Q- A disk accelerates constantly from rest. After 8 s, it has made 3 revolutions.
(a) What is the angular acceleration of the disk?
(b) What is the angular velocity of the disk at t = 8 s?
(c) If the radius of the disk is 50 cm, what is the linear velocity of a point on the rim at time t = 8 s?

The quantities of rotational dynamics are similar to the particle dynamics the main difference is that the displacement of the translation s (or x) is replaced by the angular displacement q, hence the three equations of uniformly accelerated motion can be written as

$\omega = \omega_0 + \alpha t$ ---------- (1) [v= u + at]
$\theta = \omega_0 t + \frac{1}{2}\,\alpha\, t^2$ ---------- (2) [s = u t + ½ a t^2] and
$\omega^2 = {\omega_0}^2 + 2\,\alpha\,\theta$ ---------- (3) [v^2 =u^2 +2 a s]

Solution:

Here initial angular velocity of the disk $\omega_0 = 0$
Time interval t = 8 s
And angular displacement q = 3 rev = 3*2π = 6 π radians

(a) a = ?

Using the second equation we get

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

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

Gives a = 3 π/16 radians/s^2 = 0.59 rad/s^2

(b) The angular velocity of the wheel at t =8 sec is given by using first equation as

$\omega = \omega_0 + \alpha t$

Or $\omega = 0 + (0.59) * 8 = 4.71\, rad/s$

(c) The linear tangential speed of a particle in circular motion is given by
v = ω*r

Here r is the radius of the circular motion of the point.

Thus at t = 8 s the linear speed of the particle is given by

v = 4.71*50 = 235.62 cm/s = 2.36 m/s