EXERCISE – V

JEE QUESTIONS

1. In Case II
Because change in momentum in Case II is occur two times.

2. Wind Energy/sec = $\frac{1}{2}PA_{\text{blades}} V \times v^2$

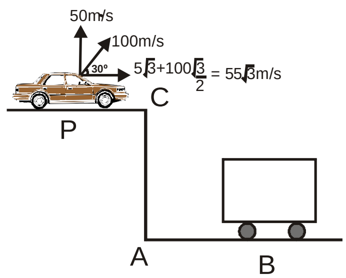
Wind Power $\propto V^3$
Generator power $\propto V^3$.

3. Change in momentum
= Force (gravitation) xtime (t_0)
= $M_1 g\, t_0 + M_2\, g\, t_0 + (M_1 + M_2)\, g\, t_0$
= $2\,(M_1 + M_2)\, g\, t_0$.

4. $-120 = 50\, t_0 - \frac{1}{2} g \text{ to } t_0^2$

$-120 = 50t_0 - 5t_0^2$

$t_0^2 - 10t_0 - 24 = 0$



$t_0 = 12$ sec.

For second Impact

$55\sqrt{3} \times 1 = (9+1) \times V_1$

$V_1 = 5.5\sqrt{3}$ m/s

$5.5\sqrt{3}\ t_0 - \frac{1}{2} a\ t_0^2 = \left(5\sqrt{3}\right) t_0$

$a = \frac{\sqrt{3}}{12}$ m/s^2

a $\rightarrow$ due to resistance

$v_x = 5\sqrt{3}$ of car

$V_{\text{carriage}} = 5.5\sqrt{3} - at_0$

$= 4.5\sqrt{3}$ m/s

Now,

$4.5\sqrt{3} \times 10 + 55\sqrt{3} \times 1 = 11 \times v_2$

$v_2 = \frac{100\sqrt{3}}{11}$

5. $V_{\text{com}} = \frac{M_1V_1 + M_2V_2}{M_1 + M_2} = \frac{10 \times 14 + 4 \times 0}{10 + 4} = 10$ m/s

6. In case of elastic collision, cofficient of restitution e = 1
Magnitude of relative velocity of approach
= Mag of rel velocity of seperation
But Relative speed of approach
$\neq$ Relative speed of seperation

7. Initial Momentum of the system

$\vec{P}_1 + \vec{P}_2 = 0$

Final momentum $\vec{P}'_1 + \vec{P}'_2$ shovia also be zero

Option A : $\vec{P}'_1 + \vec{P}'_2 \neq 0$

C_1 component of $\hat{k}$ will not be Zero

Option (B)

$\vec{P}'_1 + \vec{P}'_2 = 0$ If $C_1 = -C2 \neq 0$

Option (C)

$\vec{P}'_1 + \vec{P}'_2 = 0$
If $a_1 = -a_2 \neq 0$
$b_1 = -b_2 \neq 0$
Option D

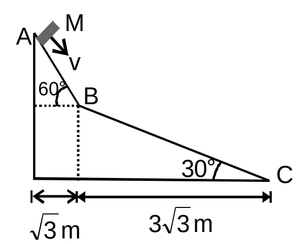
$\vec{P}'_1 + \vec{P}'_2 \neq 0$ b_1 $\hat{j}$ will not be zero

8. Between A and B

$h_1 = \tan 60° \times \sqrt{3}$

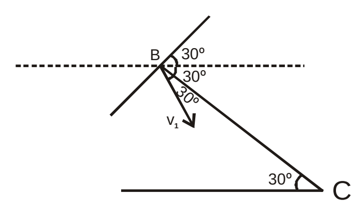
$= \sqrt{3} \times \sqrt{3} = 3$m

Speed of block just before slriking the second collision



$V_1 = \sqrt{2gh_1} = \sqrt{60}$ m/s

Inelastic collision



Comp. of $V_1 \perp$ BC is Zero
Comp of V_1 II BC is remain chnchaged
v_2 = component of v_1 along BC ....
$\therefore V_2 = \cos 30° = \sqrt{45}$ m/s

9. Height faller by the block from B to C

$h_2 = 3\sqrt{3} \tan 30° = 3$m

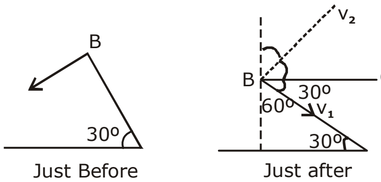
let the required speed V_3

$\therefore V_3 = \sqrt{V_2^2 + 2gh_2}$

$= \sqrt{45 + 2 \times 10 \times 3}$

$= \sqrt{105}$ m/s

10.



Elastic collision

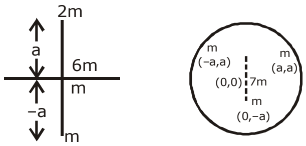
$V_{11} = v_1 \cos 30° = \sqrt{60} \times \sqrt{\frac{3}{2}} = \sqrt{45}$ m/s

$v_1 = v_1 \sin 30° = \sqrt{60} \times \frac{1}{2} = \sqrt{15}$ m/s

Now, vertical component

$V = V_1 \cos 30° - V_{11} \cos 60°$

11.

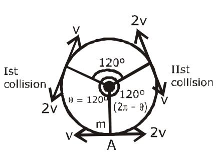


$$Y_{com} = \frac{2m(+a) + 6m(0) + m(0) + m(-a)}{2m + 6m + m + m}$$

$$= \frac{ma}{10m} = \frac{a}{10}$$

12. Collision is elastic and mass is same

So ofter collision, velocity of particles will change



$e = \frac{v_2 - v_1}{u_1 - u_2}$

At time t, Particles collide

$\theta = vt$ ....(1)

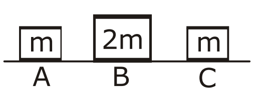
$2\pi - \theta = 2vt$ .....(2)

Now equaltion (1) and (2)

$\frac{\theta}{2\pi - \theta} = \frac{vt}{2vt} \Rightarrow 2\theta = 2\pi - \theta \Rightarrow \theta = \frac{2\pi}{3} = 120°$

After two collision they will reach at point A.

13. Collision between A & B



$m \times 9 + 2\,m \times 0 = mV_A + 2mV_B$

$v_A + 2v_B = 9$ .....(1)

$e = \frac{V_B - V_A}{u_A - u_B}$

$\because e = 1$

$u_A = 9 \quad u_B = 0$

$v_B - v_A = 9$ ....(2)

Now, equation (1) & (2)

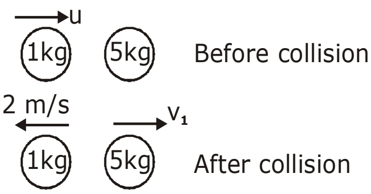
$\Rightarrow \quad v_B = 6$ m/s

Collision between B & C

$2m \times 6 + m \times 0 = (2m + m)\, v_C$

$v_C = \frac{12m}{3m} = 4$ m/s

14.



Now form $e = \frac{v_2 + 2}{u} = 1$

$u = v_2 + 2$ ....(1)

from M.C. $u(1) = -2\,(1) + 5\,v_2$ ......(2)

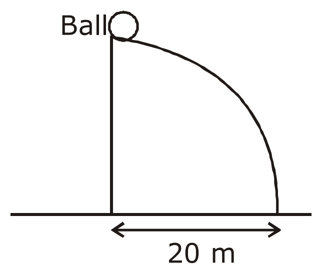
After solu equa (1) & (2)

$v_2 = 1$ m/s & $u = 5$ m/s

15. Applying momentum conservation

$0.01 \times v + 0.2 \times 0 = 0.01\, V_{f_{Bullet}} + 0.2 \times v_{Ball}$ ...(1)

for

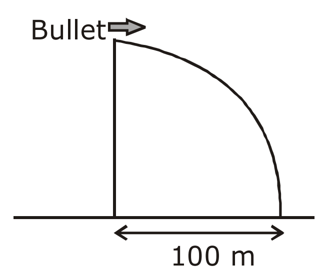


$X_B = v_B \times \sqrt{\frac{2H}{g}}$

$20 = v_B \times 1$

$v_{B_{Ball}} = 20\, m/sec$ ...(2)

for Bullet



$X_{Bullet} = V_{Bullet} \times \sqrt{\frac{2H}{g}}$

$\therefore\ 100 = v_{Ball} \times 1$

$v_{Ball} = 100$ m/s ...(3)

from (1) (2) & (3)

we get

$v = 500$ m/s