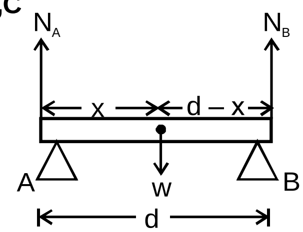
EXERCISE – II

MULTIPLE CHOICE QUESTIONS

1. A,B,C,D

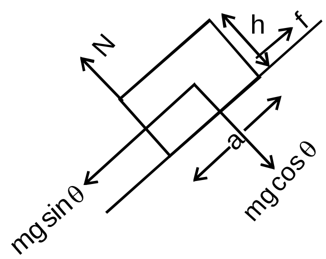
$I_1 + I_3 = I$
$2I_1 = 2I_3 = I$
$I_2 + I_4 = I,\ 2I_2 = 2I_4 = I$
$I_1 = I_2 = I_3 = I_4 = I$

2. B,C



$N_A + N_B = W$
$W(d - x) = N_A \cdot d$

3. A,D



For slippling
$\mu mg \cos\theta > mg \sin\theta$
$\tan\theta < \mu$

Topping $f.\frac{h}{2} > mg\cos\theta \cdot \frac{a}{2}$

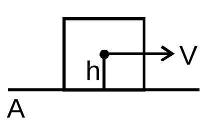
$mg\sin\theta \cdot \frac{h}{2} > mg\cos\theta \cdot \frac{a}{2}$

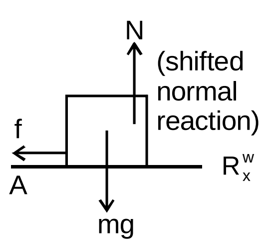
$\tan\theta > \frac{a}{h}$

4. B,C,D

Body is in equilibrium
So $\tau_{net} = 0$
or
$F_{net} = 0$

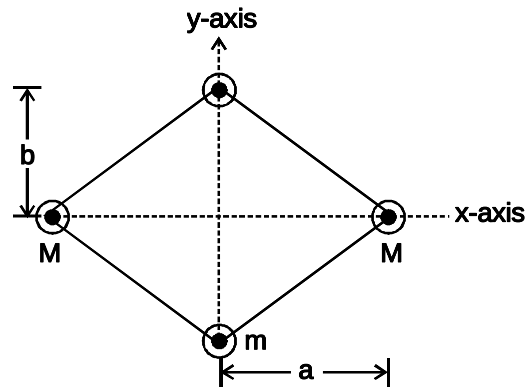
5. A,B,D





Angular momentum is not conserved

6. A,B,C



(A) KE = $\frac{1}{2} I\omega^2$
I depends on m
∴ KE depends on m

(B) $I_{y_{axis}} = 2Ma^2$

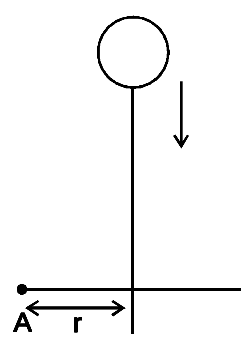
K.E. = $\frac{1}{2} \times 2Ma^2\omega^2 = Ma^2\omega^2$

$I_{z_{axis}} = 2(Ma^2 + mb^2)$

K.E. = $\frac{1}{2} I\omega^2$

$= (Ma^2 + mb^2)\omega^2$

7. A,C,D τ is constant
(mgr)



8. B K.E. = $\frac{1}{2} I\omega^2$

$= \frac{1}{2} (I\omega)\,\omega$

Angular momentum is constant
$L \rightarrow$ constant $I \downarrow\ \omega \uparrow$ K.E. $\uparrow$

9. A,C,D
10. A,C,D
11. C
12. B,C,D
After B there is no friction

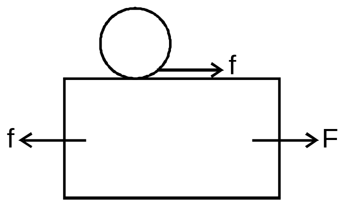
$\therefore$ $F_{net} \uparrow$ or acceleration $\uparrow$

F – f= ma

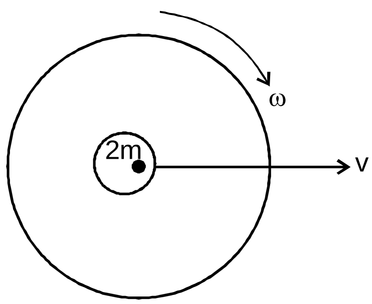
$$f \cdot R = \frac{mR^2}{2} \cdot \frac{a}{R}$$

$f = \frac{ma}{2}$ acceleration became doulble

13. A



14. C



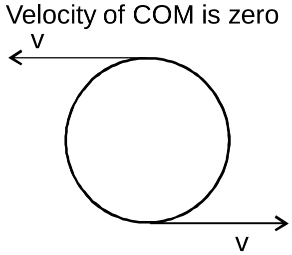
$\frac{2}{3}$ $mR^2\omega + mvR + mvR$

$\frac{8}{3}$ mvR

Water is at rest w.r.t centre.

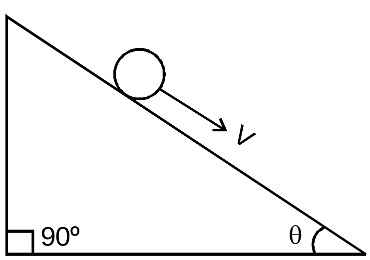
15. B,C

Velocity of COM is zero



$\omega = \frac{v}{R}$

16. A,C



Rolling with shifting $v > \omega R$

v is increasing

So it may be possible that it will never start pure rolling.

If v is always $> \omega R$

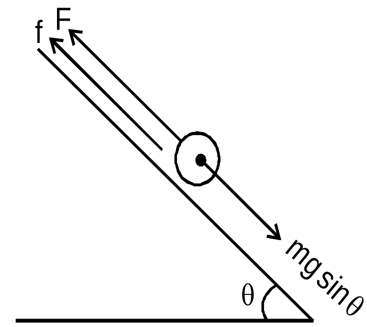
or after same time it may start pure rolling

if $V = R\omega$

17. B,C

If $F < mg \sin\theta$ friction increase

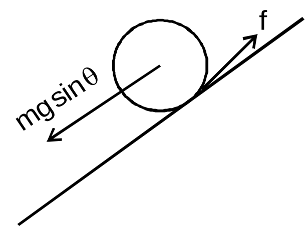
If $F > mg \sin\theta$ friction decrease



18. A,B,C,D

19. B,D

20, A,B,C



$mg \sin\theta - f = ma$, $f R = C\, mR^2 \frac{a}{R}$

$mg \sin\theta - C\, ma = ma$

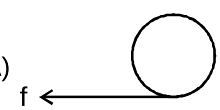
$a = \frac{g \sin\theta}{(C+1)}$

For Ring C = 1

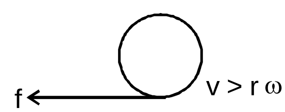
For cylinder $C = \frac{1}{2}$

21. A,B,C

(A)

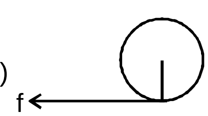


(B)



initially

(C)



Direction of I

About centre $\rightarrow$ Inward

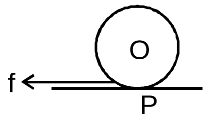
(D) No, Due to inertia

22. C

(A) Due to friction force in horizontal direction momentum to not conserved

(B) Torque by the firction forces about C.O.M. is not zero. So angular momentum is not conserved

(C) About P Torque is zero



So, We can conserved angular momentum

(D) Mechanical Energy is not conserved

23. B,C,D

(A) Center of Mass wil also more with speed V.

(B) Point of contact become stationary

Bcoz there is no slipping

$F = ma = -\mu N$

$ma = -\mu mg$

$a = -\mu g$

So after time t

$V = V_0 - \mu gt$

Rotional Motion

$\tau_{net} = I\alpha$

$f . R = I\alpha$

$\mu mgR = CmR^2\alpha$ (For Ring C = 1)

$\mu g = CR\alpha$

$$\alpha = \frac{\mu g}{R}$$

From $\omega_f = \omega_i + \alpha t$

$$\omega = \alpha t \Rightarrow \omega = \frac{\mu gt}{R}$$

$$\omega = \frac{v}{R} \text{ at Pure Rolling}$$

So $v = \mu gt$

$$\mu gt = V_0 - \mu gt \Rightarrow t = \frac{v_0}{2\mu g}$$

$$V = V_0 - \mu gt$$

$$V = V_0 - \mu g . \frac{V_0}{2\mu g} \qquad t = \frac{V_0}{2\mu g}$$

$$V = V_0 - \frac{V_0}{2}$$

$$V = \frac{V_0}{2}$$

24. A,C,D

Moves Linearly

$V_f^2 = u_1^2 + 2as$

$$\left(\frac{V_0}{2}\right)^2 = (V_0)^2 + 2(-\mu g)\, S$$

$$\frac{V_0^2}{4} - V_0^2 = -2\mu gS$$

$$S = \frac{3V_0^2}{8\mu g}$$

Work done by Friction

$(W.D.)_f = k_f - k_i$

$$k_f = \frac{1}{2}mV_f^2 + \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}m\frac{v_0^2}{4} + \frac{1}{2}MR^2 . \frac{V_0^2}{4R^2}$$

$$= \frac{mV_0^2}{8} + \frac{mv_0^2}{8} = \frac{2mv_0^2}{8} = \frac{mv_0^2}{4}$$

$$(W.D.)_f = \frac{MV_0^2}{4} - \frac{1}{2}MV_0^2$$

$$= \frac{MV_0^2 - 2M_0^2}{4}$$

$$= -\frac{MV_0^2}{4}$$

(C) Loss in K.E. = $K_f - K_i$

$$= -\frac{MV_0^2}{4}$$

(D) Gain in Rotaional K.E.

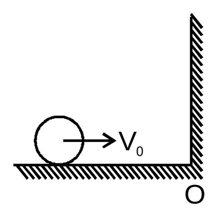
$$= \frac{1}{2}I\omega^2$$

$$= \frac{1}{2}MR^2\frac{V_0^2}{4R^2}$$

$$= \frac{MV_0^2}{8}$$

25. A,B,D

(A) Change in Angular Mom.



$= L_f - L_i$

$= (I\omega - mV_0R) - (I\omega + mV_0R)$

$= -2mV_0R$

(B) Impulse = Change in momentum

$= -2mV_0R$