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Chongqing University

Mechanics of Materials

Mid-term Test April 22,2005

question number	1	2	3	4	5	6	7	8	9	10	total
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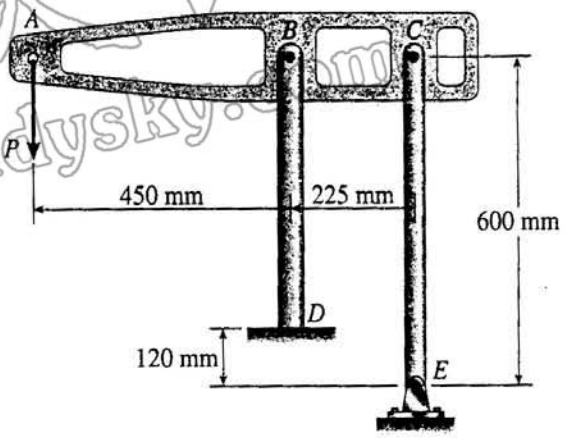
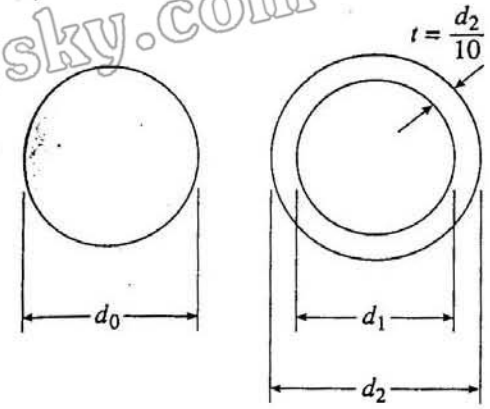
1. The contraption shown in Fig. consists of a horizontal beam *ABC* supported by two vertical bars *BD* and *CE*. Bar *CE* is pinned at both ends but bar *BD* is fixed to the foundation at its lower end. The distance from *A* to *B* is 450 mm and from *B* to *C* is 225 mm. Bars *BD* and *CE* have lengths of 480 mm and 600 mm, respectively, and their cross-sectional areas are 1020 mm^2 and 520 mm^2, respectively. The bars are made of steel having a modulus of elasticity $E = 205$ GPa. Assuming that beam *ABC* is rigid, find the maximum allowable load P_{max} if the displacement of point *A* is limited to 1.0 mm.



2. A steel shaft is to be manufactured either as a solid circular bar or as a circular tube (Fig.). The shaft is required to transmit a torque of 1200 N·m without exceeding an allowable shear stress of 40 MPa nor an allowable rate of twist of 0.75°/m. (The shear modulus of elasticity of the steel is 78 GPa.)

(a) Determine the required diameter d_0 of the solid shaft. (b) Determine the required outer diameter d_2 of the hollow shaft if the thickness t of the shaft is specified as one-tenth of the outer diameter. (c) Determine the ratio of diameters (that is, the ratio d_2/d_0) and the ratio of weights of the hollow and solid shafts.



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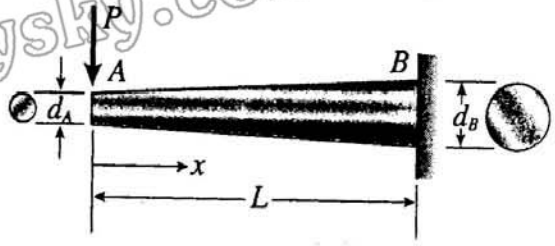
3. A tapered cantilever beam AB of solid circular cross section supports a load P at the free end (Fig.). The diameter d_B at the large end is twice the diameter d_A at the small end:

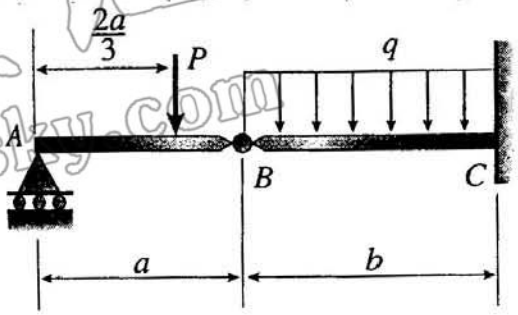
$$\frac{d_B}{d_A} = 2$$

Determine the bending stress σ_B at the fixed support and the maximum bending stress σ_{max}.



4. A compound beam ABC has a roller support at A, an internal hinge at B, and a fixed support at C (Fig.). A concentrated load P acts at distance $2a/3$ from support A and a uniform load of intensity q acts between points B and C. Determine the deflection δ_B at the hinge and the angle of rotation θ_A at support A.

(*Note:* The beam has constant flexural rigidity EI.)



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5. A beam ABC (Fig.) rests on simple supports at points A and B and is supported by a cable at point C. The beam has total length $2L$ and supports a uniform load of intensity q. Prior to the application of the load, there is no force in the cable nor is there any slack in the cable. When the load is applied, the beam deflects downward at point C and a tensile force T develops in the cable. Find the magnitude of this force.