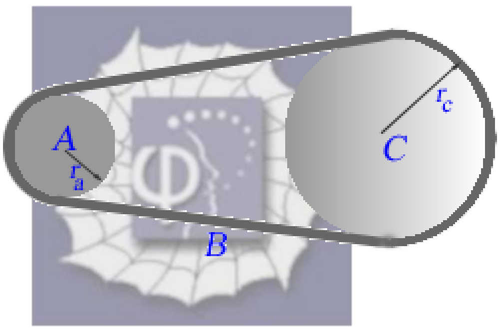
2.

<u>Problem 11.41P (HRW)</u>

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/s^2. *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/s^2.

Therefore,

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

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

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

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

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