

國立中央大學八十七學年度碩士班研究生入學試題卷

所別： 機械工程研究所 乙組 科目： 機械材料及材料力學 共 2 頁 第 1 頁

一、25%

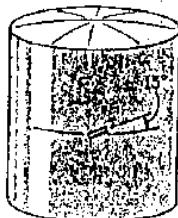
- (1) Aluminum is a face-centered cubic (FCC) crystal structure and it has a lattice constant of 0.405 nm. Answer the following questions: (a) How many atoms per unit cell are there in this crystal structure? (3%) (b) What is the coordination number for the aluminum atoms in this crystal structure? (3%) (c) Calculate a value for the atomic radius of an aluminum atom in nanometer. (5%)
- (2) (a) What type of phase diagram is necessary for a binary alloy to be precipitation-hardenable? (3%) (b) What are the three basic heat-treatment steps to strengthen a precipitation-hardenable alloy? (3%) (c) Why the strength for an overaged aluminum alloy is smaller than an as-aged specimen? (3%)
- (3) (a) Qualitatively compare the magnitude of the activation energies for the following diffusion systems and arrange them in a sequence with increasing the magnitude: Fe diffuses in α -Fe(BCC) ; Fe diffuses in γ -Fe(FCC) ; C diffuses in α -Fe(BCC) ; C diffuses in γ -Fe(FCC) (2%) (b) Give the reason for your arrangement. (3%)

二、25%

- (1) Cu-Zn 合金在工業上的應用通常不超過 40%Zn, 為什麼? (5%)
- (2) 沃斯田鐵(Austenite)晶粒大小如何影響鋼之硬化能力? (5%)
- (3) 陶瓷材料之延性一般均較金屬材料差, 為什麼? (5%)
- (4) 溫度對於金屬材料及半導體材料之導電係數(conductivity)有什麼不同的影響? 為什麼? (5%)
- (5) 為什麼玻璃材料具透光性, 而金屬材料不具透光性? (5%)

三、25%

- (1) A single strain gage forming an angle of 5° with a horizontal plane must be used to determine the gage pressure in the cylindrical steel tank shown. The cylindrical body of the tank is 6 mm thick and has a 600-mm inside diameter. It is made of a steel for which $E = 200\text{GPa}$ and $\nu = 0.29$. For a strain gage reading of 350μ , determine the pressure in the tank. (12%)

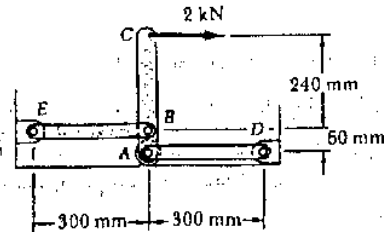


注意：背面有試題

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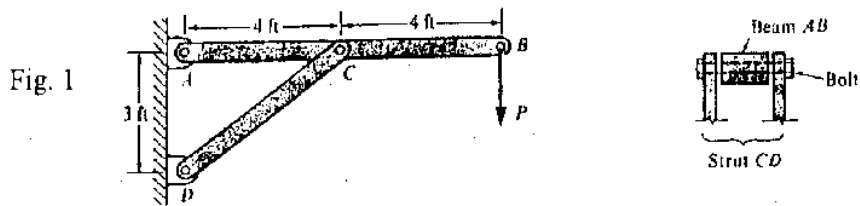
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- (2) The steel bars BE and AD each have a 5×15 -mm cross section. Assuming that lever ABC is rigid and using $E = 200 \text{ GPa}$, determine the deflection of point C . (13%)

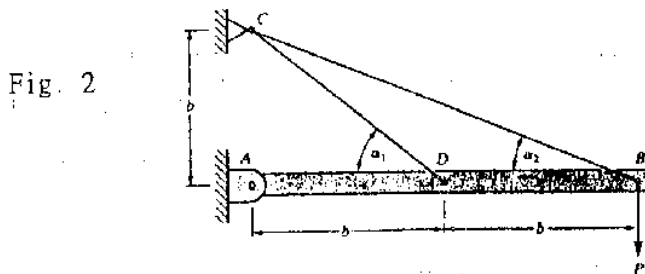


四. 25%

- (1) A beam AB is supported by a strut CD and carries a load $P = 2500 \text{ lb}$ as shown in the Fig. 1. The strut, which consists of two bars, is connected to the beam by a bolt passing through each of the bars at joint C . If the allowable average shear stress in the bolt is $14,000 \text{ psi}$, what is the minimum required diameter d of the bolt? (7%)



- (2) A horizontal rigid bar ADB of length $2b$ is supported by two inclined wires CD and CB (Fig. 2). The wires are attached to a support at C , which is located at distance b above point A . Both wires have axial rigidity EA , are made of the same material, and have the same diameter. Determine the tensile forces T_1 and T_2 in wires CD and CB , respectively, due to vertical load P acting at the end of the rigid bar. (9%)



- (3) Construct shear-force and bending-moment diagrams for the beam ABC loaded as shown in the Fig. 3. The cable passes over a small frictionless pulley at C and supports a weight $W = 5.0 \text{ kN}$. (9%)

