Mechanics of Materials　　　　　　　　　　　　　　　　　4/24/94

1. (30%) Follow Fig. 1 shows four screws (diameter 1.5mm) are employed to fasten the fracture fixation plate. (a) If the plate carries a shear force of 170Kgf, calculate the shear stress on each screw. Explain why do the screws near the fracture site fail first? (b) If the plate is 1.5mm thick and 12.4mm wide, what is the maximum tensile stress carried by the plate? (c) How to determine whether the screw or the plate will be fractured?

2. (20%) Palpation is used commonly to estimate the internal pressure in an elastic vessel (Fig. 2) such as balloon, artery, eyeball, or aneurysm. Show that the pressure acting on the finger is affected by the tension on the vessel wall. If you push so much that the membrane (vessel wall) is flat then you feel exactly the internal pressure in the vessel.

3. (10%, bonus) Derive the equation of motion for the Kelvin body (a standard linear solid, Fig. 3). In the model C is the damping coefficient of the damper and K1, K2 are the spring constants of the springs. F is the force and x the displacement. What is the application of this model in biomechanics?

4. (25%) Derive the equation $G = E / 2 (1+ \upsilon)$, where G is shear modulus of elasticity, E modulus of elasticity and υ, Poisson's ratio.

5. (25%) Give the definition of following terms:
   (a) stress
   (b) strain
   (c) Young's modulus
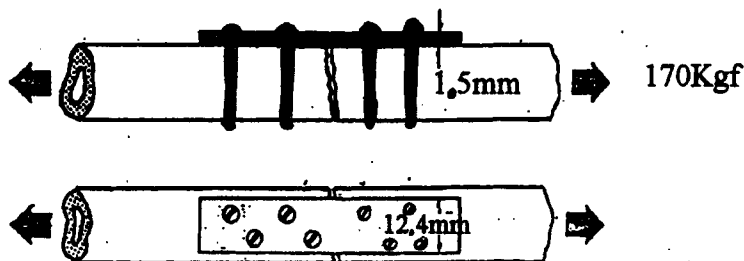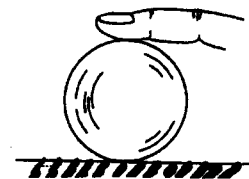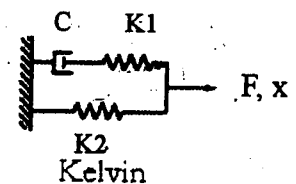   (d) Poisson ratio
   (e) Constitutive law

Fig. 2

Fig. 1

Fig. 3