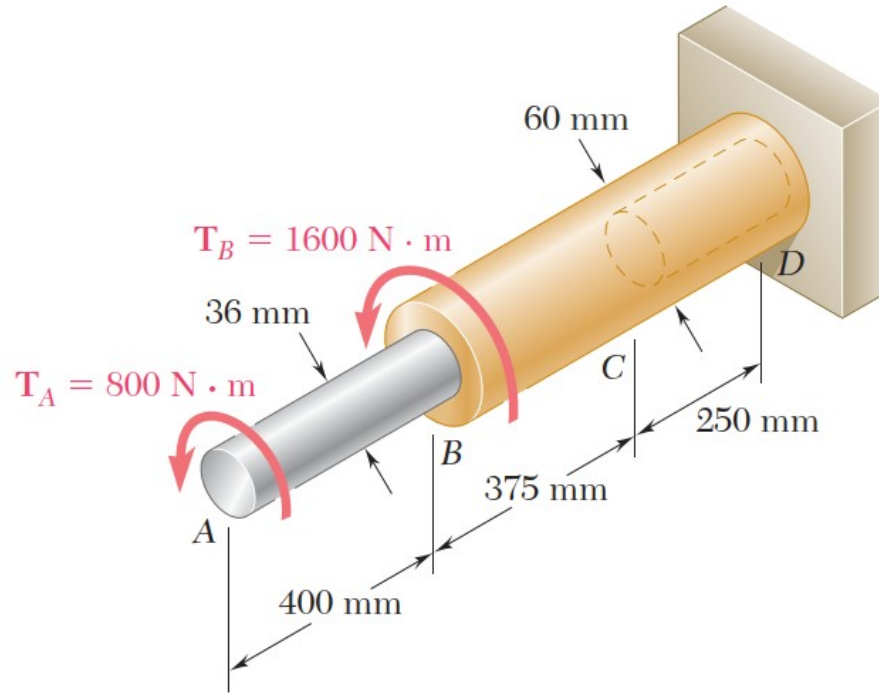


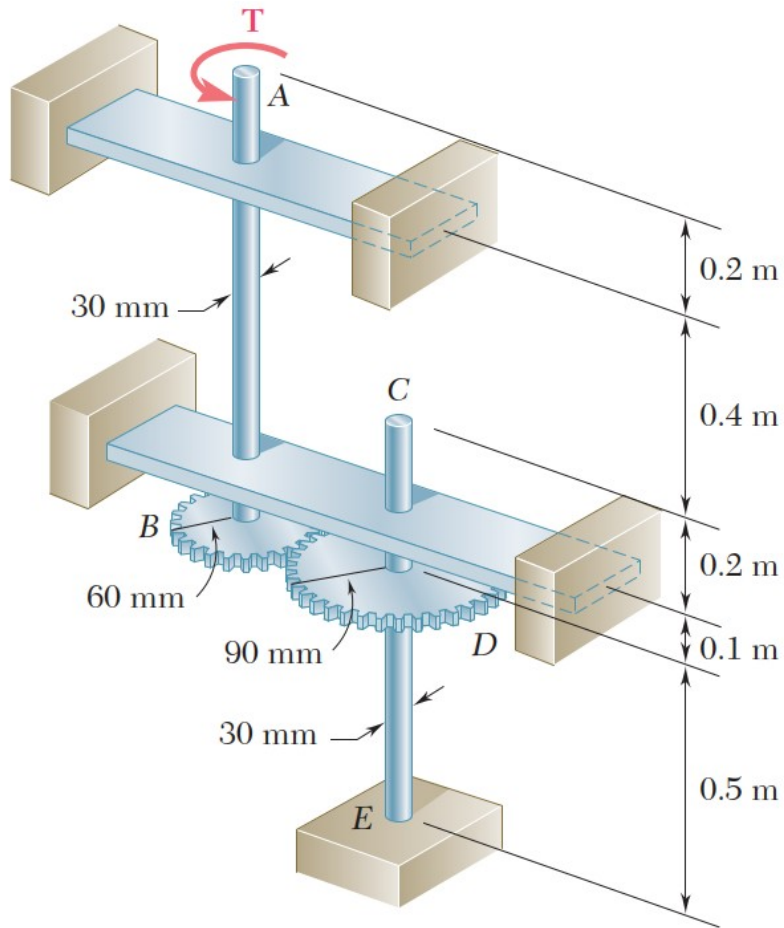
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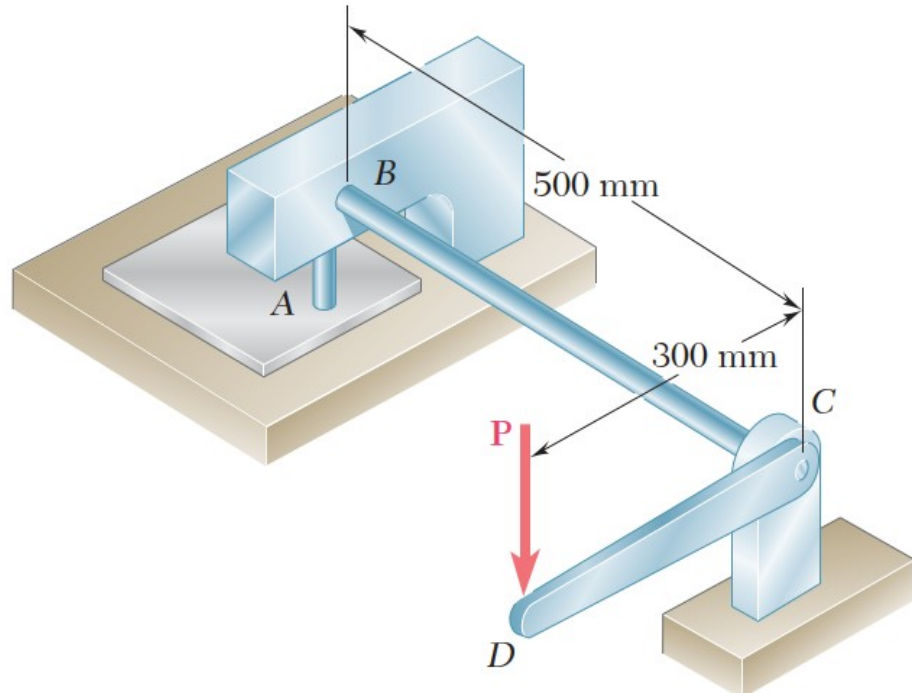
PROBLEM HOUR 3



Q1) The aluminum rod AB ($G = 27 \text{ GPa}$) is bonded to the brass rod BD ($G = 39 \text{ GPa}$). Knowing that portion CD of the brass rod is hollow and has an inner diameter of 40 mm, determine the angle of twist at A .



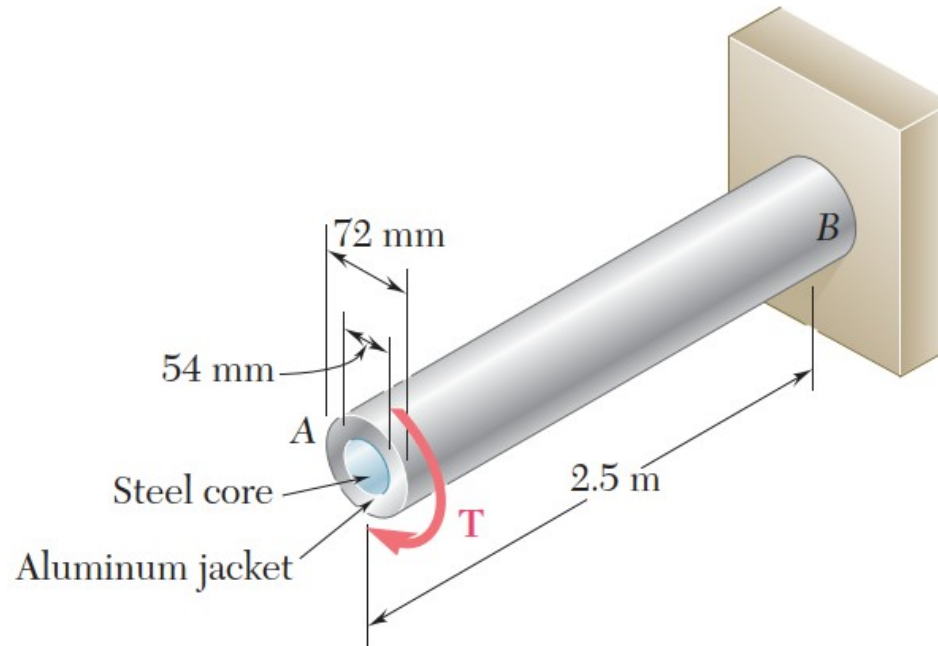
Q2) Two solid steel shafts, each of 30-mm diameter, are connected by the gears shown. Knowing that $G = 77.2\text{ GPa}$, determine the angle through which end A rotates when a torque of magnitude $T = 200\text{ N}\cdot\text{m}$ is applied at A .

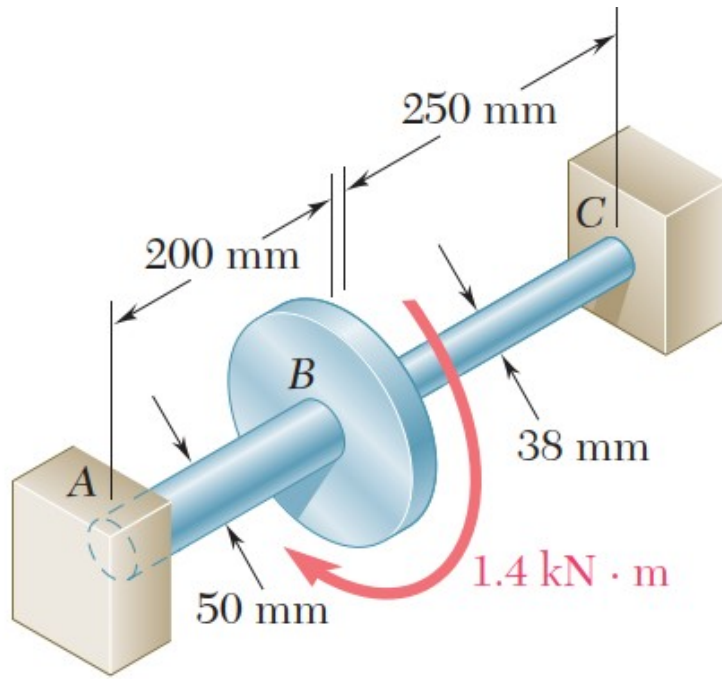


Q3) A hole is punched at A in a plastic sheet by applying a 600-N force P to end D of lever CD, which is rigidly attached to the solid cylindrical shaft BC. Design specifications require that the displacement of D should not exceed 15 mm from the time the punch first touches the plastic sheet to the time it actually penetrates it.

Determine the required diameter of shaft BC if the shaft is made of a steel with $G = 77\text{GPa}$ and $\tau_{\text{all}} = 80\text{MPa}$.

- Q4) A torque of magnitude $T = 4 \text{ kN} \cdot \text{m}$ is applied at end A of the composite shaft shown. Knowing that the modulus of rigidity is 77 GPa for the steel and 27 GPa for the aluminum, determine
- the maximum shearing stress in the steel core,
 - the maximum shearing stress in the aluminum jacket,
 - the angle of twist at A.





Q5) Two solid steel shafts ($G = 77.2$ GPa) are connected to a coupling disk B and to fixed supports at A and C. For the loading shown, determine

- the reaction at each support,
- the maximum shearing stress in shaft AB,
- the maximum shearing stress in shaft BC.