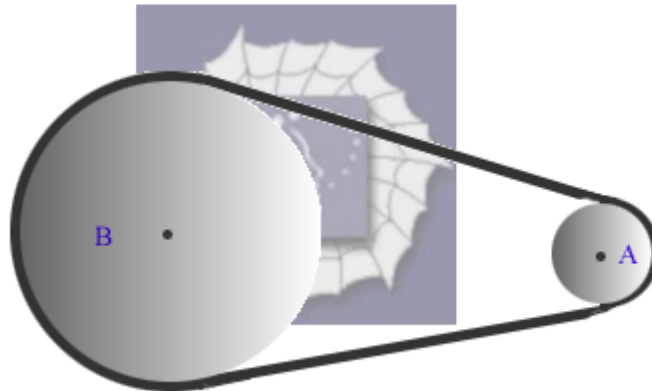


23.

**Problem 12.47P (HRW)**

*Wheels A and B as shown in the figure are connected by a belt that does not slip. The radius of the wheel B is three times the radius of the wheel A. What would be the ratio of the rotational inertias  $I_A/I_B$  if both wheels had (a) the same angular momentum about their central axis and (b) the same rotational kinetic energies?*



**Solution:**

Radius  $r_B$  of the wheel B is three times the radius  $r_A$  of the wheel A. That is

$$r_B = 3r_A.$$

As the two wheels are connected by a belt which does not slip, the speeds of the rims of the wheels will be equal and their angular speeds will be related as

$$\omega_B r_B = \omega_A r_A,$$

and

$$\omega_B = \frac{1}{3} \omega_A.$$

(a)

If both wheels have the same angular momentum

$$I_B \omega_B = I_A \omega_A,$$

and

$$\frac{I_A}{I_B} = \frac{\omega_B}{\omega_A} = \frac{1}{3}.$$



(b)

If both wheels have the same rotational kinetic energy

$$\frac{1}{2} I_A \omega_A^2 = \frac{1}{2} I_B \omega_B^2,$$

and

$$\frac{I_A}{I_B} = \frac{1}{9}.$$