Q- A torque of 50 N.m accelerates a wheel from rest to 100 rev/min in 5 seconds.
(a) What is the angular displacement of the wheel?
(b) What is the angular acceleration of the wheel?
(c) What is the moment of inertia of the wheel?

Corresponding to the second law of motion F = ma the equation of rotational motion is given by

$$\tau = I\alpha$$

Here τ is the torque and I is the moment of inertia of the body.
Here τ = 50 N.m
t = 5 s
ω = 100 rev/min = 100*2 π/60 rad/s = 10π/3 rad/s

(a)

As the angular acceleration of the wheel is constant

Angular displacement = average angular velocity* time

Or $$\theta = \left(\frac{\omega_0 + \omega}{2}\right) * t$$

Or $$\theta = \left(\frac{0 + 10\pi/3}{2}\right) * 5$$

Or $$\theta = \left(\frac{5\pi}{3}\right) * 5 = \frac{25\pi}{3} rad = 26.18 \text{ rad}$$

(b)

Using first equation of rotational motion we have

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

Or $10\pi/3 = 0 + \alpha*5$

Gives $\alpha = 2\pi/3$ rad/s^2 = 2.09 rad/s^2

(c)

The moment of inertia of the wheel is given by

$$I = \frac{\tau}{\alpha} = \frac{50}{2.09} = 23.87 \text{ kg.m}^2$$