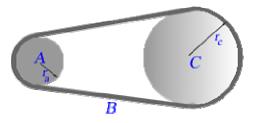
Problem 11.41P (HRW)

A wheel A of radius $r_a = 10.0$ cm is coupled by belt B to wheel C of radius $r_c = 25.0$ cm. Wheel A increases its angular speed from rest at a uniform rate of 1.6 rad/s². We have to find the time for wheel C to reach a rotational speed of 100 rev/min, assuming that belt does not slip.



Solution:

Let at time t the angular speed of wheel A be ω_a and the angular speed of wheel C be ω_c . As the two wheels are connected by a belt which does not slip, the linear speeds at the rims of the two wheels has to be equal. This requirement gives the condition

 $r_a \omega_a = r_c \omega_c.$

Also, the angular acceleration α_a of wheel A and the angular acceleration α_c of wheel C will be similarly related, that is

$$r_a \alpha_a = r_c \alpha_c$$
.

We are given that

 $r_a = 10.0$ cm, $r_c = 25.0$ cm, and $\alpha_a = 1.6$ rad/s².

Therefore,

$$\alpha_c = \frac{1.6 \times 10}{25}$$
 rad s⁻² = 0.64 rad s⁻².

We will now calculate the time in which the wheel *C* will acquire the angular speed

$$\omega_c = \frac{100 \times 2\pi}{60}$$
 rad s⁻¹ = 10.47 rad s⁻¹.

As the wheel *C* is speeding up with constant acceleration the time in which it will attain this angular speed will be

$$t = \frac{\omega_c}{\alpha_c} = \frac{10.47}{0.64}$$
 s = 16.4 s.