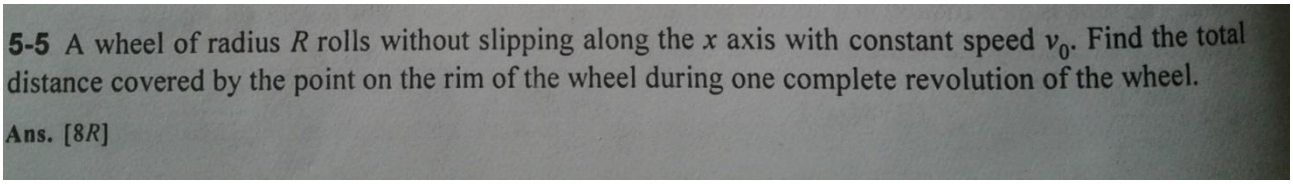
**Answer on Question #56589-Physics-Mechanics-Relativity**

Question 6 has not seen.



**5-5** A wheel of radius $R$ rolls without slipping along the $x$ axis with constant speed $v_0$. Find the total distance covered by the point on the rim of the wheel during one complete revolution of the wheel.

**Ans.** [$8R$]

**Solution**

A cycloid is the curve traced by a point on the rim of a circular wheel as the wheel rolls along a straight line without slippage.

One arch of a cycloid (one complete revolution) generated by a circle of radius $r$ can be parameterized by

$$x = r(t - \sin t); \quad y = r(1 - \cos t), 0 \le t \le 2\pi$$

So,

$$\frac{dx}{dt} = r(1 - \cos t); \frac{dy}{dt} = r \sin t$$

The arc length S of one arch is given by

$$S = \int_0^{2\pi} \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt = \int_0^{2\pi} r\sqrt{1 + \cos^2 t - 2\cos t + \sin^2 t}\, dt = \int_0^{2\pi} r\sqrt{2 - 2\cos t}\, dt$$

$$= \int_0^{2\pi} 2r \sin\frac{t}{2} dt = 8r.$$