



A wheel of 40 cm radius starts rotating from rest and accelerates at  $0.3 \text{ rad/s}^2$ .

- a) What is the angular displacement of the wheel between  $t = 0 \text{ s}$  and  $t = 15 \text{ s}$ ?
- b) What is the angular velocity of the wheel at  $15 \text{ s}$ ?
- c) What is the maximum speed of a point on the outside of the wheel 15 cm away from the outer part of the wheel during the first 15 s of motion?

### Solution

a) The angular displacement between  $t = 0 \text{ s}$  and  $t = 15 \text{ s}$  can be calculated using the formula:

$$\theta = \omega_0 * t + (1/2) * \alpha * t^2$$

where

$\omega_0 = 0$  (initial angular velocity),  
 $\alpha = 0.3 \text{ rad/s}^2$  (angular acceleration), and  
 $t = 15 \text{ s}$  (time interval).

So,

$$\theta = (1/2) * 0.3 * 15^2 = 33.75 \text{ rad.}$$

b) The angular velocity at  $t = 15 \text{ s}$  can be calculated using the formula:

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

where

$\omega_0 = 0$  (initial angular velocity),  
 $\alpha = 0.3 \text{ rad/s}^2$  (angular acceleration), and  
 $t = 15 \text{ s}$ .

So,

$$\omega = 0 + 0.3 * 15 = 4.5 \text{ rad/s.}$$

c) The maximum speed of a point on the outside of the wheel 15 cm from the outer part during the first 15 s of motion can be calculated using the formula:

$$v = r * \omega$$

where

$r = 40 \text{ cm} + 15 \text{ cm} = 55 \text{ cm}$  (distance from axle), and



$\omega = 4.5 \text{ rad/s}$  (angular velocity at 15s).

So,

$$v = 55 \text{ cm} * 4.5 \text{ rad/s}$$

$$= 247.5 \text{ cm/s}$$

$$= 2.475 \text{ m/s.}$$