I. (選擇題，單選，答錯不倒扣) (1.5 points each)

1. What is the predominant type of bonding for titanium (Ti)? **(A) Ionic (B) Covalent (C) van der Waals (D) Metallic**

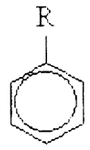
2. Which of the following bonding is the primary bonding **(A) Static (B) ionic (C) van der Waals (D) Hydrogen** bonding

3. Is Izod test a **(A)Tensile (B)Torsion (C) Impact (D) Impact Test**

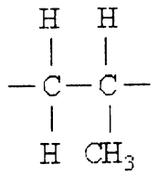
4. Hot working takes place at a temperature that is above a metal's (A) melting temperature (B) recrystallization temperature (C) eutectoid temperature (D) glass transition temperature

5. Which of the following phenomenon caused the **secondary bonding of molecules (A) free electron (B) molecular dipole (C) bonding energy (D)atomic weight**

6. For unit cell geometry, which crystal system is **a = b** = c, and $\alpha = \beta = \gamma \neq 90^0$ (A) Tetragonal (B) Orthorhombic (C) Cubic (D) Rhombohedral

7. What is the name of the hydrocarbon group shown below? 

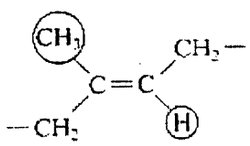
(A) ether (B) aromatic hydrocarbon (C) acid (D) alcohol (E) aldehyde

8. What is the name of the mer structure shown below? 

(A) poly(methyl methacrylate) (B) polyethylene (C) polytetrafluoroethylene (D) polypropylene (E) polystyrene (F) poly(vinyl chloride)

9. A Frenkel defect is composed with which of the following? (A) A cation interstitial and a cation vacancy (B) A cation interstitial and an anion interstitial (C) A cation vacancy and an anion vacancy (D) An anion interstitial and an anion vacancy

10. How are *continuous* fibers typically oriented in fibrous composites? (A) Aligned (B) Partially oriented (C) Randomly oriented (D) All of the above

11. 

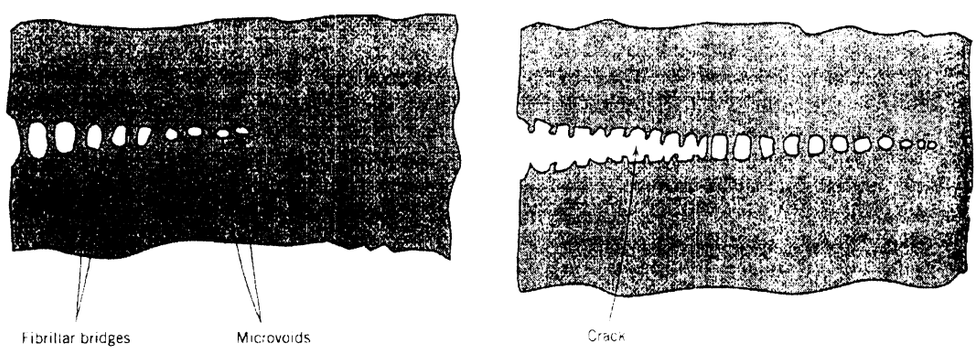
(A) Geometrical isomerism- tans (B) Geometrical isomerism- cis (C) Stereoisomerism- trans (D) Stereoisomerism-cis

12. The atoms surrounding a screw dislocation experience what kinds of strains? (A) Tensile strains (B)

(背面仍有題目,請繼續作答)

Shear strains (C) Compressive strains (D) All of the above (E) Both B and C

13. For pure metals, the recrystallization temperature is *normally* about (A) 0.1 T_m (B) 0.2 T_m (C) 0.3 T_m (D) 0.4 T_m
14. A eutectoid reaction involves which of the following phases? (A) One liquid and one solid (B) One liquid and two solid (C) Two liquids and one solid (D) Three solid
15. Which four elements in the list below are alloyed with high-carbon steels to improve their hardnesses? Silicon, Tungsten, Copper, Nickel, Molybdenum, Chromium, Vanadium (A) Silicon, Tungsten, Nickel, Molybdenum (B) Tungsten, Molybdenum, Chromium, Vanadium (C) Nickel, Molybdenum, Chromium, Vanadium (D) Silicon, Copper, Nickel, Vanadium
16. Which phenomenon causes the V-shaped " chevron markings **(A) Brittle fracture (B) Plastic deformation (C) Ductile fracture (D) Elastic Deformation**
17. What mechanical property is usually related to the **result of hardness test,** especially some metal **(A) Poisson's ratio (B) Resilience (C) Tensile Strength (D) Young Modulus**
18. Which factor will **not** affect the equilibrium number of vacancies N_v for a given material **(A) total number of atomic sites (B) grain size (C) temperature (D) energy required to form a vacancy.**
19. What test does the **S-N curve** usually represent **(A) fatigue (B) creep (C) stress relation (D) indention test**



20. What kind of fracture phenomenon is as this figure **(A) Griffith (B)Craze (C) Brittle (D) Shear**

II. Briefly explain the following terms (one to two sentences or **drawing**): (**2 points** each)

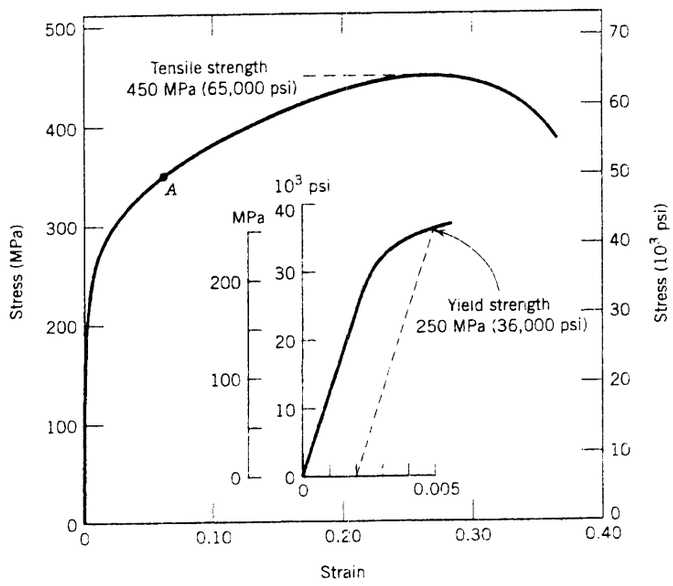
1. Fatigue limit
2. Drawing process for polymer
3. Modulus of elasticity and yield strength
4. Plane stress
5. Nonstoichiometric
6. Solid-solution strengthening
7. Strength intensity factor

8. Necking
9. Amorphous
10. Atactic configuration
11. Resolved shear stress
12. Stress Raiser
13. Slip direction
14. What **ASTM** stands for?
15. Eutectic reaction

III. Calculation: (6 points each)

1. Calculate the density (in g/cm^3) of an AX compound given that it has the rock salt crystal structure and that the radii of the A and X ions are 0.137 and 0.241 nm, respectively. Assume atomic weights of 22.7 and 91.4 g/mol for the A and X elements, respectively. (Hint: Unit cell for rock salt crystal, Avogadro' s number: 6.023 *10^{23})

2. Consider a brass alloy the stress-strain behavior of which is shown below.

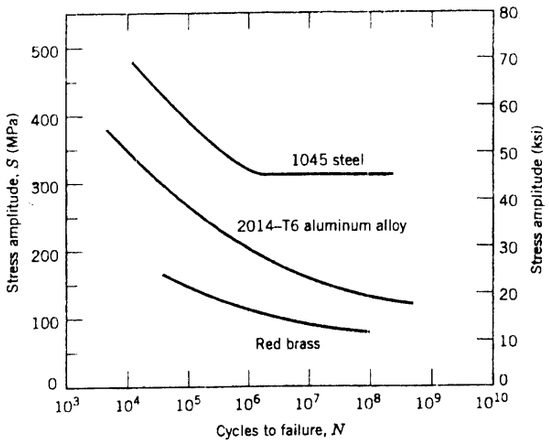


A cylindrical specimen of this alloy having a length of 63 mm must elongate only 0.11 mm when a tensile load of 53,500 N is applied. Under these circumstances, what is the radius of the specimen (in mm)?

3. A cylindrical 1045 steel bar is subjected to repeated compression-tension stress cycling along its axis. If the load amplitude is 23,000 N, calculate the minimum allowable bar diameter (in mm) to ensure that fatigue failure will not occur. Assume a factor of safety of 1.0. The *S*-versus-*N* fatigue

(背面仍有題目,請繼續作答)

behavior for this alloy is shown below.

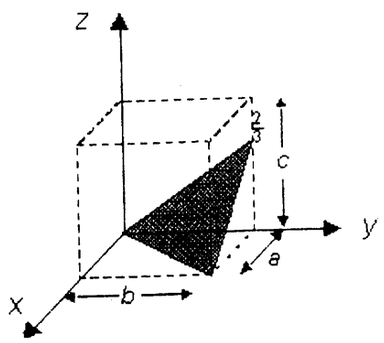


4. For a brittle material that has a specific surface energy of 0.33 J/m^2, and flexural strength and elastic modulus values of 88.1 MPa and 61 GPa, respectively, calculate the critical stress (in MPa) required for the propagation of a surface crack of length 0.04 mm. ($\sigma_c = (2E\gamma_s/\pi a)^{1/2}$)

5. Consider a single crystal of BCC iron oriented such that a tensile stress is applied along a [100] direction. Compute the resolved shear stress along a (110) plane and in a [1-11] direction when a tensile stress of 50MPa is applied.

IV. Questions and answers

1. 4 basic **structure of polymers** (4 points)
2. What are the Miller indices for the plane shown below? (2 pints)



3. Make a schematic plot showing the tensile engineering stress--strain behavior for a typical metal alloy to the point of fracture. Now superimpose on this plot a schematic compressive engineering stress-strain curve for the same alloy. Explain any differences between the two curves. (After plastic deformation) (4 points)