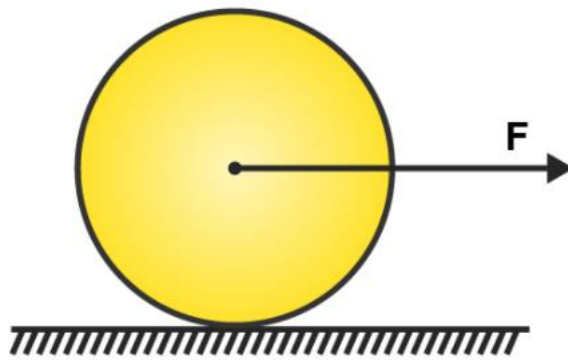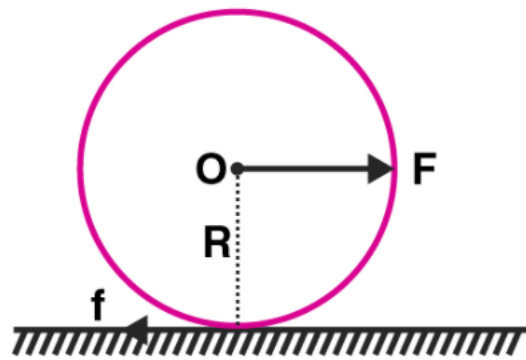7.28. A uniform disc of radius R, is resting on a table on its rim. The coefficient of friction between disc and table is μ. Now the disc is pulled with a force F as shown in the figure. What is the maximum value of F for which the disc rolls without slipping?

Answer:

Let a and α be the linear and angular acceleration respectively. Then

$F - f = Ma$

Where M is the mass of the disc

f is the force of friction which is applied at the centre O

Torque to disc, $\tau = I_D \alpha$

Moment of inertia of the disc, $I_D = 1/2\ MR^2$

$fR = 1/2\ MR^2 . a/R$

$Ma = 2f$

$F - f = 2f$

$3f = F$

$f = F/3$

$F = 3\mu Mg$ which is the maximum force that applied on the disc to roll it on the surface without slipping.