1. Fig. 1 shows the stress-strain diagram of a tensile test for a low carbon steel. ◦
   a. Redraw Fig. 1, mark and identify on the figure the following properties and terms: (1).tensile strength, (2).yield strength, (3).breaking stress, (4).elongation, (5).elastic region, (6).plastic region, (7). Young's modulus, (8).necking, (9).strain hardening, and (10).toughness. 10%
   b. On the same figure, sketch the stress-strain diagrams for the following four types of materials: (1). low carbon steel, (2). annealed medium carbon steel, (3). annealed high carbon steel, and (4) quenched high carbon steel. 4%
   c. Estimate the pulling forces required to break the four steel rods made from materials given in (1.b). Each rod has a cross section of $1mm^2$. 4%
   d. Which mechanical property of a material will be affected the most when specimens of different length are used in the tensile test? Why? 2%
   e. Explain if the volume of a metal specimen remains the same in the elastic region? How about in the plastic region? 5%

2. Fig.2 shows the cross section of a cylindrical forged part. Explain why the top, middle and bottom sections have different shapes after forging at elevated temperatures. If the original cross sectional area is A, write the equation to estimate the starting forging force. 10%

3. List three types of mold and die materials used in the casting processes. Under each type of material, list the casting processes that are used, and explain why these processes are suitable for that particular mold or die material. 15%

4 List five common cutting tool materials in increasing order of material hardness. 10%

5. Make a sketch to show all the process parameters for a wire drawing process and write the equation to estimate the drawing force for an ideal drawing process with rigid, perfectly plastic material. (10%)

6. The true stress-true strain curve of a material behaves according to the equation $\sigma = K\varepsilon^n$, with the strength coefficient of K=100 MPa and n=0.1. What is the ultimate tensile strength of this material? What are the physical significances of K and n? (10%)

7. You are given two pieces of annealed 304 stainless steel rods, each with a diameter of 1.25mm and a length of 15mm, and you are asked to reduce their diameters to 1.20mm, (a) for one piece by pulling it in tension and (b) for the other by machining it on a lathe in one pass. Calculate the respective amounts pf work involved, and explain the reasons for the difference in the energies dissipated. The material is assumed to be rigid, perfectly plastic with yield strength of Y=285 MPa. The specific cutting energy for the material is 4.1 Joule/mm^3, or equivalently 4100 MPa. 20%

(背面仍有題目,請繼續作答)

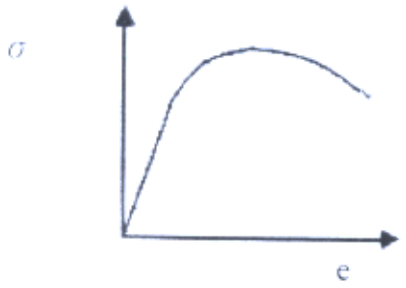

Fig. 1

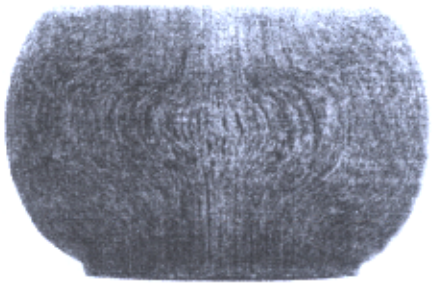

Fig. 2