1. Some high pressure hydraulic steel tubing is 4 mm bore, 15 mm outside diameter. If the greatest principal stress is not to exceed one half the yield strength of mild steel, calculate the greatest permissible internal pressure. (assume σ_y = 250 MPa)
   [*Ans: 1084 bar*]

2. A heat exchanger consists of a cylindrical vessel which contains 35 U-shaped tubes 20 mm bore, 30 mm outside diameter. The ends of these tubes are welded into one of the flat end plates. The total length of the tubes within the vessel is 7 m. Calculate the hoop and axial stresses on the inside and outside of the straight parts of these tubes, remote from the bend and the ends, due to pressures of 10 bar in the vessel (i.e. outside the tubes) and 100 bar inside the tubes.
   [*Ans: ID: σ_z = 6.2 MPa, σ_θ = 22.4 MPa; OD: σ_z = 6.2 MPa, σ_θ = 13.4 MPa*]

3. A thick cylindrical tube, of internal diameter *D* is supported so that there is no longitudinal stress, and is subjected to an internal pressure *p*. If the maximum direct stress is to be limited to a value *Y*, assuming Lame's equations, show that the necessary wall thickness is

$$\left(\left(\frac{Y+p}{Y-p}\right)^{\frac{1}{2}}-1\right)\frac{D}{2}$$

   With this wall thickness, show that the increase in outer diameter when the pressure is applied will be

$$\frac{D}{E}\sqrt{Y^2-p^2}$$

4. A steel shaft 4 cm dia is encased in a bronze sleeve 6 cm outside dia, which is forced into position. Before forcing on the inside diameter is .005 cm smaller than the diameter of the shaft. Find the radial pressure between the shaft and sleeve, the maximum hoop stress in the sleeve, and the change of outside diameter of the sleeve. For steel E= 200 GPa; v= 0.3 and for bronze E= 120 GPa; v= 0.34.
   [*Ans: p = 44.64 MPa, σ_θ = 116.1 MPa, ΔD = 0.00357 mm*]

5. A circular saw, 5 mm thick and 900 mm dia has a bore of 100 mm. The steel, of which the saw is made, has a density of 7800 kg m^{-3}, and v= 0.3. Find the maximum speed permitted if the hoop stress is restricted to 240 MPa. What is then the maximum value of the radial stress?
   [*Ans: 4093rpm, σ_r = 94.56 MPa*]