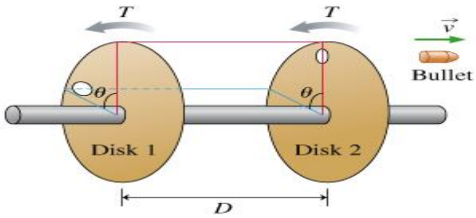
Q- A bullet is shot through two cardboard disks attached a distance D apart to a shaft turning with a rotational period T, as shown. Derive a formula for the bullet speed v in terms of D, T and a measured angle θ between the position of the hole in the first disk and that of the hole in the second. Both of the holes lie at the same radial distance from the shaft.



For the bullet to pass through the two holes it is fired in such a way that it passes through the first disk at time t = 0. Now before the bullet reaches the second desk the disc should rotate by the angle θ. Hence the time taken by the bullet to cross the distance D must be equal to the time taken by the disc to rotate by an angle θ.

Time taken by the discs to make one rotation (by angle 2π radians) is T

Therefore, time taken to rotate by angle θ will be = (T/2π)θ.

If the velocity of the bullet to is v than time taken by it to travel a distance D will be = D/v.

As the two times are equal we get

$$D/v = (T/2\pi)\theta.$$

Or **v = (2πD/T θ)**

This is the required relation.