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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2014 SESSION

SUBJECT CODE	:	**NMB 10203**
SUBJECT TITLE	:	**MATERIALS ENGINEERING**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**(3 HOURS)**
DATE	:	

INSTRUCTIONS TO CANDIDATES

1. **Please read the instructions given in the question paper CAREFULLY.**
2. **This question paper is printed on both sides of the paper.**
3. **Please write your answers on the answer booklet provided.**
4. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
5. **This question paper consists of FIVE (5) sections. Answer any FOUR (4) questions only.**
6. **Answer all questions in English.**

THERE ARE 7 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer only FOUR questions.

Please use the answer booklet provided.

Question 1

(a) Calculate the atomic radius in cm for the following:

(i) BCC metal with a_0 0.3294 nm and one atom per lattice point

(ii) FCC metal with a_0 4.0862 Å and one atom per lattice point.

(6 marks)

(b) The density of potassium, which has the BCC structure and one atom per lattice point, is 0.855 g/cm^3. The atomic weight of potassium is 39.09 g/mol. Calculate

(i) the lattice parameter, and

(ii) the atomic radius of potassium.

(7 marks)

(c) Draw the direction of [1 0 0], [1 1 1] and [1 $\bar{2}$ 0] in cubic unit cell. Determine the Miller index of the shaded plane in Figure 1 and 2.

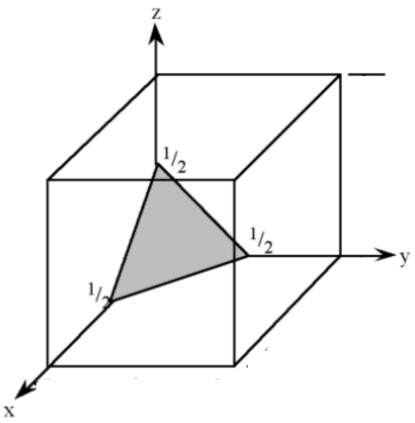


Figure 1

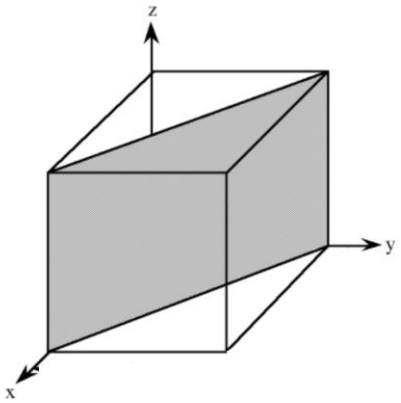


Figure 2

(12 marks)

Question 2

(a) A tensile stress is to be applied along axis of a cylindrical brass rod that has a diameter of 10 mm as shown in Figure 3. Determine the magnitude of the rod required to produce a 2.5 $\times 10^{-3}$ mm change in diameter if the deformation is entirely elastic. The poisson's ratio *v* of brass material is 0.34 and Young Modulus is 97MPa. Given $v = -\frac{\varepsilon_x}{\varepsilon_z}$.

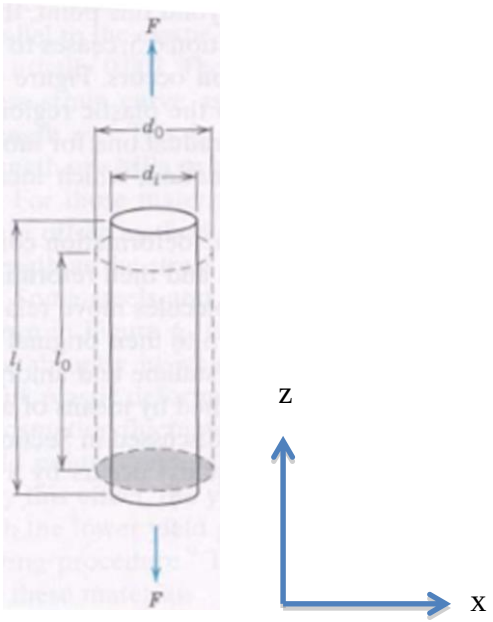


Figure 3

(6 marks)

(b) A 10.2 mm diameter, 305 mm long titanium bar has yield strength of 345 MPa, a modulus of elasticity of 110 X 10^9 Pa and Poisson ratio of 0.30. Determine the length and diameter of the bar when 2.2 kN load is applied.

(7 marks)

(c) Explain the term "hardness of a material". Calculate the tensile strength of the steel when a 3000 kg load is applied to a 10 mm diameter indenter in a Brinell test which produces the indentation of 3.1 mm on the steel surface.

(12 marks)

QUESTION 3

(a) Define the phase diagram.

(4 marks)

(b) Please refer Figure 4, for question i-ii. Alloy composed of Ag-15%Cu at 800 °C. Determine;

i. the phase mass fraction

(4 marks)

ii. the volume fraction

(12 marks)

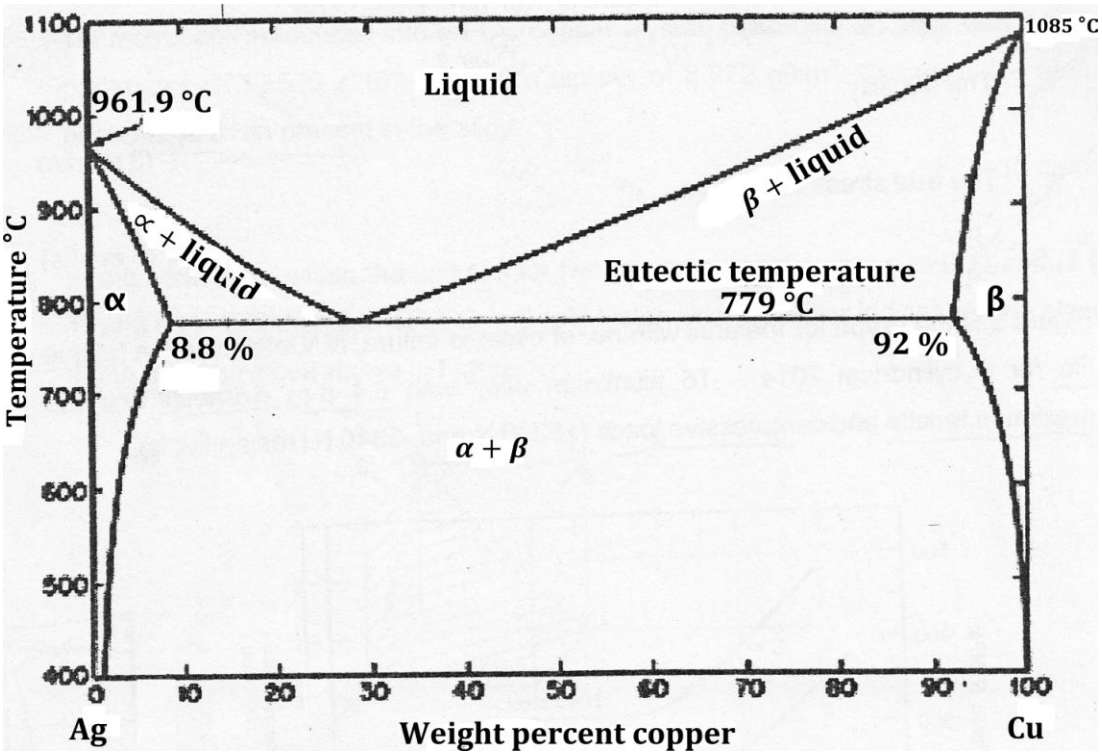


Figure 4

(c) An alloy containing 7×10^{22} atoms of Ge atoms 4×10^{22} atoms of Si is composed as illustrated in Figure 5. At temperature 1400 K, determine;

i. The chemical composition

(3 marks)

ii. The fraction of phase physically present

(2 marks)

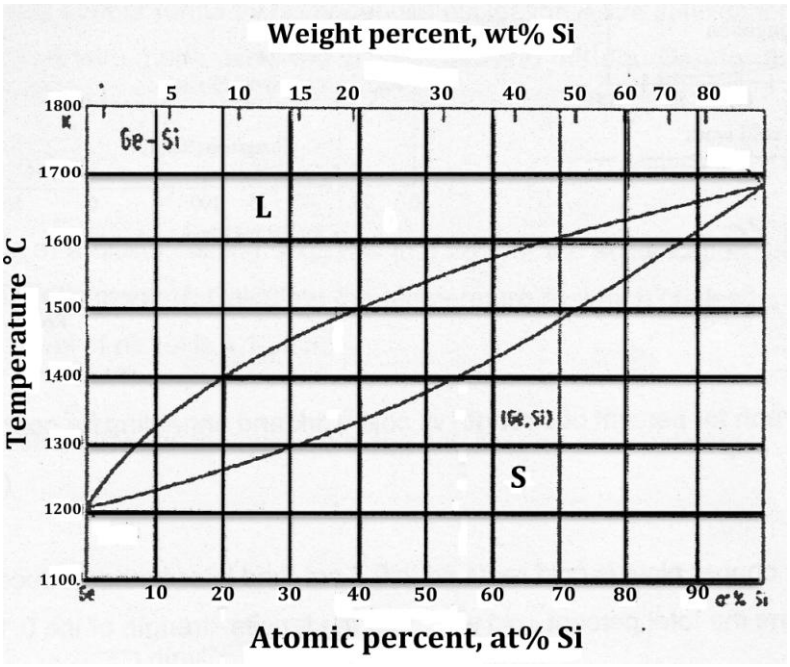


Figure 5

Question 4

(a) (i) Compare the advantage and disadvantage of cold working and hot working.

(4 marks)

(ii) Please give the work hardening equation and sketch a graph to show how to obtain work hardening exponent.

(4 marks)

(b) A cylindrical specimen of steel having an original diameter of 12.8 mm is tensile tested to fracture and found to have an engineering fracture strength σ_f of 460 MPa. If it's cross-sectional diameter at fracture is 10.7 mm. Determine

(i) The ductility

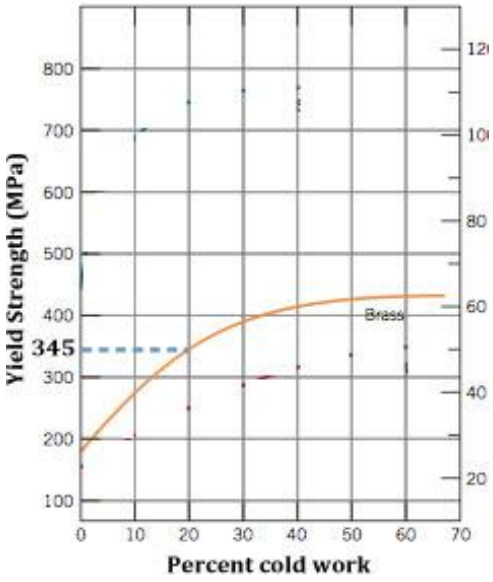
(3 marks)

(ii) The true stress at fracture

(3 marks)

(c) A cylindrical rod of noncold-worked brass having an initial diameter of 6.4 mm is to be cold worked by drawing such that the cross-sectional area is reduced. It is required to have a cold-worked yield strength of at least 345 MPa and a ductility in excess of 20% EL; in addition, a final diameter of 5.1 mm is necessary. Describe the manner in which this procedure may be carried out. The yield strength and ductility of brass are illustrated in Figure 6.

(a)



(b)

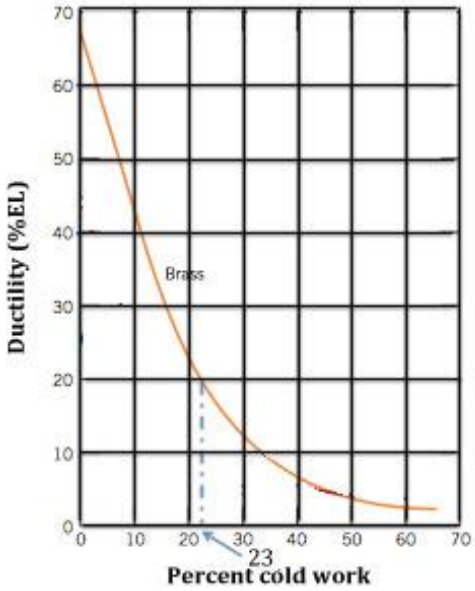


Figure 6 (11 marks)

Question 5

(a) Explain the terms of

(i) Homogeneous nucleation

(2 marks)

(ii) Heterogeneous nucleation

(2 marks)

(b) A disk-shaped brass casting 2 inch thick and 18 inch in diameter is designed for production. It is believe that by making the casting solidify 25% faster, the improvement in the tensile properties of the casting will permit the casting to be made lighter in weight. Design the casting thickness to permit this. Assume that the mold constant is 22 min/in^2 for this process.

(12 marks)

(c) A 4-in-diameter aluminium bar solidifies to a depth of 0.5 in. beneath the surface in 5 minutes. After 20 minutes, the bar has solidified to a depth of 1.5 in. How much time is required for the bar to solidify completely?

(9 marks)

END OF QUESTION