所別：機械工程學系碩士班 乙組　　　　　　　科目：機械材料及材料力學

一、(25%)

1. (a) What is model for the Bohr atom? 2% (b) is the model correct? 1% what is the problem of the model? 2% (c) compare Bohr with wave-mechanical atom model. 2%　　　　　　　　　7%

2. The diffusion coefficients for carbon in nickel are given at two temperatures:

T (℃)	D (m²/s)
600	5.5×10^{-14}
700	3.9×10^{-13}

(a) Determine the values of D_0 (3%) and the activation energy Q_d. (3%)

(b) What is the magnitude of D at 850℃?　　(4%)

(The gas constant R is 8.31 J/mol-K)　　　　　　10%

3. (a) Is there any relationship existed between the tensile strength and the hardness? Describe their relationship in detail as you can. (4%)
Briefly explain why the hardness of tempered martensite diminishes with tempering time (at constant temperature) and with increasing temperature (at constant tempering time). (4%)　　　　　8%

二、(25%)

1. 合金的強化之基本機制有哪些？簡單說明之。(5%)

2. 簡單說明光學顯微鏡試片研磨、腐蝕及觀察方法。(5%)

3. 請列舉兩種不同系列的不鏽鋼，並說明在微結構上、特性上有何不同。(5%)

4. 熱處理用之合金鋼是由碳鋼改良而成，請問合金鋼可以改良碳鋼的哪些缺點？(5%)

5. 溫度對半導體材料與金屬材料之導電性之影響有何差別？(5%)

注意：背面有試題

參考用

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三、(25%)

1. As shown in Fig. 1a, a steel beam, AB, is designed to be cantilevered from a rigid wall at A and supported by a steel hanger rod, BC, that is pinned to a rigid support at C. The rod diameter is $d = 5/8$ in, $E_{steel} = 30 \times 10^6$ psi, the beam is a W10x12 and $I = 53.8$ in^4.

(a) If the rod is manufactured 1/16 in too short, how much stress will be induced in the rod by stretching it, inserting the pin at B, and then releasing the external force required to mate the parts? (5%)

(b) How much additional stress is induced in the rod by uniformly distributed load of 100 lb/ft subsequently applied to the beam, as shown in Fig. 1b? What is the final displacement of B? (10%)

(a) The beam and rod before assembly.
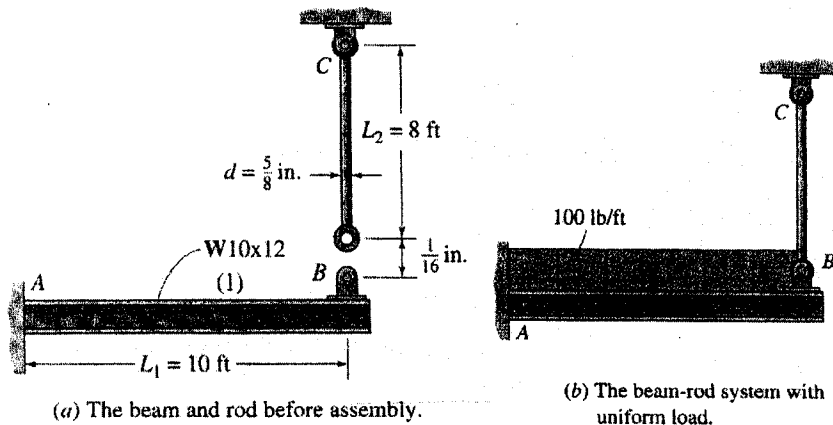
(b) The beam-rod system with uniform load.

Fig. 1

2. As shown in Fig. 2, buckling of columns AB and CD in the xz plane was considered. However, there is nothing to prevent the columns from bulking in the y direction. For the frame in Fig. 2a, determine whether the columns AB and CD will buckle in the xz plane (y axis buckling), or whether they will buckle in the y direction (z axis buckling), and determine the buckling load? (Assume that the joints at B and C are rigidly welded joints, that the beam BC is rigid, and that it applies a vertical load P at the centroid of the top of each column), let $E = 29 \times 10^3$ ksi, $\sigma_Y = 36$ ksi, $I_y = 13.3$ in^4, $I_z = 41.4$ in^4, $A = 5.87$ in^2, $L = 16$ ft. (10%)

(a) Front view.
(y-axis buckling)

(b) Side view.
(z-axis buckling)

(c) Detail B.

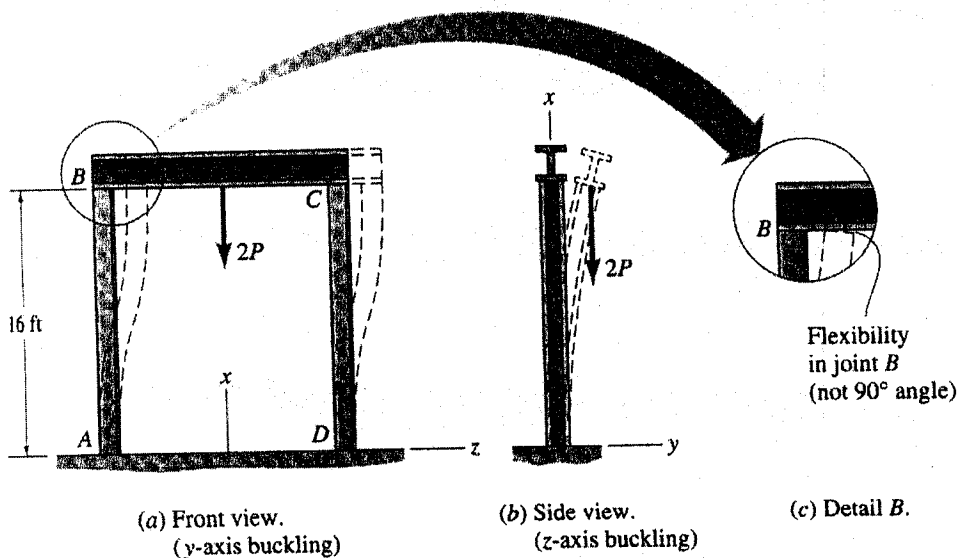Flexibility in joint B (not 90° angle)

Fig. 2

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四、(25%)

1. As shown in figure 1, determine the shear stress at point B on the web of the beam located at section a-a. (8%)

2. The steel shaft of a socket wrench is 0.5 in. in diameter and 18 in. long (see figure 2). If the allowable stress is 11,000 psi, what is the maximum possible torque T that may be exerted with the wrench? Through what angle φ will the shaft twist under the action of the maximum torque? (Assume $G = 11.8 \times 10^6$ psi and disregard any bending of the shaft.) (8%)

3. A "bungee jumper" having a mass of 50 kg leaps from a bridge, braking her fall with a long elastic shock cord having axial rigidity EA = 2.1 kN (see figure 3). If the jumpoff point is 60 m above the water, and if it is desired to maintain a clearance of 10 m between the jumper and the water, what length L of cord should be used? (9%)
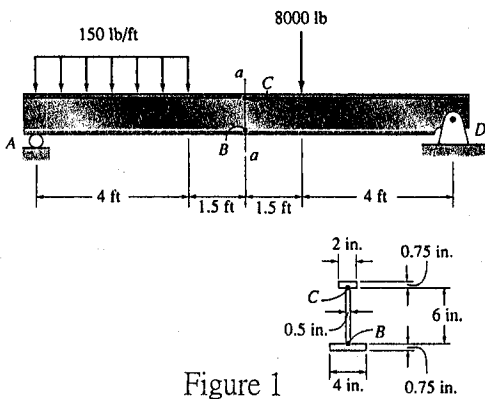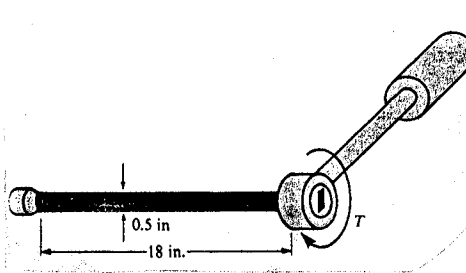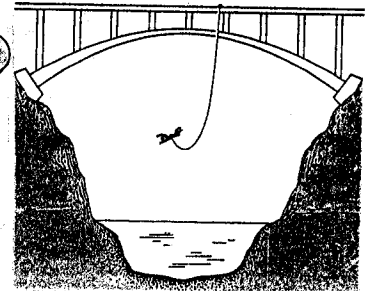
Figure 1　　　　Figure 2　　　　Figure 3