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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2013/2014**

COURSE NAME : MATERIAL SCIENCE  
COURSE CODE : DAM 20802  
PROGRAMME : 2 DAM  
EXAMINATION DATE : DECEMBER 2013/JANUARY 2014  
DURATION : 2 HOURS  
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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- Q1**
- (a) With suitable sketch, give explanation of ionic bond, covalent bond and metallic bond.  
(9 Marks)
- (b) Give definition and **one (1)** example (product) for following types of material:  
(i) Smart material  
(ii) Advance material  
(4 Marks)
- (c) There are three most common metal crystal structures which are face-centered cubic (FCC), body-centered cubic (BCC) and hexagonal close-packed (HCP). Show that the atomic packing factor (APF) for FCC is 0.74, for BCC is 0.68 and HCP is 0.74.  
(12 Marks)
- Q2**
- (a) With suitable sketch, explain **three (3)** types of point defects.  
(6 Marks)
- (b) List **three (3)** examples of bulk defects.  
(3 Marks)
- (c) With suitable sketch, explain **two (2)** type of diffusion process in a solid.  
(4 Marks)
- (d) There are two conditions that must be met before diffusion process occurs. List these **two (2)** conditions.  
(2 Marks)
- (e) A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 700°C. If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 5 and 10 mm ( $5 \times 10^{-3}$  and  $10^{-2}$  m) beneath the carburizing surface area is 1.2 and 0.8 kg/m<sup>3</sup>, respectively. Assume a diffusion coefficient of  $3 \times 10^{-11}$  m<sup>2</sup>/s at this temperature.  
(10 Marks)

**Q3** (a) What is **three (3)** important information that we could obtain from phase diagram? (3 Marks)

(b) Explain the meaning of  
 (i) Peritectic  
 (ii) Eutectic  
 (iii) Eutectoid (3 Marks)

(c) Figure **Q3(c)** showed the copper-silver alloy phase diagram. Name the item as label by:

Phase  
 (i) A  
 (ii) B  
 (iii) C  
 (iv) D  
 (v) E  
 (vi) F

Line  
 (vii) G  
 (viii) H  
 (ix) I

(9 Marks)

(d) Figure **Q3(d)** showed the phase diagram of Pb-Sn. Plot the graph and make a phase analysis for composition of 30% Sn at  $183^{\circ}\text{C} + \Delta T$  and 30% Sn at  $183^{\circ}\text{C} - \Delta T$  find:

- i. Each phase composition for 30% Sn at  $183^{\circ}\text{C} + \Delta T$  and 35% Sn at  $183^{\circ}\text{C} - \Delta T$ .
- ii. Amount of weight proportion for each fraction for 30 % Sn at  $183^{\circ}\text{C} + \Delta T$  and 35% Sn at  $183^{\circ}\text{C} - \Delta T$ .

(10 Marks)

- Q4** (a) Give definition and **Two (2)** purposes of heat treatment. (4 Marks)
- (b) Describe the following heat treatment procedures for steels and, for each, the intended final microstructure  
(i) Annealing  
(ii) Normalizing  
(iii) Marquenching  
(iv) Tempering  
(v) Austempering (15 Marks)
- (c) Discuss the properties of following phase  
(i) Pearlite  
(ii) Bainite  
(iii) Martensite (6 Marks)
- Q5** (a) Explain briefly the difference between ferrous and non-ferrous metals alloys. Give **two (2)** examples for each type. (6 Marks)
- (b) Steels are basically categorized into three types, namely, low carbon, medium carbon and high carbon steels. Indicate the percentage of carbon content for each type of steel and give **two (2)** examples (products) for each one of them. (9 Marks)
- (c) List **two (2)** properties of the following non-ferrous material:  
(i) Aluminium  
(ii) Ceramic  
(iii) Polymers  
(iv) Nickel  
(v) Copper (10 Marks)

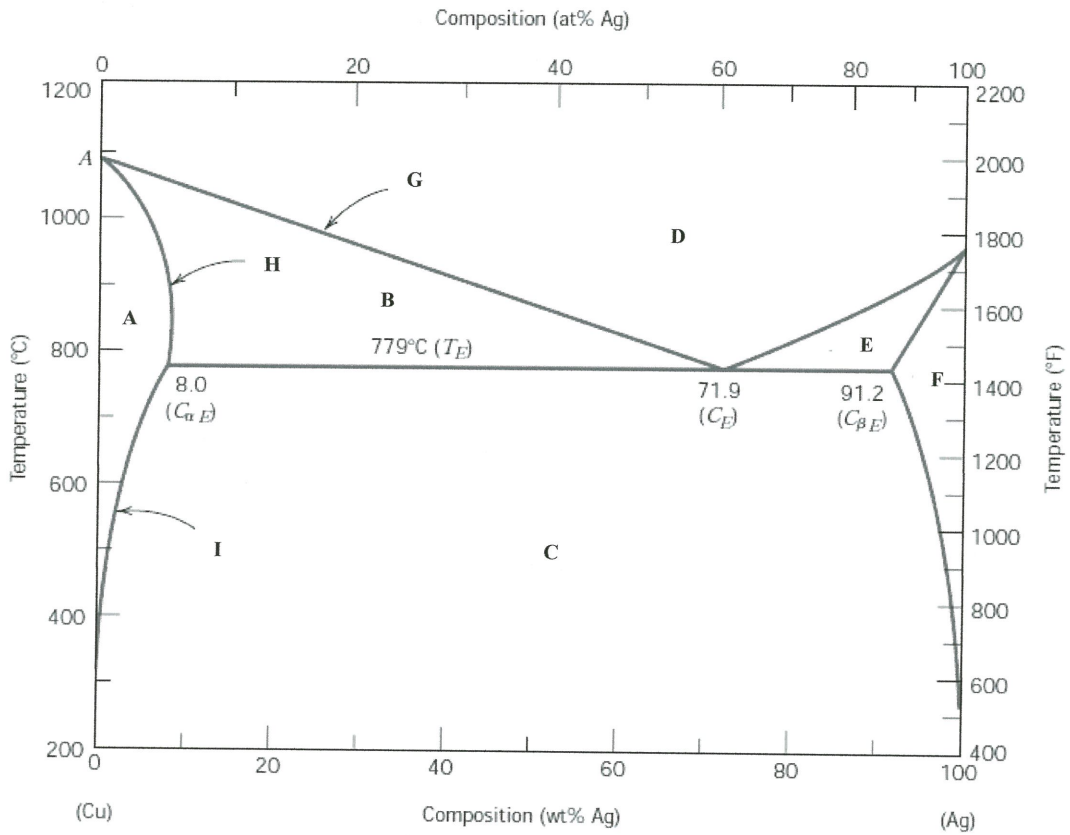
- Q6** (a) Briefly explain electrochemical corrosion and cite two locations where corrosion normally started.  
(3 Marks)
- (c) Briefly explain the following types of corrosion.  
(i) Uniform Attack – General Corrosion  
(ii) Galvanic Corrosion  
(iii) Crevice Corrosion  
(iv) Pitting  
(v) Intergranular Corrosion  
(10 Marks)
- (d) Discuss **Four (4)** steps to controlled or prevent corrosion in a metal  
(12 Marks)

- END OF QUESTION -

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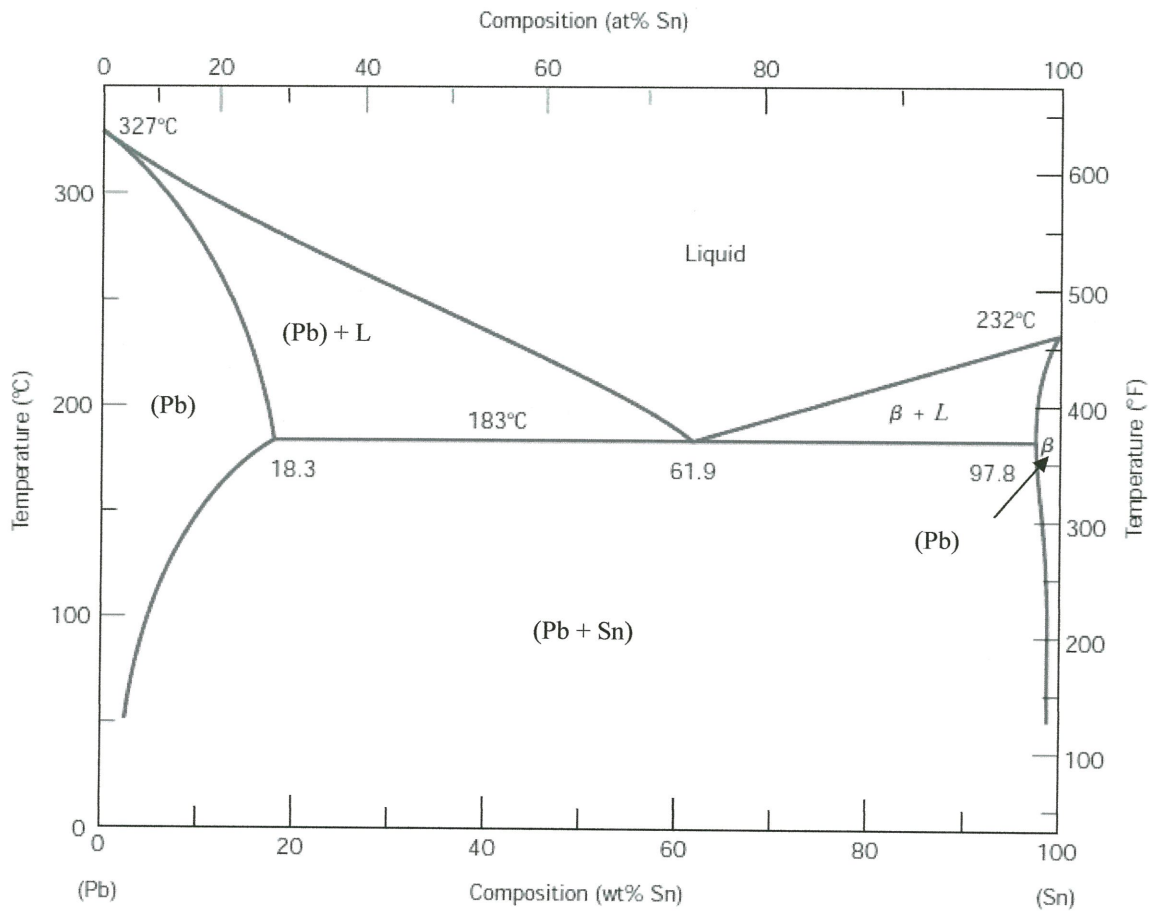


**FIGURE Q4 (c)**

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**FIGURE Q4 (b)**