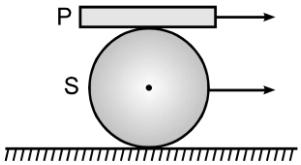
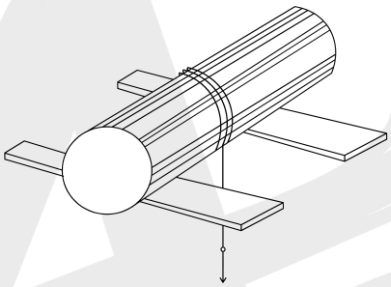
DPP 06

Pure Rolling

1. A plank P is placed on a solid cylinder S, which rolls on a horizontal surface. The two are of equal mass. There is no slipping at any of the surfaces in contact. The ratio of the kinetic energy of P to the kinetic energy of S is n : 3 where n is :



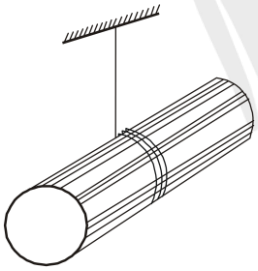
2. A uniform solid cylinder of mass m = 1kg rests on two horizontal planks. A thread is wound on the cylinder. The hanging end of the thread is pulled vertically down with a constant force F.



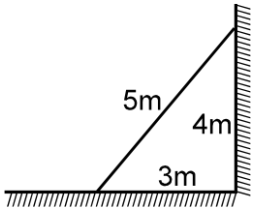
(a) Find the maximum magnitude of the force F(in N) which still does not bring about any sliding of the cylinder, if the coefficient of friction between the cylinder and the planks is equal to $\mu = \frac{1}{3}$.

(b)The acceleration a_{max} of the axis of the cylinder rolling on the planks is $\frac{n}{3} m/s^2$ where n is:

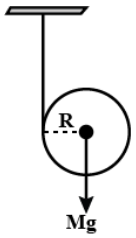
3. A string is wrapped over the curved surface of a uniform solid cylinder and the free end is fixed with rigid support. The solid cylinder moves down, unwinding the string. Find the downward acceleration of the solid cylinder.



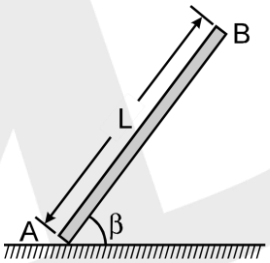
4. A uniform ladder of length 5m is placed against the wall in vertical plane as shown in the figure. If coefficient of friction μ is the same for both the wall and the floor then minimum value of μ for it not to slip is____



5. A solid cylinder of mass M has a string wrapped several times around its circumference. The free end of string is attached to the ceiling and the cylinder is released from rest. Find the acceleration of the cylinder and the tension in the string.



6. The uniform rod AB of mass m is released from rest when $\beta = 60°$. Assuming that the friction force between end A and the surface is large enough to prevent sliding, determine (for the instant just after release)

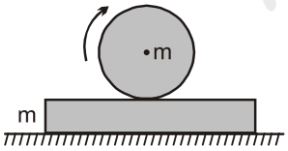


(a) The angular acceleration of the rod

(b) The normal reaction and the friction force at A.

7. A uniform disk of mass m is released from rest from the rim of a fixed hemispherical bowl so that it rolls along the surface. If the rim of the hemisphere is kept horizontal, find the normal force exerted by the bowl on the disk when it reaches the bottom of the bowl.

8. A uniform sphere of mass ' m ' is given some angular velocity about a horizontal axis through its centre and gently placed on a plank of mass ' m '. The co-efficient of friction between the two is μ. The plank rests on a smooth horizontal surface. The initial acceleration of the centre of sphere relative to the plank will be :

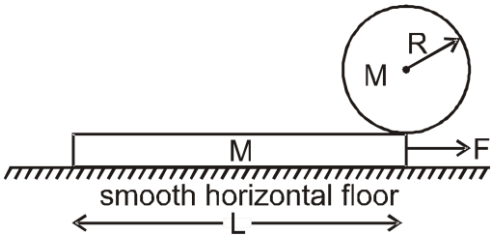


(A) zero (B) μg (C) (7/5) μg (D) 2 μg

Passage

A uniform disc of mass M and radius R initially stands vertically on the right end of a horizontal plank of mass M and length L, as shown in the figure.

The plank rests on smooth horizontal floor and friction between disc and plank is sufficiently high such that disc rolls on plank without slipping. The plank is pulled to right with a constant horizontal force of magnitude F.



9. The magnitude of acceleration of plank is

(A) $\frac{F}{8M}$ (B) $\frac{F}{4M}$ (C) $\frac{3F}{2M}$ (D) $\frac{3F}{4M}$

10. The magnitude of angular acceleration of the disc is -

(A) $\frac{F}{4mR}$ (B) $\frac{F}{8mR}$ (C) $\frac{F}{2mR}$ (D) $\frac{3F}{2mR}$

11. The distance travelled by centre of disc from its initial position till the left end of plank comes vertically below the centre of disc is

(A) $\frac{L}{2}$ (B) $\frac{L}{4}$ (C) $\frac{L}{8}$ (D) L

ANSWER KEY

1. 8 **2.** (a) 10 (b) 20 **3.** 6.66 **4.** $\frac{1}{3}$ **5.** $a = \frac{2g}{3}$ and $T = \frac{Mg}{3}$

6. (a) $\frac{3g}{4L}$ (cw) (b) $N = \frac{13\,mg}{16}\uparrow, F = \left(\frac{3\sqrt{3}}{16}\right)mg \rightarrow$ **7.** $\frac{7}{3}$mg **8.** 2μg **9.** (D)

10. (C) **11.** (A)