Q- A car accelerates uniformly from rest and reaches a speed 20.0 m/s in 10.0 s. The tires have diameter 60.0 cm and do not slip on the pavement. (a) Find the number of revolutions each tire makes during this motion. (b) What is the final angular speed of a tire in revolutions per second?

(a) Initial velocity of the car u = 0
Final velocity of the car v = 20.0 m/s
Time required t = 10.0 s

Hence acceleration a of the car will be given by the first equation of motion as

[v = u + a*t]

20.0 = 0 + a*10.0

Gives a = 20.0/10.0 = 2.00 m/s$^2$

The distance covered by the car during this time is given by the second equation of motion

[s = u*t + ½*a*t$^2$]

s = 0 + 0.5*2.00*100 = 100 m

Now as in each revolution a wheel rolling without slipping covers a distance equal to its periphery ($2\pi R$), if the total numbers of revolution of each tire be n, then we have

s = n*$2\pi$R [radius of the wheel is 0.60/2 m]

or $n = \frac{s}{2\pi R} = \frac{100}{2*3.1416*0.30} = 53.1\, rev$ .

(b)

As discussed above is the wheel is rolling without slipping, its angular velocity is related to the linear speed as

$$\omega = \frac{v}{R} = \frac{20.0}{0.30} = 66.7\, rad/s \; = \frac{66.7}{2\pi} \; = 10.6\, rev/s$$