Exercise:

(1) a · As the spheres are identical if they collide they will interchange the velocities. So we can't make out wether collision has occourred or not.

(2) b $v_1 = -eu_1 + (1+e)u_2$ if $m_1 << m_2$

$e = 1$ for elastic collision

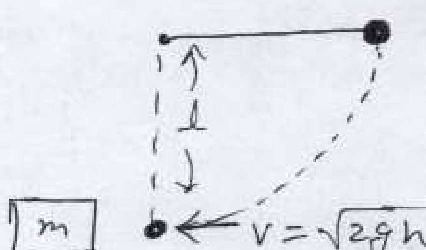
$\Rightarrow v_1 = -u_1 + 2u_2 = -12 + 2\times 10 = +8$

(3) a + c As no friction is present. Normal forces which acts during collision will make velocities to interchange whereas angular velocities will remain unchanged.

(4) c By energy conservation (on pendulum)

loss in P.E = gain in K.E

$mgl = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gl}$



∴ in perfectly elastic collision of equal mass velocities get interchanged. So K.E of block $= \frac{1}{2}mv^2$

$= \frac{1}{2}m(\sqrt{2gl})^2$

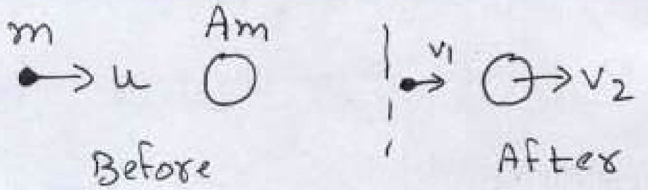
$= mgl$

we could also go by another method

loss in P.E of Pendulum = gain in K.E of block.

as final K.E of pendulum is zero.

(5) a



if we assume mass of Proton & neutron is same mass of nucleus will be Am.

$$v_1 = \frac{(m_1 - em_2)u_1 + (1+e)m_2u_2}{m_1+m_2} = \frac{m(1-A)u}{m(1+A)} = \left(\frac{1-A}{1+A}\right)u$$

$$v_2 = \frac{(m_2 - em_1)u_2 + (1+e)m_1u_1}{m_1+m_2} = \frac{2u}{(1+A)}$$

$$\frac{K.E_{nucleus}}{K.E_{total}} = \frac{\frac{1}{2}(Am)v_2^2}{\frac{1}{2}mu^2} = A\left(\frac{2}{1+A}\right)^2 = \frac{4A}{(1+A)^2}$$

(6) (a) $v_1 = \dfrac{(m-2m)u}{m+2m} = -\dfrac{u}{3}$

So $\dfrac{K.E_i}{K.E_F} = \dfrac{\frac{1}{2}mu^2}{\frac{1}{2}mv_1^2} = \dfrac{9}{1}$

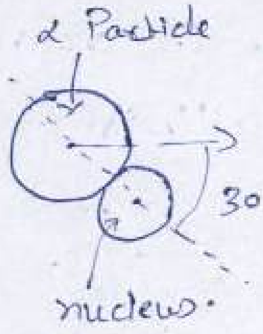
~~(7) (a) As~~ $\cancel{v_1 = \frac{(m_1-m_2)u_1}{m_1+m_2}}$ ~~$\Rightarrow$ for maximum v_2~~ $\cancel{m_2 >> m_1}$

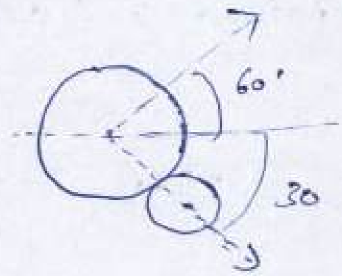
$\cancel{\Rightarrow m_B >> m_A}$

(7) b As $v_2 = \dfrac{2m_Au_A}{m_A+m_B}$ to maximise v_2 $m_A >> m_B$

(8). Transfer of momentum is maximum when masses (c) are equal.

(9) (b)





In an oblique collision of two equall masses. They will move ⊥ to each other if collision is elastic and one mass was at rest initially.

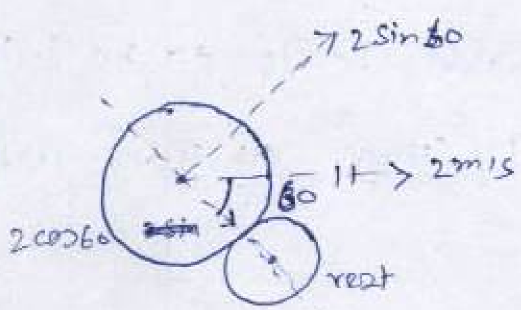
(10) (d) Same as above.

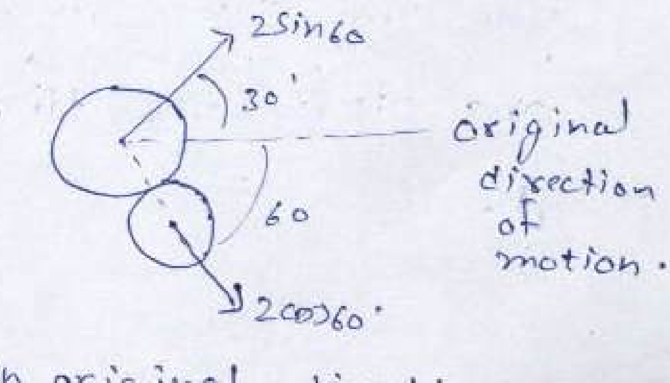
This occur because velocities along the line of collision get interchanged whereas velocities ~~along~~ ⊥ to line of collision, remains unchanged.

(11) (b) Same as above

If both component of velocity are equal then final velocity will be ~~along~~ at an angle of 45' with initial velocity of colliding ball.

(12) (a)





So $V = 2\sin 60$ at 30' with original direction.

$= \sqrt{3}$

(13) Error in question.

(14) velocity retained = $V\cos 45$ where v is velocity
(a) before collision.

So Velocity after n collisions $= \dfrac{u}{(\sqrt{2})^n}$

$$K.E_f = \frac{1}{2} m \left(\frac{u}{(\sqrt{2})^n}\right)^2 = \frac{1}{2} m u^2 (2^{-n}) = 10^{-6} \frac{1}{2} m u^2$$

$$\Rightarrow \quad 2^{-n} = 10^{-6} \quad \Rightarrow n \approx 20$$

(15) (d) It is property of colliding surfaces.

(16) (b)

(17) Kinetic energy get conerted to Potential energy
(d) during collision and then get back converted to Kinetic energy. ~~So Kin~~ There are some losses takes place in between. So K.E before collision is greater than K.E after collision. But if you can choose any inbetween State to be initial and after Some time final. Then answer will be d.

(18) (b)

(19)

(d)

$\Delta P_1 = p - (-ep)$

$= p(1+e)$

$\Delta P_2 = ep - (-e^2 p)$ and so on.

$= ep(1+e)$

so $\Delta P_{net} = \Delta P_1 + \Delta P_2 + \cdots$

$= p(1+e) + e\,p(1+e) + \cdots$

$= p(1+e)(1+e+e^2+\cdots) = \dfrac{p(1+e)}{(1-e)}$

(20), (21)

$v\sin\phi = u\sin\theta$ (v along common tangent do not change)

$v\cos\phi = e\,u\cos\theta$

from above eq. $\Rightarrow v = u\sqrt{\sin^2\theta + e^2\cos^2\theta}$

and $\tan\phi = \dfrac{\tan\theta}{e}$

(22)

conservation of linear momentum

$mu + (-mu) = 2mv \Rightarrow v = 0$

(23)

(b) loss in K.E $= \frac{1}{2}\left(\frac{m_1 m_2}{m_1+m_2}\right)(V_{rel})^2 = \frac{1}{2}\times\frac{50\times 950}{1000}\times 10^2$
(e = 0)

Initial K.E $= \frac{1}{2}\, 50\times 10^2$

$\Rightarrow$ % loss in K.E $= \dfrac{\frac{1}{2}\,\frac{50\times 950\times 10^2}{1000}}{\frac{1}{2}\times 50\times 10^2}\times 100 = 95\%$.

(24) Velocity of m_1 when it collides $= \sqrt{2gd}$

(a) loss in K.E $= \frac{1}{2}\,\frac{m_1 m_2}{m_1+m_2}\,(\sqrt{2gd})^2$

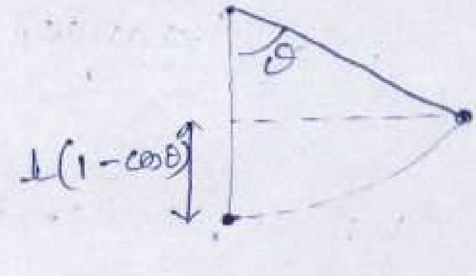
So $K.E_i = P.E_F$ + loss

$\frac{1}{2} m_1 (\sqrt{2gd})^2 = (m_1+m_2)gh + \frac{1}{2}\,\frac{m_1 m_2}{m_1+m_2}\, 2gd$

$\frac{1}{2} m_1 \left(1 - \frac{m_2}{m_1+m_2}\right) 2gd = (m_1+m_2)gh$

$\Rightarrow \quad h = \frac{m_1^2}{(m_1+m_2)^2}\, d$

(25)



let the maximum angle be θ.

$K.E_i = P.E_{final}$ + losses

$\frac{1}{2}\times 0.1\times (150)^2 = 3gl(1-\cos\theta) + \frac{1}{2}\times\left(\frac{0.1\times 2.9}{0.1+2.9}\right)(150)^2$

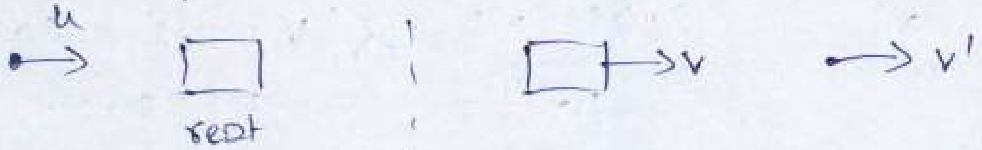
$\frac{1}{2}\times 0.1\times (150)^2\left(1 - \frac{2.9}{3}\right) = 3gl(1-\cos\theta)$

$\cdot \frac{1}{2} \times 2250 \times \frac{0.1}{3} = 3g \times 2.5 (1-\cos\theta)$

$\frac{225}{2 \times 9 \times 10 \times 2.5} = (1-\cos\theta) \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \underline{\theta = 60^\circ}$

(26) Let the velocity of block after bullet passed through
(c) it be v.

$\Rightarrow \frac{1}{2} m v^2 = mgh \Rightarrow v = \sqrt{2gh} = \sqrt{2 \times 10 \times .1} = \sqrt{2}$ m/s



$\underline{\underline{COM}} \Rightarrow 0.01 \times 500 + 0 = 2 \times \sqrt{2} + 0.01 \times v'$

$\frac{5 - 2\sqrt{2}}{10^{-2}} = v' = \underline{5 - 2.828 \times 10^2}$

$= 220$ m/s

(27) $\frac{\text{loss in K.E}}{\text{Initial K.E}} = \frac{\frac{1}{2}\frac{mM}{m+M}u^2}{\frac{1}{2}mu^2} = \frac{M}{m+M} = \frac{1}{\left(1+\frac{m}{M}\right)}$
(a)

$= \left(1+\frac{m}{M}\right)^{-1}$ if $\frac{m}{M} << 1 \Rightarrow \left(1-\frac{m}{M}\right)$

(28) loss in K.E = gain in P.E (by block)
(a) $\frac{1}{2}mv^2 = mgh \Rightarrow v = \sqrt{2gh}$

(29) As collision is perfectly elastic
(d) so loss $= \frac{1}{2}\left(\frac{mM}{M+m}\right)v^2$

(30) $K.E_i = P.E_{final} + \text{losses}$
(d)
$$\text{loss} = \frac{1}{2}\times(10\times10^{-3})v^2 - (2+10\times10^{-3})g\times10\times10^{-2}$$

$$\text{losses} = \frac{1}{2}\times10^{-2}v^2 - (2.01) = \frac{1}{2}\times\frac{2\times10\times10^{-3}}{(2+10\times10^{-3})}\times v^2$$

$$\Rightarrow \frac{1}{2}\times10^{-2}v^2\left(\frac{10^{-2}}{2+10\times10^{-3}}\right) = 2.01$$

$$v^2 = \frac{(2.01)^2\times2}{10^{-4}} \Rightarrow V = \sqrt{2}\times201$$
$$= 280\ m/s$$

(31) Let v' be the speed of Pendulum bob.
(d)
COM $\quad mv + 0 = mv/2 + Mv' \Rightarrow v' = \frac{m\,v}{2M}$

to complete circular motion $v' \geq \sqrt{5gl}$

$$\Rightarrow v_{min} = \frac{2M}{m}\sqrt{5gl}$$

(32) C

(33) 60% of energy is left $\Rightarrow$ height covered $= 0.6\,h_{initial}$
(d)
$= 6\ m$

(34) (c) momentum of ball and earth as a system is conserved because there will be no external force. The force of gravity will become an internal force.

(35) Total momentum of system will remain zero.
(C)

$\Rightarrow \quad 0 = 3\times16 + 6\times v \quad \Rightarrow \quad v = -\frac{3\times16}{6} = 8 \text{ m/s}$

$\underset{(\text{total})}{K.E} = \frac{1}{2}\times3\times16^2 + \frac{1}{2}\times6\times8^2 = \frac{1}{2}\times3\times8^2(4+2)$

$= \frac{1}{2}\times3\times6\times64 = 64\times9 = 576$

$\underset{(6\,kg)}{K.E} = \frac{1}{2}\times6\times8^2 = 64\times3 = 192$ Joules.

(36) $\sqrt{2m(K.E)} = P \quad \Rightarrow \quad \sqrt{K.E}$ V_s P will a straight line Passing through origin.
(a)

(37) Same as question No- 22
(a)

(38) if bullet comes out with same velocity then the
(b) recoil force will be equal in both cases thus lighter gun will try to move with greater acceleration.

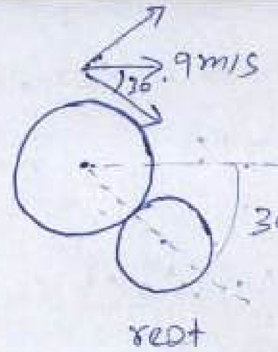
(39) F_{Avg} = (No of bullets/sec) × momentum of each bullet.
(a)

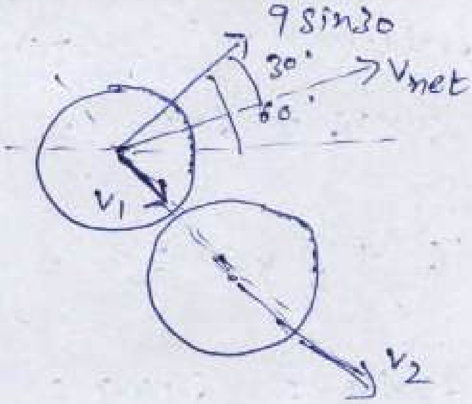
$200 = x \times (40\times10^{-3})\times10^3 \quad \Rightarrow \quad x = 5$ bullets/sec

$\Rightarrow$ 300 bullets/minute.

(40) loss in $K.E = \frac{1}{2}\left(\frac{mm}{m+m}\right)\times(u_1-u_2)^2 = \frac{1}{4}m(u_1-u_2)^2$
(b)

(41)





As ball 1 is moving at an angle of 30° with initial line of motion.

$\Rightarrow \tan 30° = \dfrac{v_1}{9\sin 30} \Rightarrow v_1 = 9 \times \dfrac{1}{\sqrt{3}} \times \dfrac{1}{2} = 1.5\sqrt{3}$

Com along common normal.

$m\, 9\cos 30 = mv_1 + mv_2 \Rightarrow (v_1 + v_2) = 4.5\sqrt{3}$

$\Rightarrow v_2 = 3\sqrt{3} = 5.2$ m/s

(42) Let m be the mass of 2cm ball

(b) $\Rightarrow$ mass of 3 cm ball $= \dfrac{m}{2^3} \times 3^3 = m\left(\dfrac{3}{2}\right)^3 = 3.375m$

(taking density constant)

$m \times 5 = mv_1 + mv_2 \times \left(\frac{3}{2}\right)^3$

$\boxed{\cancel{m} \times 5 = \cancel{m}v_1 + 3.375\, v_2 \cancel{m}}$ only option b is satisfied by v_1 & v_2.

(43) Force = (No of bullets/sec) × change in momentum of one bullet.

(C)

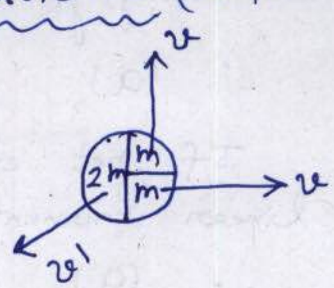
$Mg = x \times 2mv \Rightarrow v = \dfrac{Mg}{2mx} = \dfrac{1 \times 10}{2 \times 0.05 \times 10}$

$M = 1,\ x = 10,\ m = 0.05$

$= 10$ m/s

Previous Year's Questions (Impulse & Momentum)

(1) $\vec{p_1} + \vec{p_2} + \vec{p_3} = 0$



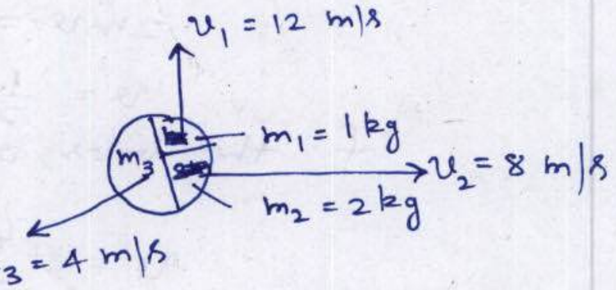
$\therefore \quad \sqrt{2}\, mv = 2m v'$

$\Rightarrow \quad v' = \dfrac{v}{\sqrt{2}}$

$K = \frac{1}{2}mv^2 + \frac{1}{2}mv^2 + \frac{1}{2}\, 2m\left(\frac{v}{\sqrt{2}}\right)^2 = \frac{3}{2}mv^2$

$\therefore$ (d)

(2) $p_3 = \sqrt{p_1^2 + p_2^2}$



$m_3 \times 4 = \sqrt{12^2 + 16^2}$

$4 m_3 = 20$

$\therefore \quad m_3 = 5$ kg

$\therefore$ (C)

(3) perfectly inelastic ($e = 0$)

$\therefore$ (a)

(4) $F = \dfrac{\Delta p}{\Delta t} = \dfrac{2mv}{\Delta t} = \dfrac{2 \times 0.25 \times 10}{0.01}$

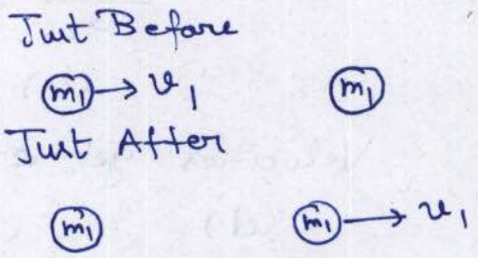
$F = 500$ N

$\therefore$ (d)

(5) $e = 1$

$\therefore$ (C)

(6) For head-on elastic collision of equal masses velocities get exchanged.



$\therefore$ (b)

(7) $u = \sqrt{2gh_1}$, $v = \sqrt{2gh_2}$

$\vec{a} = \dfrac{\vec{v} - \vec{u}}{\Delta t}$

$a = \dfrac{v - (-u)}{\Delta t} = \dfrac{\sqrt{2g}\left(\sqrt{h_2} + \sqrt{h_1}\right)}{\Delta t} = \dfrac{10 + 20}{0.02}$

$a = 1500$ m/s^2

$\therefore$ (d)

(8) Velocity of heavy body remains same.

$\therefore$ (a)

(9) If net external force on a system is zero, its linear momentum remains conserved.

$\therefore$ (a)

(10) speed of bob just before collision $= \sqrt{2gh}$

let speed just after collision is v

$$2mv = m\sqrt{2gh}$$

$$v = \frac{1}{2}\sqrt{2gh}$$

if the bobs rises to height h' then,

$$v = \sqrt{2gh'}$$

$$\frac{1}{2}\sqrt{2gh} = \sqrt{2gh'}$$

$$h' = \frac{h}{4}$$

$\therefore$ (d)

(11)

(m) $\rightarrow u$ (m) $\Rightarrow$ (m) $\rightarrow v_1$ (m) $\rightarrow v_2$

$$mu = mv_1 + mv_2 \Rightarrow v_1 + v_2 = u \quad - (1)$$

$$v_2 - v_1 = eu \quad - (2)$$

$$\frac{(2)}{(1)} \Rightarrow \cancel{\frac{v_2 + v_1}{v}} \quad \frac{v_2 - v_1}{v_1 + v_2} = \frac{eu}{u}$$

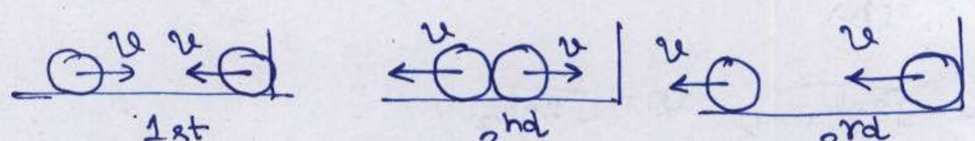
$$\frac{v_1}{v_2} = \frac{1-e}{1+e}$$

$\therefore$ (b)

(12) Velocities get exchanged.

$\therefore$ (d)

(13)



$\therefore$ (c)

(14) $\Delta K_{loss} = \frac{m_1 m_2}{2(m_1+m_2)} (u_1 - u_2)^2 (1-e^2)$

here, $m_1 = m$, $m_2 = \frac{m}{9}$, $u_1 = u$, $u_2 = 0$, $e = 0$

$\therefore$ $\Delta K_{loss} = \frac{m \times \frac{m}{9}}{2 \times \frac{10m}{9}} u^2 = \left(\frac{1}{2} m u^2\right) \times \frac{1}{10}$

$$\frac{\Delta K_{loss}}{\frac{1}{2} m u^2} = \frac{1}{10} = 0.1$$

$\therefore$ (a)

(15) $v_1 \leftarrow (m_1 | m_2) \rightarrow v_2$ $p_1 = p_2$

$$\frac{E_1}{E_2} = \frac{p_1^2 / 2m_1}{p_2^2 / 2m_2} = \frac{m_2}{m_1} \quad (\because p_1 = p_2)$$

$\therefore$ (C)

(16) $v \leftarrow (2kg | 1kg) \rightarrow 80$ m/s

$p_1 = p_2 \Rightarrow 2v = 1 \times 80 \Rightarrow v = 40$ m/s

$E = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = 1600 + 3200 = 4800$ J
$= 4.8$ kJ

$\therefore$ (d)

(17) $u = \sqrt{2gh}$

speed after one bounce $= ue = e\sqrt{2gh}$

let the height achieved after one bounce is h_1,

then, $e\sqrt{2gh} = \sqrt{2gh_1}$

$\therefore$ $\boxed{h_1 = e^2 h}$

$\therefore$ (a)

(18) $mv = mv_1 + 2mv_2$ (m) $\rightarrow v$ (2m)

$\therefore$ $v_1 + 2v_2 = v$ — (1)   (m) $\rightarrow v_1$ (2m) $\rightarrow v_2$

$v_2 - v_1 = v$ — (2)

(1) + (2) $\Rightarrow$ $3v_2 = 2v \Rightarrow v_2 = \frac{2v}{3}$

(1) $\Rightarrow$ $v_1 = -\frac{v}{3}$

$(\Delta K_{loss})_{m_1} = \frac{1}{2} m v^2 - \frac{1}{2} m v_1^2 = \frac{1}{2} m \left(v^2 - \frac{v^2}{9}\right)$
$= \frac{8}{9}\left(\frac{1}{2} m v^2\right)$

$\therefore$ (C)

(19) Only linear momentum is conserved in inelastic collision.

$\therefore$ (d)

(20) Ball will bounce back with same speed.

$\therefore \quad \Delta p = mv - (-mv) = 2mv$

$\therefore$ (b)

(21) $m_1 u = m_1 \frac{2u}{3} + m_2 v_2$ $\qquad$ $m_1 \rightarrow u_1 = u$ $\qquad$ $m_2 \rightarrow u_2 = 0$

$3 m_1 u = 2 m_1 u + 3 m_2 v_2$ $\qquad$ $m_1 \rightarrow v_1 = \frac{2u}{3}$ $\qquad$ $m_2 \rightarrow v_2$

Elastic collision.

$m_1 u = 3 m_2 v_2$

$v_2 = \frac{m_1 u}{3 m_2} \quad — (1)$

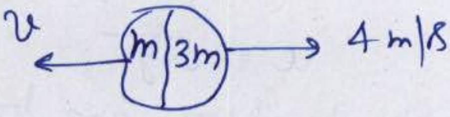
$v_2 - v_1 = u$

$\frac{m_1 u}{3 m_2} - \frac{2u}{3} = u \Rightarrow \frac{m_1 u}{3 m_2} = \frac{5u}{3}$

$\therefore \quad \frac{m_1}{m_2} = \frac{5}{1}$

$\therefore$ (b)

(22) $\cancel{m} v = 12 \cancel{m}$



$v = 12$ m/s

$\therefore$ (a)

(23) (d)

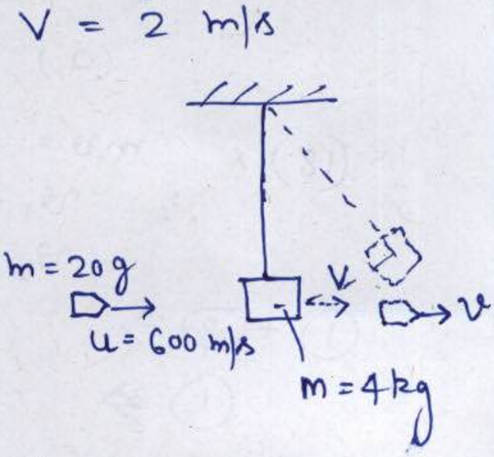
(24) speed of block after collision $= \sqrt{2gh} = \sqrt{2 \times 10 \times 0.2}$

$V = 2$ m/s

$mu = MV + mv$

$0.02 \times 600 = 4 \times 2 + 0.02 \times v$

$v = 200$ m/s



$\therefore$ (a)

(25) $\dfrac{e_1}{e_2} = \dfrac{3}{1}$

$e_1 = \dfrac{\text{relative vel. of sep.}}{\text{rel. vel. of approach}} = \dfrac{1}{2}$

$\therefore \quad e_2 = \dfrac{e_1}{3} = \dfrac{1}{6}$, $\dfrac{\text{rel. vel. of approach}}{\text{rel. vel. of separation}} = \dfrac{1}{e_2}$

$\therefore$ (d)

(26) $12v = 6 \times 18$

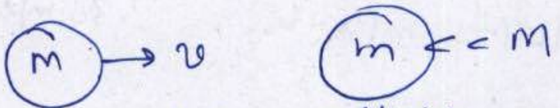
$v = 9$ m/s

K.E. of 12 kg mass $= \frac{1}{2} \times 12 \times 9^2 = 486$ J

$\therefore$ (b)

(27)

(28)

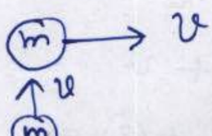


elastic collision

The velocity of heavier body will not change and m will move with double the velocity.

$\therefore$ (b)

(29) $\vec{p}_i = \vec{p}_f$



$mv\hat{i} + mv\hat{j} = 2m\vec{v}$

$\vec{v} = \frac{v}{2}\hat{i} + \frac{v}{2}\hat{j}$

$\therefore \quad v = \frac{v}{\sqrt{2}}$

(d)

(30) Speed before collision $= \sqrt{2gh} = \sqrt{2 \times 9.8 \times 4.9}$

$= 9.8$ m/s

Speed after first bounce

$= \frac{3}{4} \times 9.8 = \frac{29.4}{4}$

$= 7.35$ m/s

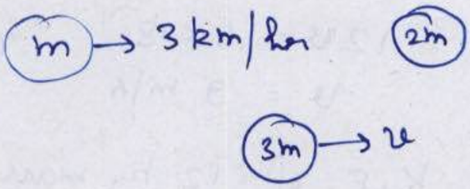
Time to strike again

$= \frac{2u}{g} = \frac{2 \times 7.35}{9.8} = 1.5 s$

$\therefore$ (b)

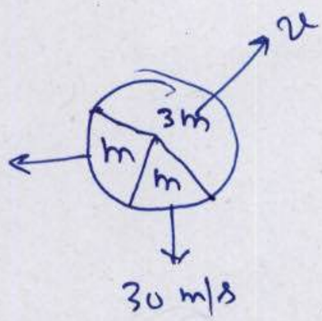
(31) $3m = 3mv$

$v = 1$ km/hr



$\therefore$ (d)

(32) $3mv = \sqrt{900m^2 + 900m^2}$



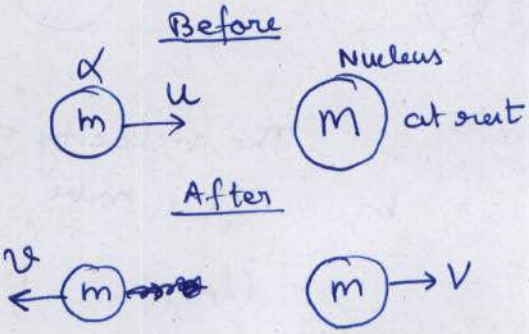
$3\cancel{m}v = \cancel{900}\ 30\sqrt{2}\ \cancel{m}$

$v = 10\sqrt{2}$ m/s

$\therefore$ (b)

(33) $\frac{1}{2} mv^2 = \frac{25}{100} \times \frac{1}{2} mu^2$

$v = \frac{1}{2} u$ — (1)



$mu = -mv + MV$

$u + v = \frac{M}{m} V$ — (2)

$V + v = u$ — (3)

$\left(\frac{M}{m}\right) \times (3) + (2) \Rightarrow u + v + \frac{M}{m} v = \frac{M}{m} u$

$u + v = \frac{M}{m} (u - v)$

$M = \frac{(u+v)m}{(u-v)} = 3m$

$\therefore$ (c)

(34) $4 \times 12 = 10 v$

$4kg \rightarrow 12\ m/s$ $\quad$ $6kg$ at rest

$v = \dfrac{4 \times 12}{10} = 4.8\ m/s$

$10kg \rightarrow v$

$$\Delta K_{loss} = \frac{m_1 m_2}{2(m_1+m_2)} (u_1 - u_2)^2 (1-e^2)$$

$e = 0$ for perfectly inelastic collision.

$$\Delta K_{loss} = \frac{4 \times 6}{2(4+6)} (12-0)^2 = \frac{4 \times 6 \times 144}{2 \times 10} = 172.8\ J$$

$\therefore$ (c)

(35) $$100 \times \frac{\Delta K_{loss}}{U_i} = \frac{U_i - U_f}{U_i} = \left(1 - \frac{10}{20}\right) \times 100$$

$$= 50\%$$

$\therefore$ (c)

Before

$10kg \rightarrow 2\ m/s$ $\quad$ $20kg$ at rest

(36) $10 \times 2 = 30 \times v$

$v = \dfrac{2}{3}\ m/s$

$30kg \rightarrow v$ $\quad$ After

$\therefore$ (d)

x: $m_1 \rightarrow p$ $\quad$ y: m_2 at rest

(37) $p = p_1 + p_2$ — ①

x: $\xleftarrow{J} m_1$, $\rightarrow p_1$ $\quad$ y: $\xrightarrow{J} m_2$, $\rightarrow p_2$

For x, $\quad -J = p_1 - p$ — ②

For y, $\quad J = p_2$ — ③

$p = m_1 u_1 \Rightarrow u_1 = \dfrac{p}{m_1} = \dfrac{p}{m}$

② $\Rightarrow$ $p_1 = p - J \Rightarrow m_1 v_1 = p - J \Rightarrow v_1 = \dfrac{p-J}{m_1} = \dfrac{p-J}{m}$

③ $\Rightarrow$ $p_2 = J \Rightarrow m_2 v_2 = J \Rightarrow v_2 = \dfrac{J}{m_2} = \dfrac{J}{m}$

$(\because m_1 = m_2 = m)$

$$e = \frac{v_2 - v_1}{u_1} = \frac{\frac{J}{m} - \left(\frac{p-J}{m}\right)}{p/m}$$

$$e = \frac{J - p + J}{p} = \frac{2J}{p} - 1$$

$\therefore$ (a)

(38) $mu_1 = mv_1 + 2mv_2$ neutron deutron

$m \rightarrow u_1$ $\quad 2m \; u_2 = 0$

$m \rightarrow v_1$ $\quad 2m \rightarrow v_2$

$v_1 + 2v_2 = u_1 \quad - (1)$

$v_2 - v_1 = u_1 \quad - (2)$

$(1) + (2) \Rightarrow \quad 3v_2 = 2u_1$

$v_2 = \dfrac{2u_1}{3}$

$\therefore \quad (2) \Rightarrow \quad v_1 = \dfrac{u_1}{3}.$

$$\frac{(\Delta K_{loss})_{neutron}}{\frac{1}{2}mu_1^2} = \frac{\frac{1}{2}mu_1^2 - \frac{1}{2}mv_1^2}{\frac{1}{2}mu_1^2} = 1 - \frac{v_1^2}{u_1^2} = \frac{8}{9}$$

$\therefore$ (b)

(39) $mv = (m + 2m)V$

$V = \dfrac{v}{3}$

$\therefore$ (c)

(40) After bounce speed becomes e times and height becomes e^2 times $\left(\because h = \dfrac{v^2}{2g}\right)$

$\therefore$ After second bounce height gained will be $e^4 h$.

$\therefore$ (d)

(41) (c)

(42) $2u = 2 \times \dfrac{u}{4} + mv$

$2\text{kg} \rightarrow u$ $\quad m$ rest

$2\text{kg} \rightarrow \dfrac{u}{4}$ $\quad m \rightarrow v$

elastic collision

$v = \dfrac{3u}{2m} \quad - (1)$

$v - \dfrac{u}{4} = u$

$\dfrac{3u}{2m} - \dfrac{u}{4} = u \Rightarrow \dfrac{3u}{2m} = \dfrac{5u}{4}$

$m = \dfrac{6}{5}\text{kg} = 1.2\text{ kg}$

$\therefore$ (b)

(43) If masses will be same then during elastic collision velocities get exchanged.

$\therefore$ (c)

(44) ~~(4)~~ (d)

(45) Velocities get exchanged.

$\therefore$ (d)

(46) Velocities get exchanged.

$\therefore$ (C)

(47) $\vec{r_2} - \vec{r_1} = -8\hat{i} - 8\hat{j}$

$\vec{v_1} - \vec{v_2} = (4-\alpha)\hat{i} - 4\hat{j}$

$(\vec{v_1} - \vec{v_2}) = \dfrac{\vec{r_2} - \vec{r_1}}{t}$

$(4-\alpha)\hat{i} - 4\hat{j} = -4\hat{i} - 4\hat{j}$

$\therefore \quad 4 - \alpha = -4$

$\alpha = 8$

$\therefore$ (C)

(48) Change in momentum = Impulse

$= F\Delta t$

$|(m_1\vec{v_1} + m_2\vec{v_2}) - (m_1\vec{v_1} + m_2\vec{v_2})| = (m_1 g + m_2 g) \times 2t_0$

$= 2(m_1 + m_2) g t_0$

$\therefore$ (C)

(49) Total distance travelled

$h + 2e^2 h + 2e^4 h + \cdots$

$= h + 2e^2 h(1 + e^2 + e^4 + \cdots)$

$= h + 2e^2 h\left(\dfrac{1}{1-e^2}\right)$

$= h\dfrac{(1+e^2)}{(1-e^2)}$

$\therefore$ (a)