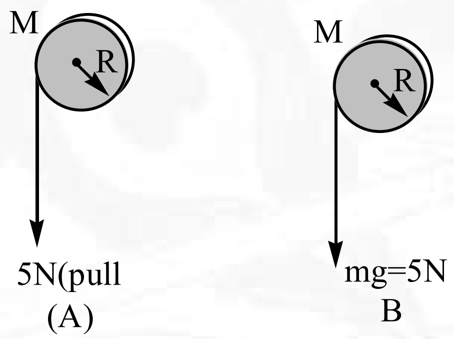
PHYSICS

1. A uniform disc of mass $M = 2.50kg$ and radius $R = 0.20m$ is mounted on an axle supported on fixed frictionless bearings. A light cord wrapped around the rim is pulled with a force 5N. On the same system of pulley and string instead of pulling it down, a body of weight 5N is suspended. If the first process is termed A and the second B, the tangential acceleration of circumference point will be



1) equal in the process A and B

2) greater in process A than in B

3) greater in process B than in A

4) independent of the two process

2. A uniform rod kept vertically on the ground falls from rest. Its foot does not slip on the ground. Choose incorrect option.

1) No point of the rod can have acceleration greater than g in any position

2) At any position of the rod, different points on it have different accelerations

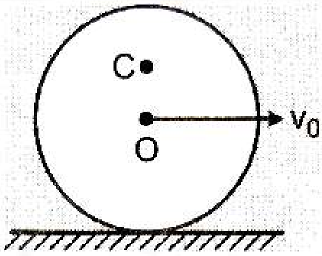
3) Any particular point on the rod has different acceleration at different positions of the rod.

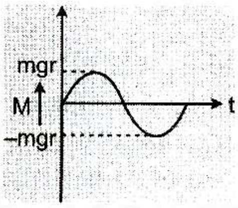
4) The maximum acceleration of end point on the rod, at some particular position , is greater than $1.5g$.

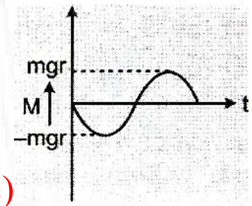
3. Torque of force $(2\hat{i}-4\hat{j}+\hat{k})N$ acting at a point (2, 3, 6) m about z-axis is of magnitude

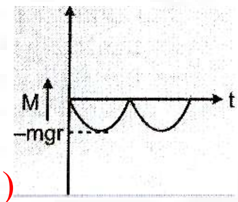
1) $14\ N \cdot m$	2) $12\ N \cdot m$
3) $7\ N \cdot m$	4) $2\ N \cdot m$

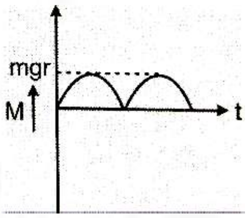
4. A disc of mass m and radius R is under pure rolling with a constant velocity υ_0 on a smooth surface. The centre of mass of the disc C is offset from centre O by a distance r. A time varying couple M is applied such that the disc continues to roll with a constant velocity. Initial position of the point C is shown in the figure. The correct plot of variation of couple M with time t will be: (Take clockwise torque as positive)



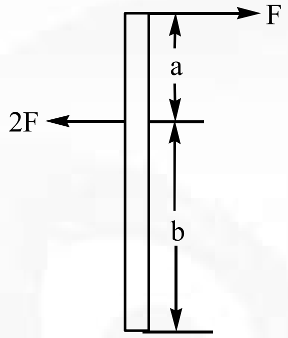
1) 

2) 

3) 

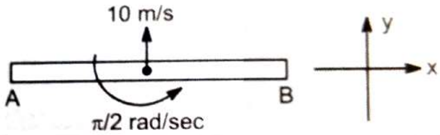
4) 

5. Two forces F and 2F act on a smooth uniform rod placed on horizontal surface. If the rod has zero angular acceleration, then ratio $\frac{a}{b}$ is:



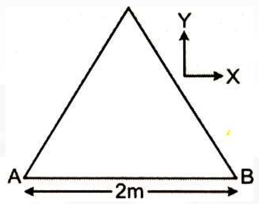
1) 1:1 2) 1:2 3) 1:3 4) 2:5

6. A uniform rod *AB* of length 4m and mass 12 kg is thrown such that just after the projection the centre of mass of the rod moves vertically upwards with a velocity 10 m/s and at the same time it is rotating with an angular velocity $\pi/2\ rad/\sec$ about a horizontal axis passing through its midpoint. Just after the rod is thrown it is horizontal and as shown in the figure. The acceleration (in m/s^2) of the point A when the centre of mass is at the highest point is: (Take $\pi^2 = 10$ and g = 10 m/s^2)



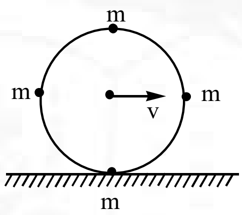
1) $5\hat{j}$ 2) $-5\hat{j}$ 3) $-10\hat{j}$ 4) $5\hat{i} - 10\hat{j}$

7. A rigid equilateral triangular plate ABC of side 2m, is in motion in the x-y plane. At the instant shown in the figure, the point B has velocity $\vec{\upsilon}_B = (3\hat{i} + 8\hat{j})\ m/s$ and the plate has angular velocity $\vec{\omega} = 2\hat{k}\ rad/s$. Find the speed of point A.



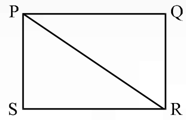
1) 5 m/s 2) 4 m/s 3) 3 m/s 4)8 m/s

8. Four beads each of mass m are glued at the top, bottom and the ends of the horizontal diameter of a ring of mass m. If the ring rolls without sliding with the velocity v of its CM, the kinetic energy of the system (beads + ring) is:



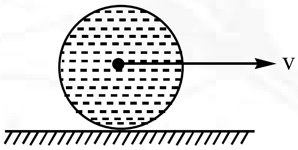
1) $5mv^2$ 2) $4mv^2$ 3) $2mv^2$ 4) $7mv^2$

9. Moment of inertia of a uniform rectangular plate about an axis passing through P and perpendicular to the plate is I. Then the moment of inertia of its part PQR about an axis perpendicular to the plane of the plate and



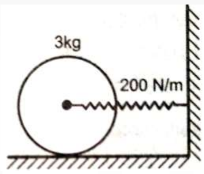
1) passing through P = I/2
2) passing through R = I/2
3) passing through P > I/2
4) passing through R > I/2

10. A thin spherical shell of mass M and radius R is completely filled with non-viscous liquid of mass $2M$. Assume pure rolling, kinetic energy of the system is given by:



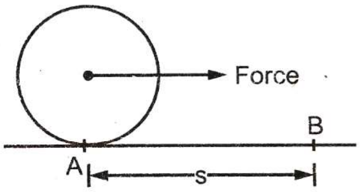
1) $\frac{11}{6}MV^2$
2) $\frac{2}{3}MV^2$
3) $3MV^2$
4) $4MV^2$

11. The uniform solid cylinder rolls without slipping in the system shown. If the maximum compression in spring is 15cm, the maximum friction force acting on the cylinder during its motion is:



1) 14 N 2) 10 N 3) 12 N 4) 15 N

12. A disc of circumference s is at rest at a point A on a horizontal surface when a constant horizontal force begins to act on its centre. Between A and B there is sufficient friction to prevent slipping, and the surface is smooth to the right of B. $AB = s$. The disc moves from A to B in time T. To the right of B, choose incorrect option



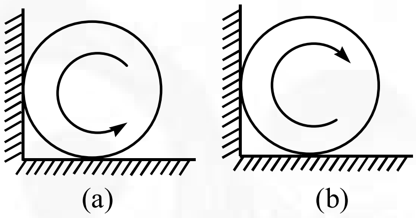
1)the angular acceleration of the disc will disappear.

2)linear acceleration of the disc will increase

3)the disc will make one rotation in time T

4) the disc will cover a distance greater than s in a further time T

13. A sphere is placed rotatingwith its centre initially at rest in a corner as shown in figure (a) and (b). Coefficient of friction between all surfaces and the sphere is 1/3. Find the ratio of the frictional forces $\frac{f_a}{f_b}$ by ground in situations (a) and (b).

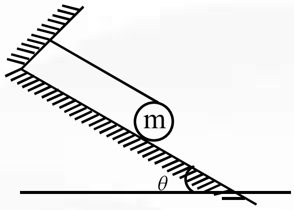


1) 1 2) 9/10 3) 10/9 4) 2/5

14. A massless string is wrapped around a solid cylinder of mass m and radius R. The string is pulled vertically upward to prevent the centre of mass from falling as the cylinder unwinds the string. The length of the string unwound when the cylinder has reached a speed ω will be :

1) $\frac{R\omega}{4g}$ 2) $\frac{R^2\omega^2}{2g}$ 3) $\frac{R^2\omega^2}{4g}$ 4) $\frac{R^2\omega^2}{8g}$

15. A uniform cylinder of mass m being wrapped by a light string remains in equilibrium on a sufficiently rough inclined plane. Then :



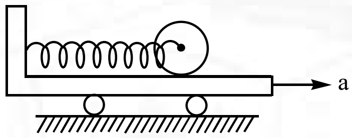
1) The tension in the string is equal to $mg\sin\theta$

2) Friction force acting on the cylinder is $\frac{mg\sin\theta}{2}$

3) tension in the string is equal to $\frac{mg\sin\theta}{4}$

4) frictional force acting on the cylinder is zero

16. A solid uniform sphere is connected with a moving trolley car by a light spring. The trolley car moves with an acceleration a. If the sphere remains at rest relative to the trolley car, then :



1) spring force is equal to 2ma

2) friction between the sphere and trolley car is equal to zero

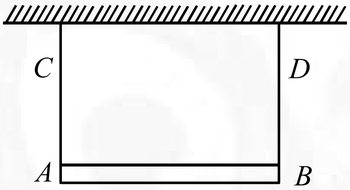
3) friction between the sphere and trolley car is equal to $\frac{ma}{2}$

4) spring force is equal to $\frac{ma}{2}$

17. A carpet of mass M is rolled along its length in the form of a cylinder of radius R and kept on a rough floor. If the carpet is unrolled, without sliding, to a radius R/2, the decrease in potential energy is

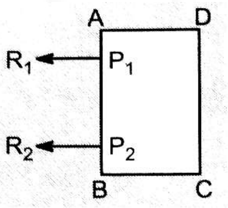
1) $\frac{1}{2}MgR$ 2) $\frac{3}{4}MgR$ 3) $\frac{5}{8}MgR$ 4) $\frac{7}{8}MgR$

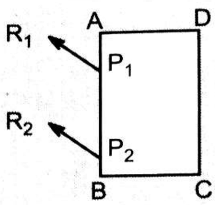
18. A uniform rod AB of mass m and length L is suspended by two strings C and D of negligible mass as shown in Figure. When string D is cut, the tension in string C just after cutting will be

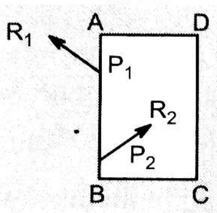


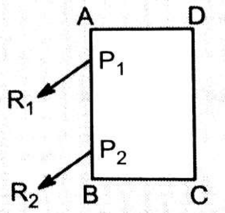
1) $\frac{mg}{4}$ 2) mg 3) $2mg$ 4) $4mg$

19. A uniform rectangular metal plate ABCD is supported by two hinges P_1 and P_2 so that it remains in equilibrium in vertical plane (with line AB vertical) as shown in the figure. The reaction forces R_1 and R_2 exerted by hinges on the metal plate is best depicted by:

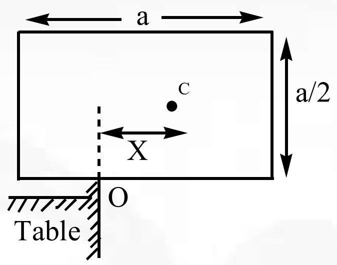
1) 

2) 

3) 

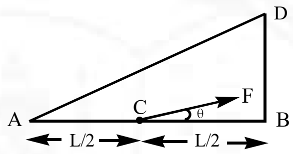
4) 

20. The uniform rectangular slab is released from rest in the position shown. Determine the value X for which angular acceleration is a maximum in the same position shown?



1) $\frac{a}{4}$ 2) $\frac{a}{3}$ 3) $\frac{a}{\sqrt{6}}$ 4) $\frac{a}{\sqrt{3}}$

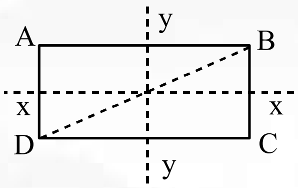
21. A triangular plate of uniform thickness and density is made to rotate about an axis perpendicular to the plane of the paper and (a) passing through A, (b) passing through B, by the application of some force F at C (mid-point of AB) as shown in the figure. In which case angular acceleration is more in magnitude?



1) In case (a) 2) In case (b)

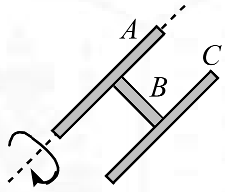
3) Same in both cases (a) and (b) 4) can't be said

22. In a uniform rectangular plate $ABCD, AB = 2l$ and $BC = l$ Axes xx and yy pass through the centre of the rectangle. The moment of inertia is least about :



1) DB 2) BC 3) $xx-$ axis 4) $yy-$ axis

23. A rigid body is made of three identical thin rods. Each of length L fastened together in the form of letter H. The body is free to rotate about a horizontal axis that runs along the length of one of the legs of the H. The body is allowed to fall from rest from a position in which the plane of H is horizontal. What is the angular speed of the body when the plane of H is vertical ?



1) $\sqrt{\frac{g}{L}}$ 2) $\frac{1}{2}\sqrt{\frac{g}{L}}$ 3) $\frac{3}{2}\sqrt{\frac{g}{L}}$ 4) $2\sqrt{\frac{g}{L}}$

24. A solid sphere starts from rest at the top of an incline of height h and length l, and moves down. The force of friction between the sphere and the incline is F. This is insufficient to prevent slipping. The kinetic energy of the sphere at the bottom of the incline is W.

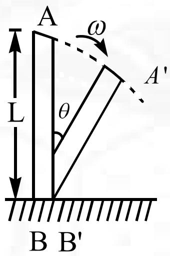
1) The work done against the force of friction is $Fl/2$.

2) $W < (mgh - Fl)$

3) $W = mgh - Fl$

4) $W > (mgh - Fl)$

25. A uniform rod of length L is free to rotate in a vertically plane about fixed horizontal axis through B. The rod begins rotating from rest from its unstable equilibrium position(where $\theta \to 0$) When it has turned though an angle θ its angular velocity ω is given as :



1) $\sqrt{\frac{6g}{L}}\sin\theta$ 2) $\sqrt{\frac{6g}{L}}\sin\frac{\theta}{2}$ 3) $\sqrt{\frac{6g}{L}}\cos\frac{\theta}{2}$ 4) $\sqrt{\frac{6g}{L}}\cos\theta$

26. Two wheels are mounted side by side and each is marked with a dot on its rim. The two dots are aligned with the wheels at rest, then one wheel is given a constant angular acceleration of $\pi/2\,rad/\sec^2$ and the other $\pi/4\,rad/\sec^2$ in same direction. Then the two dots become aligned again for the first time after

1) $2s$ 2) $4s$ 3) $1s$ 4) $8s$

27. Two rings of radius R and nR made up of same material have the ratio of moment of inertia about normal axis passing through centre as 1 : 8. The value of n is :

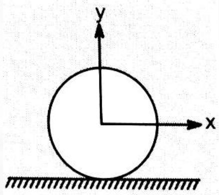
1) 2 2) $2\sqrt{2}$ 3) 4 4) $1/2$

28. If $\vec{F}$ is the force acting on a particle having position vector $\vec{r}$ and $\vec{\tau}$ be the torque of this force about the origin. Then

1) $\vec{r}.\vec{\tau} > 0$ and $\vec{F}.\vec{\tau} < 0$ 2) $\vec{r}.\vec{\tau} = 0$ and $\vec{F}.\vec{\tau} = 0$

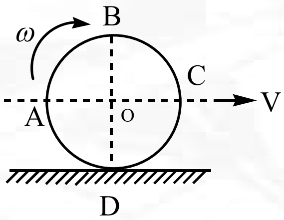
3) $\vec{r}.\vec{\tau} = 0$ and $\vec{F}.\vec{\tau} \neq 0$ 4) $\vec{r}.\vec{\tau} \neq 0$ and $\vec{F}.\vec{\tau} = 0$

29. A disc of radius R rolls and slips on a horizontal surface with linear velocity $\upsilon\hat{i}$ and angular velocity $\omega(-\hat{k})$ such that $\upsilon < R\omega$. There is a particle P on the circumference of the disc which has velocity in vertical direction. The height of that particle from the ground will be:



1) $R+\frac{\upsilon}{\omega}$ 2) $R-\frac{\upsilon}{\omega}$ 3) $R+\frac{R}{2}$ 4) $R-\frac{R}{2}$

30. A uniform ring of mass M rolls without slipping on a horizontal surface. At any instant, its position is as shown in the figure, then



1) section ABC has kinetic energy= $MV^2\left(\frac{\pi+2}{2\pi}\right)$

2) section BC has kinetic energy = $MV^2\left(\frac{\pi+4}{3\pi}\right)$

3) section BC has the same kinetic energy as section DA

4) the section AB, BC,CD and DA have the same kinetic energy