UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	BDA 10803
PROGRAMME	:	BDD
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	**SECTION A** IS **COMPULSORY** **SECTION B** – ANSWER **THREE (3)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

SECTION A

Q1 Refer to the Pb-Sn phase diagram in **Figure Q1**.

(a) State the components of the phase diagram.

(2 marks)

(b) Explain the simplest process to obtain Pb-Sn phase structure from liquid and determine the dominant phase.

(6 marks)

(c) Analyse the constitution point for Pb - 50wt%Sn at 183°C + ΔT .

(i) What phases are present?

(2 marks)

(ii) Interpret each phase composition

(2 marks)

(iii) Find amount of weight proportion for each fraction.

(4 marks)

(d) Compare the microstructure and dominant phase between sample of 30% Sn at 183°C - ΔT and 30% Pb at 183°C - ΔT.

(4 marks)

Q2 (a) List TWO (2) types of forming methods for ceramic with its raw materials form.

(2 marks)

(b) Identify THREE (3) classifications of low alloy steel with brief explanation.

(6 marks)

(c) Illustrate FOUR (4) steps in uniaxial powder pressing in ceramic processing.

(8 marks)

(d) Compare between brass and bronze of copper alloys

(4 marks)

SECTION B

Q3 (a) Define space lattice.

(2 marks)

(b) Refer to **Figure Q3(b i-iv)**, identify all the indices of direction and plane.

(6 marks)

(c) Calculate:

(i) the atomic packing factor (APF) for the simple cubic structure (SCC)

(4 marks)

(ii) the linear atomic density, ρ_l of the [101] for FCC iron structure with lattice constant 0.287nm.

(4 marks)

(d) According to stress-strain behaviour of metal, it can display an elastic or plastic deformation. Differentiate between elastic and plastic deformation.

(4 marks)

Q4 (a) List FOUR (4) factors to be considered in service condition.

(2 marks)

(b) Explain all THREE (3) stages of creep by using a typical creep curve of strain versus time at constant stress and constant elevated temperature.

(6 marks)

(c) (i) Calculate the engineering stress on a bar 10 cm long and having a cross section of 4.2 mm x 12.0 mm that is subjected to a load of 40 kN.

(3 marks)

(ii) Sketch a graph showing the relationship between impact energy and temperature for BCC metal. Indicates on the graph the point of ductile to brittle transition temperature.

(5 marks)

(d) Distinguish between solid slip casting and drain slip casting by using appropriate figures.

(4 marks)

Q5 (a) What is heat treatment?

(2 marks)

(b) Explain in details the process to produce martensite structure.

(6 marks)

(c) Differentiate between annealing and normalizing.

(4 marks)

(d) Sketch the interdiffusion and self diffusion process.

(4 marks)

(e) The diffusivity, D for the diffusion of carbon in γ iron (FCC) at 927°C is 1.32×10^{-11} m^2/s. If temperature-independent preexponential is 2.0×10^{-5} m^2/s, and the gas constant is 8.314 J/mol.K, calculate the activation energy for diffusion.

(4 marks)

Q6 (a) What is polymer?

(2 marks)

(b) Compare between thermoplastic and thermoset in terms of polymer structure and temperature sustainability.

(4 marks)

(c) Explain TWO (2) classifications of composite and give an example of each type.

(6 marks)

(d) Sketch the particle reinforced composite, continuous fiber composite, unidirectional and multidirectional laminate composite.

(8 marks)

-END OF QUESTION-

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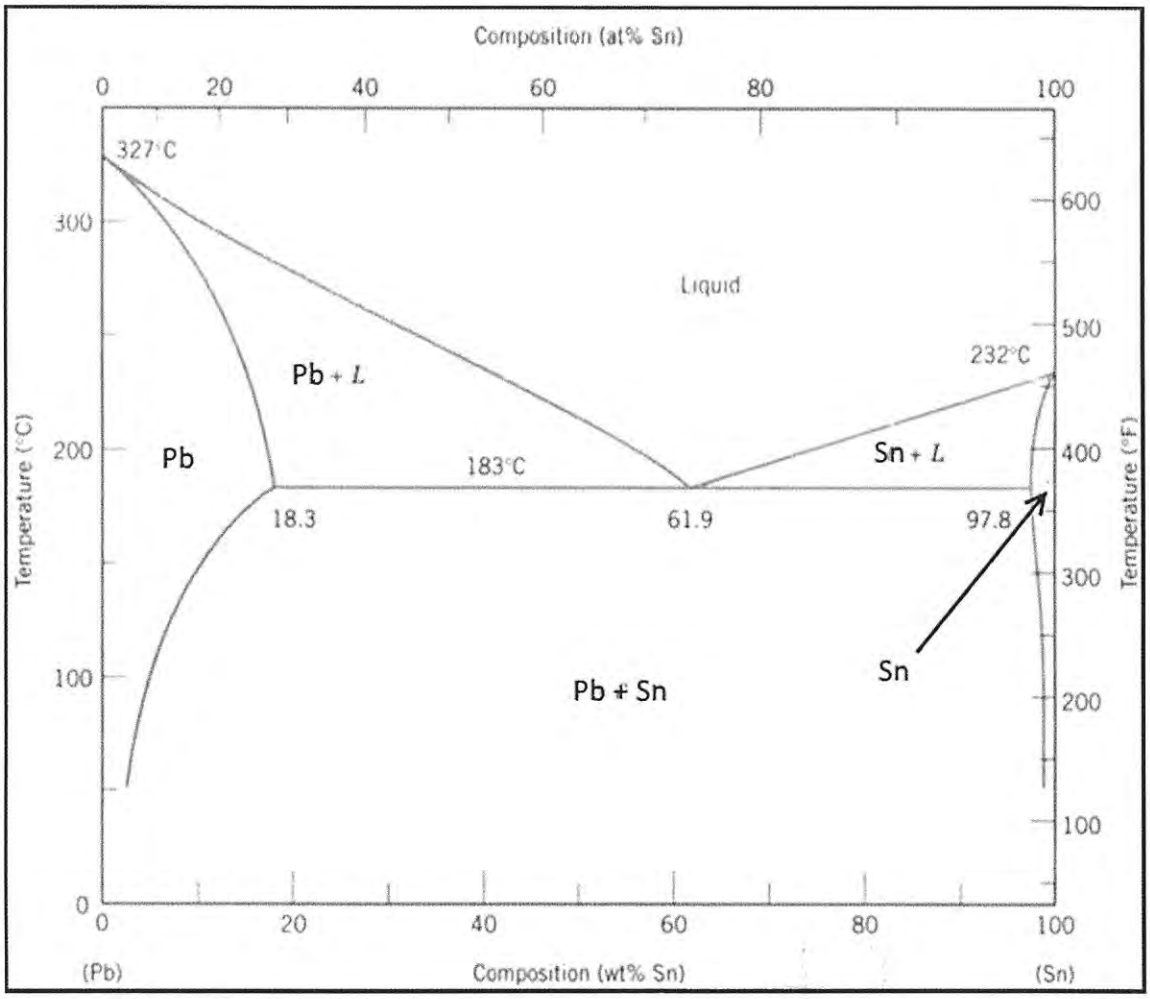

Figure Q1

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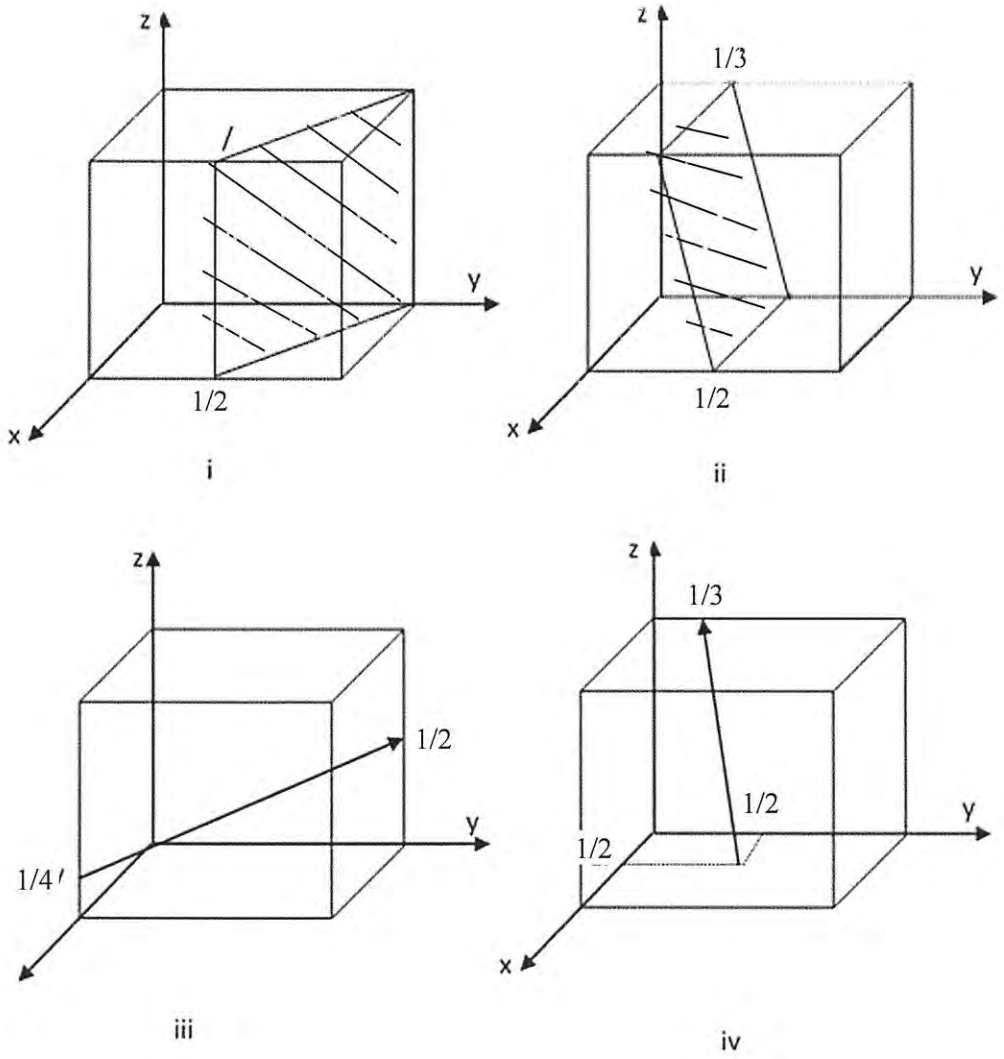

Figure Q3(b i-iv)