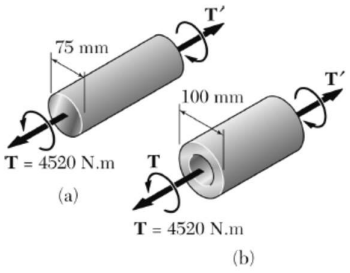
APL105

Tutorial and Assignment 4

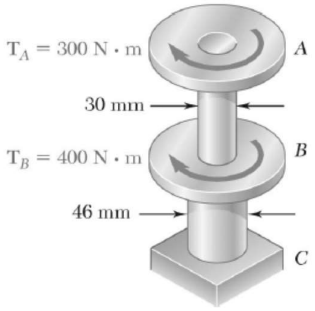
Assignment Problems: 3.9,15,37,60,74

Due on Monday 5th February (Lecture Class)



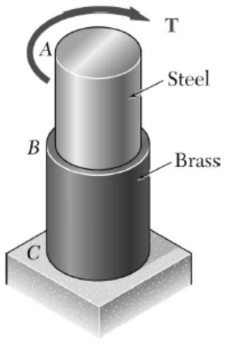
PROBLEM 3.5

(*a*) For the 75 mm diameter solid cylinder and loading shown, determine the maximum shearing stress. (*b*) Determine the inner diameter of the hollow cylinder, of 100 mm outer diameter, for which the maximum stress is the same as in part *a*.



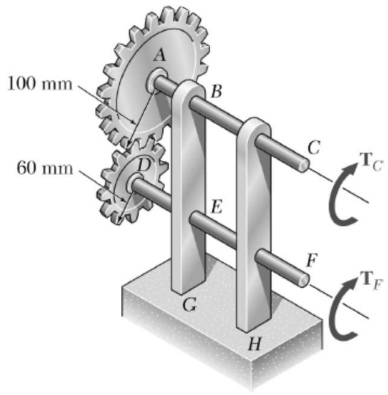
PROBLEM 3.9

The torques shown are exerted on pulleys *A* and *B*. Knowing that both shafts are solid, determine the maximum shearing stress (*a*) in shaft *AB*, (*b*) in shaft *BC*.



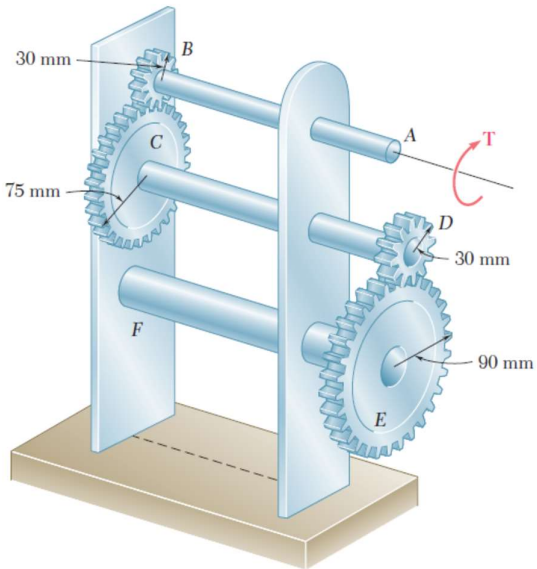
PROBLEM 3.15

The allowable shearing stress is 100 MPa in the 36-mm-diameter steel rod *AB* and 60 MPa in the 40-mm-diameter rod *BC*. Neglecting the effect of stress concentrations, determine the largest torque that can be applied at *A*.



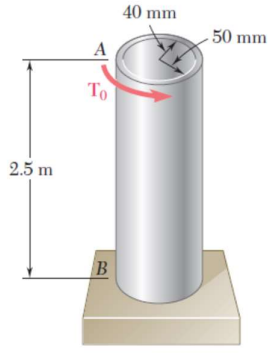
PROBLEM 3.25

The two solid shafts are connected by gears as shown and are made of a steel for which the allowable shearing stress is 50 MPa. Knowing the diameters of the two shafts are, respectively, $d_{BC} = 40$ mm and $d_{EF} = 30$ mm determine the largest torque $\mathbf{T}_C$ that can be applied at C.



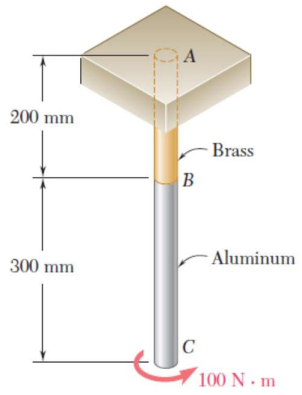
PROBLEM 3.28

A torque $T = 900$ N · m is applied to shaft AB of the gear train shown. Knowing that the allowable shearing stress is 80 MPa, determine the required diameter of (*a*) shaft AB, (*b*) shaft CD, (*c*) shaft EF.



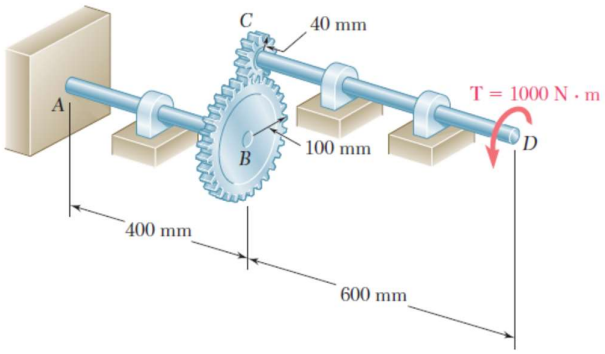
PROBLEM 3.34

(*a*) For the aluminum pipe shown ($G = 27$ GPa), determine the torque $\mathbf{T}_0$ causing an angle of twist of 2°. (*b*) Determine the angle of twist if the same torque $\mathbf{T}_0$ is applied to a solid cylindrical shaft of the same length and cross-sectional area.



PROBLEM 3.37

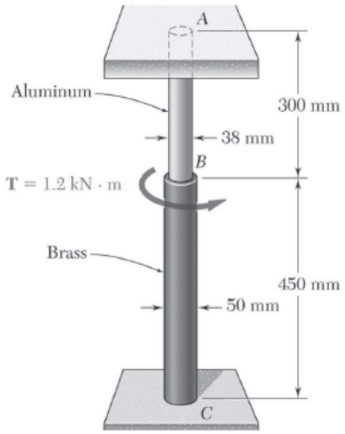
The aluminum rod BC (G = 26 GPa) is bonded to the brass rod AB (G = 39 GPa). Knowing that each rod is solid and has a diameter of 12 mm, determine the angle of twist (a) at B, (b) at C.



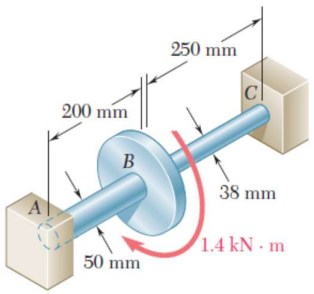
PROBLEM 3.48

The design of the gear-and-shaft system shown requires that steel shafts of the same diameter be used for both AB and CD. It is further required that $\tau_{max} \leq 60$ MPa, and that the angle ϕ_D through which end D of shaft CD rotates not exceed 1.5°. Knowing that G = 77.2 GPa, determine the required diameter of the shafts.

Problem 3.51



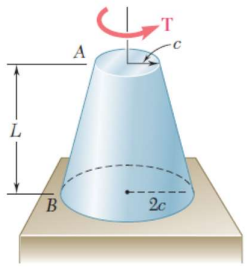
3.51 The solid cylinders AB and BC are bonded together at B and are attached to fixed supports at A and C. Knowing that the modulus of rigidity is 26 GPa for aluminum and 39 GPa for brass, determine the maximum shearing stress (a) in cylinder AB, (b) in cylinder BC.



PROBLEM 3.56

Solve Prob. 3.55, assuming that the shaft AB is replaced by a hollow shaft of the same outer diameter and 25-mm inner diameter.

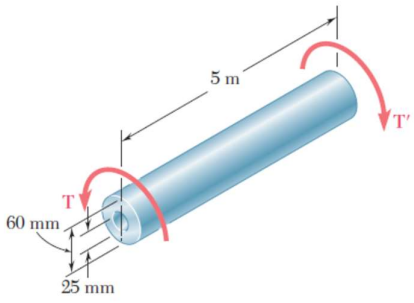
PROBLEM 3.55 Two solid steel shafts (G = 77.2 GPa) are connected to a coupling disk B and to fixed supports at A and C. For the loading shown, determine (a) the reaction at each support, (b) the maximum shearing stress in shaft AB, (c) the maximum shearing stress in shaft BC.



PROBLEM 3.60

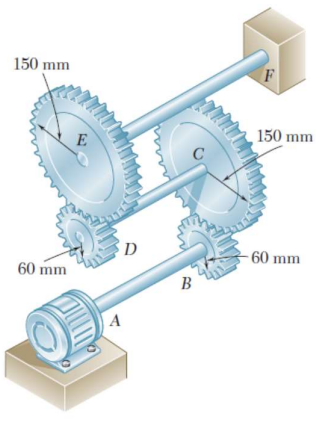
A torque **T** is applied as shown to a solid tapered shaft AB. Show by integration that the angle of twist at A is

$$\phi = \frac{7TL}{12\pi Gc^4}$$



PROBLEM 3.71

The hollow steel shaft shown (G = 77.2 GPa, τ_{all} = 50 MPa) rotates at 240 rpm. Determine (a) the maximum power that can be transmitted, (b) the corresponding angle of twist of the shaft.



PROBLEM 3.74

Three shafts and four gears are used to form a gear train that will transmit power from the motor at A to a machine tool at F. (Bearings for the shafts are omitted in the sketch.) The diameter of each shaft is as follows: d_{AB} = 16 mm, d_{CD} = 20 mm, d_{EF} = 28 mm. Knowing that the frequency of the motor is 24 Hz and that the allowable shearing stress for each shaft is 75 MPa, determine the maximum power that can be transmitted.