



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME : MATERIALS SCIENCE
COURSE CODE : BDA 10803
PROGRAMME : BDD
EXAMINATION DATE : DECEMBER 2019/ JANUARY 2020
DURATION : 3 HOURS
INSTRUCTION : **SECTION A IS COMPULSORY
SECTION B – ANSWER 3
(THREE) QUESTIONS ONLY**

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THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

SECTION A

- Q1**
- (a) What is a phase diagram? (2 marks)
 - (b) Discuss briefly THREE (3) types of invariant reactions. (6 marks)
 - (c) Refer to the Sn-Pb phase diagram in Figure Q1 (c).
 - (i) Interpret each phase composition for eutectic + ΔT and eutectic - ΔT . (4 marks)
 - (ii) Find amount of weight proportion for each fraction for eutectic + ΔT and eutectic - ΔT . (4 marks)
 - (d) Refer to the Figure Q1 (c), compare the microstructure and dominant phase between the sample of 30% Sn at $183^{\circ}\text{C} - \Delta T$ and 30% Pb at $183^{\circ}\text{C} - \Delta T$. (4 marks)
- Q2**
- (a) List FOUR (4) types of cast iron. (2 marks)
 - (b) Identify THREE (3) classifications of ceramic with an example. (6 marks)
 - (c) Illustrate the investment casting methods for metals. (8 marks)
 - (d) Compare between slip casting and extrusion methods in ceramic in terms of raw ceramic materials foam and production volume. (4 marks)

SECTION B

- Q3**
- (a) Define the meaning of crystal structure and sketch it. (2 marks)
 - (b) Ferrous and non-ferrous are types of metal alloys. Explain THREE (3) factors contribute to widespread of ferrous alloy usage. (6 marks)

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- (c) Choose one metal or alloy that best suited for each of the following applications and cite one reason for each choice. Given metals and alloys are stainless steel, tool steel, gray cast iron, and titanium alloy.
- (i) The block of an internal combustion engine
 - (ii) Condensing heat exchanger for steam
 - (iii) Jet engine turbofan blades
 - (iv) Drill bit
- (8 marks)
- (d) Compare in between BCC and HCP crystalline structure in term of atomic packing factor and coordination number for both structures.
- (4 marks)
- Q4**
- (a) State ONE (1) of thermoplastic and thermoset materials
- (2 marks)
- (b) Explain the different in terms of band gap between metal and insulator (semiconductor) in terms of band gap.
- (6 marks)
- (c) Classify the functional materials of metal, semi-conductor, ceramic and polymer-based on their electrical and thermal conductivities properties
- (8 marks)
- (d) Differentiate between Thermoplastic and thermoset materials in terms of their processing property, chemical structure, and mechanical properties. At least ONE (1) example must be given for each criterion.
- (4 marks)
- Q5**
- (a) State FOUR (4) types of destructive mechanical testing.
- (2 marks)
- (b) Identify devitrification and provide TWO (2) properties that may be improved by it.
- (6 marks)
- (c) Choose the best ceramic material to use for wear, grind, or cut away other material which necessarily is softer based on its properties.
- (8 marks)
- (d) Differentiate between Izod and Charpy impact test.
- (4 marks)

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- Q6** (a) Dislocation is a linear defect. Three types of dislocation are edge dislocation, screw dislocation, and mix-dislocation. Define edge dislocation. (2 marks)
- (b) Explain briefly the following heat treatment;
(i) Normalizing
(ii) Quenching
(iii) Annealing (6 marks)
- (c) Figure Q6 (c) shows the TTT diagram. Sketch and label the time-temperature paths to produce the following microstructures:
(i) 50 % bainite, 50% martensite
(ii) 100% bainite
(iii) 100% pearlite
(iv) 50% pearlite, 50% martensite
Attach the figure with your answer script. (8 marks)
- (d) Differentiate between vacancy diffusion and interstitial diffusion. (4 marks)

TERBUKA**-END OF QUESTION-**

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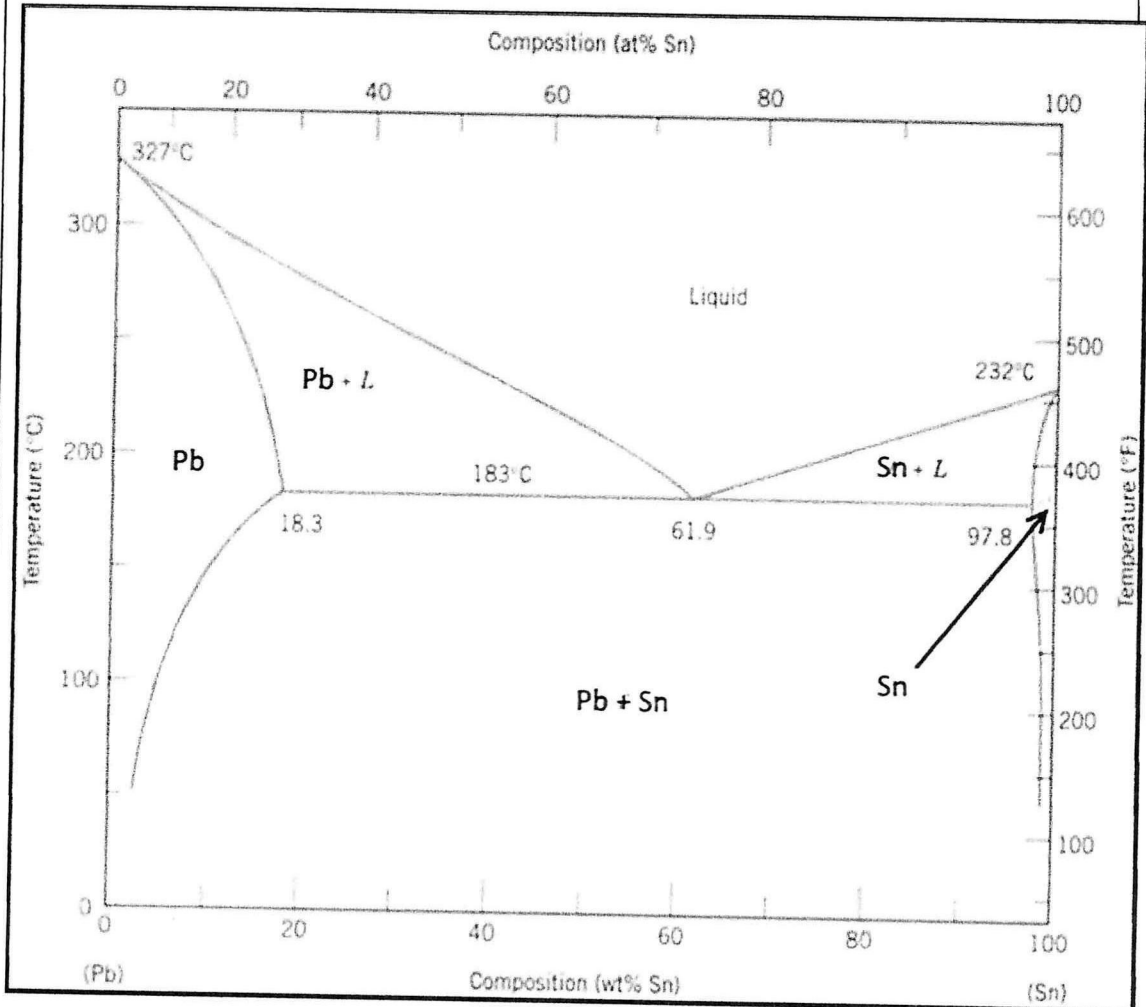


Figure Q1 (c)

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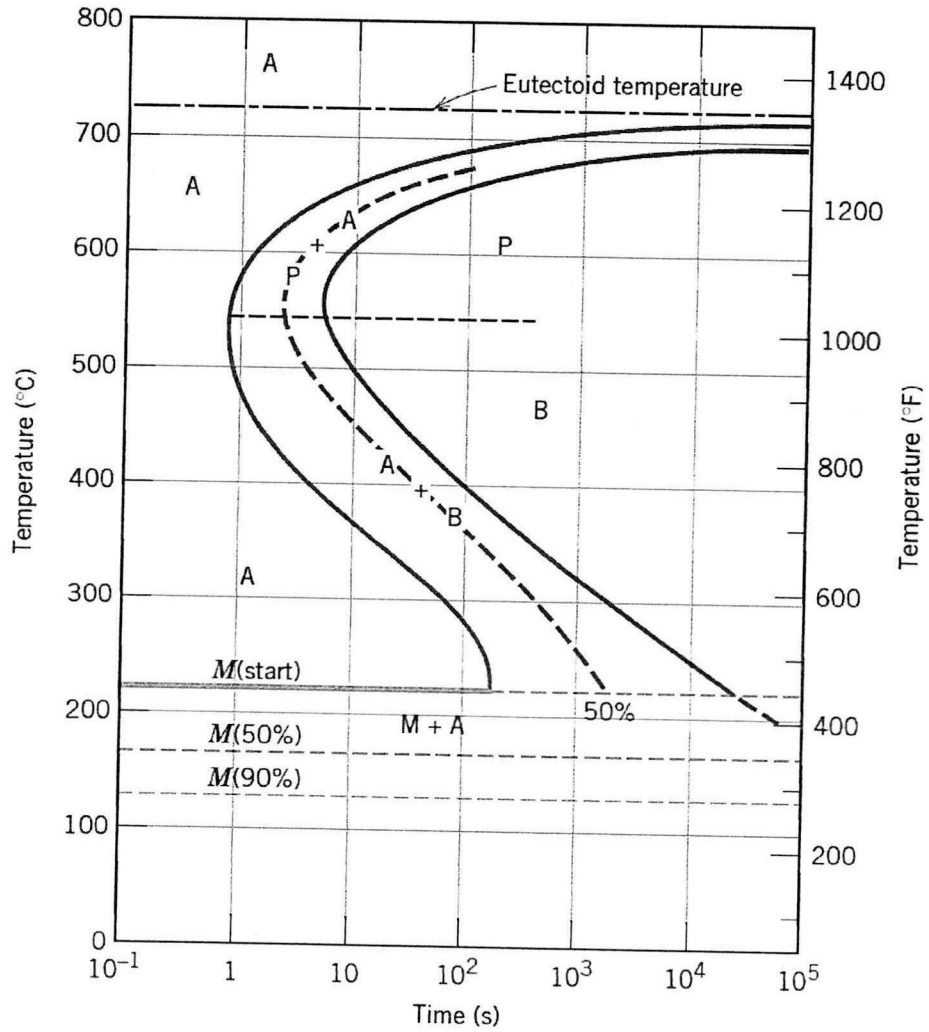


Figure Q6 (c)

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