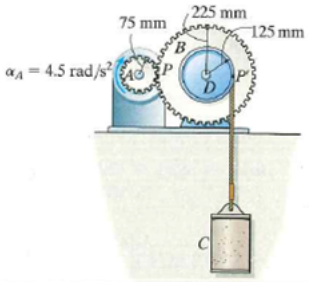
Engingee ing Mechanics | (14th Edition)

Problem

For a short period of time, the motor turns gear *A* with a constant angular acceleration of α_A = 4.5 rad/s^2, starting from rest. Determine the velocity of the cylinder and the distance it travels in three seconds. The cord is wrapped around pulley *D* which is rigidly attached to gear *B*.



Prob. F16-6

Step-by-step solution

Step 1 of 5

Given:

Constant angular acceleration of the gear A is $\alpha_A = 4.5\,\text{rad/s}^2$

Comment

Step 2 of 5

Initially gear is at rest.

For gears A and B, we have

$r_A \alpha_A = r_B \alpha_B$

Accordingly,

$0.075 \times 4.5 = 0.225 \times \alpha_B$

$0.225\,\alpha_B = 0.3375$

$\alpha_B = 1.5\,\text{rad/s}^2$

Comment

Step 3 of 5

Angular velocity of gear B is expressed as

$\omega_B =$

$\omega_B =$ [illegible]

We also have angular displacement expressed as

$$\theta_B = (\theta)_0 + (\omega_B)_0 t + \frac{1}{2}\alpha_B t^2$$

Comment

Step 4 of 5

By substituting the values of the parameters into the above relation, we have

$$\theta_B = 0 + (0 \times 3) + \left(\frac{1}{2} \times 1.5 \times 3^2\right)$$

$$\theta_B = 6.75\,\text{rad}$$

Velocity of the cylinder is expressed as

$$v_C = r_D \omega_B$$

Accordingly, we have

$$v_C = 0.125 \times 4.5$$

$$v_C = 0.5625\,\text{m/s}$$

Velocity of the cylinder is $\boxed{v_C = 0.5625\,\text{m/s}}$

Comment

Step 5 of 5

Distance travelled by the cylinder is expressed as

$$s_C = r_D \theta_B$$

Accordingly, we have

$$s_C = 0.125 \times 6.75$$

$$s_C = 0.844\,\text{m}$$

Distance travelled by the cylinder is $\boxed{s_C = 0.844\,\text{m}}$

Comment

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with a const
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rad/s2, starting from rest....

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Chapter 16, Problem 6FP

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displacement of gear A, measured in...

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