common velocity, so collision is inelastic.

(b) A running man jumps into a train, After collision both move with same velocity, so collision is inelastic.

No conservation of energy taken place.

(26)

let

(a) $m_1 = 4\,kg$; $m_2 = 2\,kg$; $u_2 = 0$

Energy retained by the first body

$$= \left[\frac{m_1 - m_2}{m_1 + m_2}\right]^2$$

$$= \left[\frac{4-2}{4+2}\right]^2 = \left[\frac{\cancel{2}}{\cancel{6}}\right]^2$$

$$= \frac{1}{9}$$

(b) when a body of m_1 collides with a stationary body of mass m_2, then the $m_1 = 1$ $m_2 = A$

fraction of energy retained by first body

$$= \frac{4 m_1 m_2}{(m_1 + m_2)^2} = \frac{4A}{(A+1)^2}$$

$$= \frac{4A}{(A+1)^2}$$

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