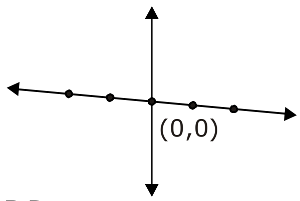
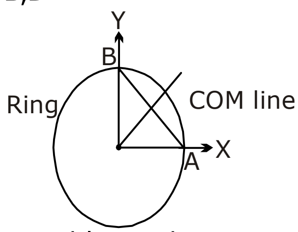
EXERCISE – II

MULTIPLE CHOICE QUESTIONS

1. [CD]



2. B,D



Possible combination

$\left(\frac{R}{3}, \frac{R}{3}; \frac{R}{4}, \frac{R}{4}\right)$

3. AB

Density continously changes.

Non-Uniform distribution.

4. C

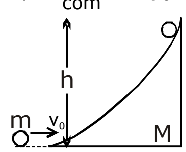
C	T	H	R	S	D
h	h	R	2R	3R	4R
4	3	2	π	8	3π

5. BC

$F_{net} = 0$

It means $a_{com} = 0$ $\Rightarrow V_{com} =$ constant.

6. B



$MV_0 = (M + m)V_2$

$V_2 = \frac{MV_0}{M+m}$

7. BD

$V_{COM} = \frac{MV + mV}{M+m} = V$

$\therefore$ At rest.

8. C

By Energy conservation

$\frac{1}{2}mv_0^2 = \frac{1}{2}(M + m)\left(\frac{mv_0}{M+m}\right)^2 + mgh$

$\Rightarrow h = \left(\frac{M}{M+m}\right)\frac{V_0^2}{2g}$

9. [C]

$(V_1 + V_2)$ = vel. of particle w.r.t. wedge

$\Rightarrow -\left(\frac{mV_0 + M(-V_0)}{M+m}\right) + \left(\frac{mV_0 + mV_0}{M+m}\right)$

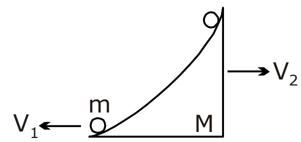
$= V_0$

10. BC

By momentum conservation

$Mv_2 - mv_1 = mV_0$

and $V_1 + V_2 = V_0$



11. B

By momentum conservation

$MV_2 - mV_1 = mV_0$ ....(1)

$V_1 + V_2 = V_0$ ....(2)

By solving

$V_1 = V_0\left(\frac{M-m}{M+m}\right)$

12. ABCD

(a) $\because V_1 + V_2 = V_0$

$V_2 = V_0 - V_0\left(\frac{M-m}{M+m}\right)$

$= \frac{(M+m)V_0 - V_0M + V_0m}{M+m}$

$= \frac{2mV_0}{M+m}$

$K.E. = \frac{1}{2} \times M \times \frac{4m^2V_0^2}{(M+m)^2}$

$[\because h = \frac{M}{(m+M)}\frac{V_0^2}{2g}]$

$\therefore K.E. = \frac{4m^2}{(m+M)}gh$

(b) $V_2 = \frac{2mv_0}{M+m}$

(c) $\Delta K.E. = k_f - k_i$

$= \frac{1}{2}M\left(\frac{4m^2V_0^2}{(M+m)^2}\right) - 0$

$= \frac{4mM}{(m+M)^2}\left(\frac{1}{2}mV_0^2\right)$

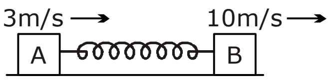
(d) $\because$ vel. of wedge $V_2 = \frac{2mV_0}{M+m}$

Vel. of particle $V_1 = V_0\left(\frac{M-m}{M+m}\right)$

$V_{COM} = \frac{MV_2 + (-mV_1)}{M+m}$

$= \frac{mv_0}{M+m}$

13. B,C



Momemtum conservation
$5 \times 3 + 2 \times 10 = 7V$
$\Rightarrow V = 5$ m/s

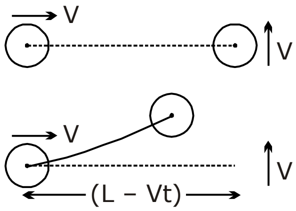
$\frac{1}{2} \times 5\,(3)^2 + \frac{1}{2} \times 2 \times 10^2$

$= \frac{1}{2} \times (1120) \times x^2 + \frac{1}{2} \times 7 \times 5^2$

$45 + 200 = 1120x^2$
$x = 25$ cm

$T = 2\pi\sqrt{\frac{5\times 2}{7\times 1120}} = 0.071\,\pi$

14. AC

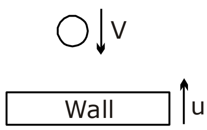


$\sqrt{(Vt)^2 + (L-vt)^2} \le L$
$2V^2t^2 + L^2 - 2LVt \le L^2$
$Vt - L \le 0$

$t \le \frac{L}{V}$

15. BC

e = 1 → Given



$u_1 = -v$
$u_2 = u$
$v_1 = ?$
$v_2 = u$

On solving $e = \frac{V_2 - V_1}{u_1 - u_2} \Rightarrow v_1 = v + 2u$

$\int F \cdot \Delta t = \Delta P$

Average elastic force

$\frac{\Delta P}{\Delta t} = \frac{m(V+2u) + mu - (-mv + mu)}{\Delta t}$

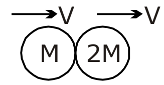
$= \frac{2m(u+v)}{\Delta t}$

(ii) Kinetic energy of the ball increases by
$= K_f - K_i$

$= \frac{1}{2}m(2u + v)^2 - \frac{1}{2}mv^2$

$= 2mu\,(u + v)$

16. ABD



For minimum kinetic energy
$MV_0 = 3MV$
$\Rightarrow V = V_0/3$

$\therefore \Delta K = -\left[\frac{1}{2}3m\left(\frac{V_0}{3}\right)^2 - \frac{1}{2}mv_0^2\right]$

= 2 Joule

17. ABC

Momentum conservation
$1 \times 21 - 2 \times 4 = 1 \times 1 + 2 \times V'$
$V' = 6$ m/s

$e = \frac{6-1}{21+4} = \frac{1}{5}$

Loss of kinetic energy $= k_f - k_i$

$= \frac{1}{2} \times 1 \times (1)^2 + \frac{1}{2} \times 2 \times (6)^2$

$- \left(\frac{1}{2}\times 1\times(21)^2 + \frac{1}{2}\times 2\times(4)^2\right)$

= 200 J

18. D

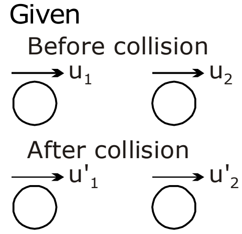
When velocity is same means maximum compression.
$\therefore$ Maximum loss
$M_R \times 8 = M_R \times 0.4 + M_s \times 1$
$0.4M_R = M_S$
$\therefore M_R > M_S$

19. ABCD

Inelastic collision
$0 < e < 1$

20. BD

Given



$u_2 - u_1 = v_1$ and $u'_2 - u'_1 = v_2$

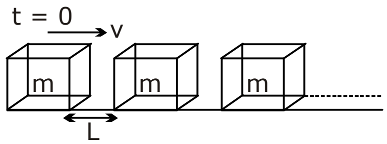
$e = \frac{u_2' - u_1'}{u_1 - u_2}$

$\vec{v}_1 = -\vec{v}_2$ (elastic collision, e = 1)

In general for all cases

$\vec{v}_1 = -k\vec{v}_2 \;\; k \geq 1$

21. AC



Since completely inelastic

[e = 0]

By momentum conservation

$mv + 0 = 2mv' \Rightarrow v' = \frac{v}{2}$

Similarly for next state

$2mv' + 0 = 3mv_1$

$v_1 = \frac{v}{3} \qquad \left[v' = \frac{v}{2}\right]$

$\therefore$ The centre of mass of the system will have a final speed

$= \frac{v}{n}$

Last block start moving at

$t = \frac{L}{V} + \frac{2L}{V} + \frac{3L}{V} + \ldots\ldots \frac{(n-1)L}{V}$

$= \frac{L}{V}[1 + 2 + 3 + \ldots\ldots(n-1)]$

It is an A.P. $S_{AP} = \left(\frac{a+\ell}{2}\right)n$

or $\frac{n}{2}[2a + (n-1)d]$

$t = \frac{n(n-1)L}{2V}$

22. a AC

(a) Since the speed remains same for both sand and car at same instant

$\therefore$ Momentum is conserved in both A and C point

(b) B

Car maintains the same speed.