TOPIC
Strength of Materials – Section VIII – Question 4

QUESTION
A hollow cylinder of length $6''$, and inner and outer radii $1.5''$ and $3''$, respectively is twisted by a torque of 2000 lb-in. Given the shear modulus, G =11000 psi, Poisson's ratio, $v = 0.3333$, the angle of twist in degrees most nearly is
   (A) 0.0873
   (B) 0.524
   (C) 1.048
   (D) 1.397

HINT
Polar moment of area, $J = \frac{\pi}{2}(r_0^4 - r_i^4)$
The angle of twist, $\varphi = \frac{TL}{JG}$

SOLUTION
Polar moment of area, J is
$$J = \frac{\pi}{2}(r_0^4 - r_i^4)$$
$$= \frac{\pi}{2}(3^4 - 1.5^4)$$
$$= 119.28\text{in}^4$$
where
   r_0 = Outer radius of cylinder
   r_i = Inner radius of cylinder
The angle of twist, φ then is
$$\varphi = \frac{TL}{JG}$$
$$= \frac{(2000)(6)}{(119.28)(11000)}$$
$$= 0.00914578 \text{ radians}$$
$$= 0.524°$$

ANSWER
(B)

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