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國立成功大學 79 學年度醫工所碩士班考試（材料力學 試題）共 貳 頁 第 壹 頁

題目共有六題，除第1題佔20%外，其餘每題各佔16%。

1. A rough sketch of a human femur subjected to a vertical load of 400 N is shown..

(*a*) Determine the distribution of stress across the section *BB* assuming that the circular section is solid bone.

(*b*) Same as (*a*), except that this time assume that the inner half of the bone radius consists of "spongy" bone. Assume that the "spongy" bone does not carry appreciable stress.

(*c*) What is the percentage increase in the maximum stress of distribution (*b*) compared with the maximum stress of distribution (*a*)?

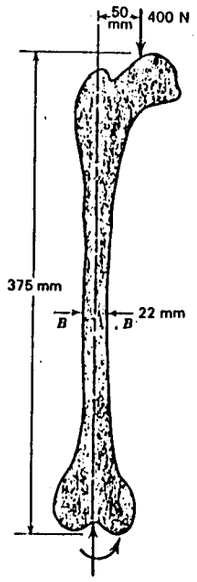

Fig. 1.

2. The rigid bar of length L is stabilized by a spiral spring which exerts a torque $k\theta$ when the bar is turned through the angle θ. Find the equilibrium deflection angle as a function of the magnitude of P. For what values of P is the equilibrium stable? Assume that ϵ is small and that the analysis can be limited to small angles θ.

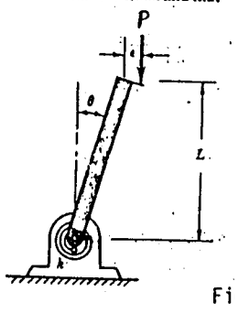

Fig. 2

3. A composite shaft is made up of an inner circular cylinder of elastic material with shear modulus G_1 and an outer circular annulus of elastic material with shear modulus G_2. The materials are bonded securely at the interface r_1. Derive formulas for the twist angle ϕ and for the shear stress $\tau_{\theta z}$ which result from the application of the twisting moment M_t.

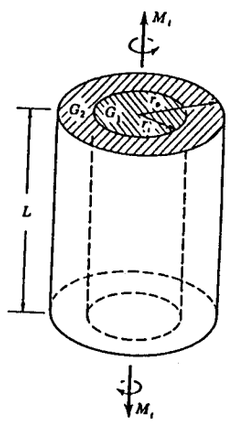

Fig. 3

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4. A 2.5-m-diameter sound baffle weighing 1.1 kN is to be hung from a ceiling with three springs which are to be mounted on radii making angles of 120° with each other, as shown in the sketch. Three springs, each 250 mm long, are delivered to the job. Springs *a* and *b* have a spring constant of 14 kN/m and spring *c* one of 16 kN/m. If the springs *a* and *b* are mounted 1 m from the center, how far from the center should the spring *c* be mounted if the sound baffle is to hang level?

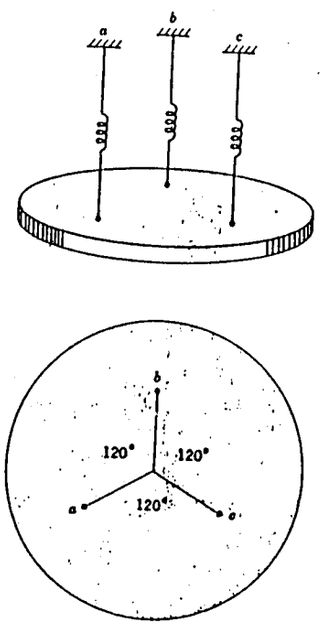

Fig. 4

5. For the thin-walled section shown in the figure, locate the position of the shear center relative to point *A*.

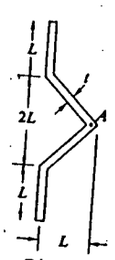

Fig. 5

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6. Gas pressure in a soap bubble is related to the surface tension σ and the radius R by the equation $P = 4\sigma/R$. Derive this equation.

Take a pippette, put a valve in the middle, close it, and blow two bubbles, one at each end: One bubble is large and one is small. Now open the middle valve so that the gas in the two bubbles can move into each other. In which way will the bubble diameters change? Explain in detail.

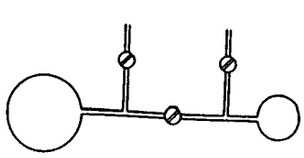

Fig. 6