7.26. Two cylindrical hollow drums of radii R and 2R and of a common height h, are rotating with angular velocities ω (anti-clockwise) and ω (clockwise) respectively. Their axes, fixed are parallel and in a horizontal plane separated by (3R + δ). They are now brought in contact

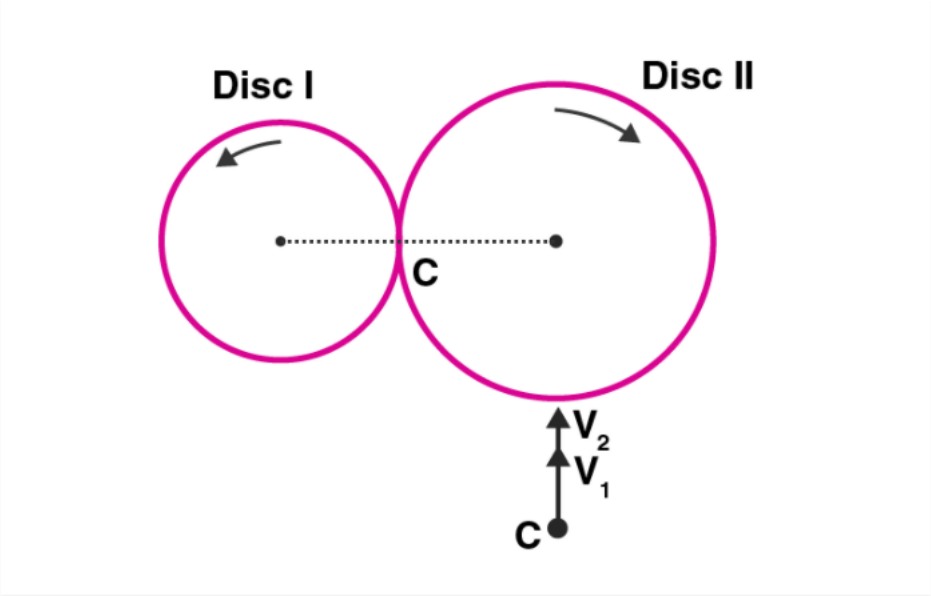
$$(\delta \to 0)$$

a) show the frictional forces just after contact

b) identify forces and torques external to the system just after contact

c) what would be the ratio of final angular velocities when friction ceases?

Answer



a) We know that $v_1 = \omega R$

$v_2 = \omega^2 R$

From the figure we can see that the direction of v_1 and v_2 are tangentially upwards and meet at point C. Therefore, the frictional forces on the surfaces is $f_{12} = -f_{21}$.

b) The external forces f_{12} and f_{21} are equal and opposite and is given as

$f_{12} = -f_{21}$

$f_{12} + f_{21} = 0$

$|f_{12}| = |-f_{21}| = F$

Therefore, the external torque is given as

(F)(3R)

So, it can be said that the velocity of the drum got doubled that is $v_2 = 2v_1$.

c) The anticlockwise and clockwise angular velocities of the drum are ω_1 and ω_2 respectively. When the velocities are equal, there is no force of friction and it is given as

$\omega_1 / \omega_2 = 2/1$