Q- A wheel starting from rest with uniform angular acceleration makes 3 revolutions in 8 s
(a) What is the angular acceleration of the wheel?
(b) What is its angular velocity at t = 8 s?
(c) What is the linear speed of a particle at distance 0.50 m from the axis of rotation?

The equations for rotational motion with uniform angular acceleration of a body are the same as that for the linear motion with uniform acceleration; only we have to substitute the corresponding quantities. Let the initial angular velocity of the body is w_0 and its angular acceleration is a then its final angular velocity w and the angular displacement q at time t are related as

$\omega = \omega_0 + \alpha t$ ------ (1) same as v = u + at

$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$ ------ (2) same as s = ut + (1/2)at^2

And $\omega^2 = \omega_0^{\ 2} + 2\alpha\theta$ ------ (3) same as $v^2 = u^2 + 2as$

According to the question the wheel starting from rest makes 3 revolutions in 8 s hence

$w_0 = 0$; t = 8 s; and $\theta = 3*2\pi$ radians

(a) Using second equation of rotational motion we get

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

Or $$6\pi = 0*8 + \frac{1}{2}\alpha *8^2$$

Or $$\alpha = \frac{3\pi}{16} = 0.589 \text{ rad/s}^2$$

(b) Using first equation we get

$$\omega = \omega_0 + \alpha t$$

Or $$\omega = 0 + 0.589*8 = 4.712 \text{ rad/s}$$

(c) the linear speed of a particle at distance R from the axis of rotation is given by

$v = \omega*R = 4.712*0.50 = 2.356$ m/s