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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2017/2018**

COURSE NAME : MATERIALS SCIENCE  
COURSE CODE : DAM 20802  
PROGRAMME : DAM  
EXAMINATION DATE : JUNE/JULY 2018  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY

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THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

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- Q1** (a) List down **four (4)** factors that involved in materials selection. (4 marks)
- (b) Crystal system refer to one of several classes of space lattice, lattice point and unit cell. Describe space lattice, lattice point and unit cell. (6 marks)
- (c) Hexagonal closed-packed (HCP) is one of crystal structure as shown in **Figure Q1(c)**. Prove that 74% of the HCP unit cell is occupied with atoms and 26% is empty space. (10 marks)
- Q2** (a) Mechanical properties are used to classify and identify material. Mechanical properties of materials are ascertained by performing laboratory experiments. There are several of mechanical properties testing. List and discuss **three (3)** types of mechanical testing. (6 marks)
- (b) Sketch a stress-strain graph for metal material with offset line 0.002. Label the region of elastic behaviour, plastic behaviour, necking region, yield strength point, ultimate strength point and fracture point. (4 marks)
- (c) A steel bar 150 mm long and having a square cross section 25 mm on edge is pulled in tension with a load of 76000 N and experiences an elongation of 0.15 mm. Assuming that the deformation is entirely elastic, calculate the elastic modulus of the steel. (3 marks)
- (d) A cylinder specimen of brass alloy with 7 mm in diameter and 70 mm long is pulled in tension with a force of 8000 N. If Poisson Ratio is 0.30, compute:
- (i) the specimen elongation if strain is 0.002 (5 marks)
- (ii) the reduction in specimen diameter (2 marks)

$$v = -\frac{\epsilon_x}{\epsilon_z} = -\frac{(\Delta d/d_o)}{(\Delta l/l_o)}$$

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- Q3** (a) Point defect happens due to deviation around a point or an atom in a crystal. There are six types of point defect. Describe each of defect:
- (i) Lattice vacancy
  - (ii) Scottky imperfection
  - (iii) Frenkel imperfection
- (6 marks)
- (b) List **four (4)** types of bulk defects.
- (4 marks)
- (c) Consider an alloy which is undergoing carburizing process, initially has a uniform carbon concentration of 0.20 wt% and is to be treated at 950 °C. If the concentration of carbon at the surface is suddenly brought to and maintained at 1.25 wt%, how long will it take to achieve a carbon content of 0.70 wt% at a position 0.35 mm below the surface. The diffusion coefficient for carbon in iron at this temperature is  $1.87 \times 10^{-11} \text{ m}^2/\text{s}$ ; assume that the steel piece is semi finite and refer to **Table Q3(c)** for tabulation of error function values.
- (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
- (10 marks)
- (c) Discuss the properties of following phase.
- (i) Pearlite
  - (ii) Bainite
  - (iii) Martensite
- (6 marks)

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**Q5** (a) What is **three (3)** important information that we could obtain from phase diagram? (3 marks)

(b) Explain the properties of

- (i) Peritectic
- (ii) Eutectic
- (iii) Eutectoid

(3 marks)

(c) **Figure Q5(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

- (vi) G
- (vii) H
- (vii) I

(9 marks)

(d) Refer phase diagram of Pb-Sn **Figure Q5(d)**, plot the graph and make a phase analysis for composition of 30 % Sn at  $183\text{ }^{\circ}\text{C} + \Delta T$  and 30 % Sn at  $183\text{ }^{\circ}\text{C} - \Delta T$  find:

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

(5 marks)

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- Q6** (a) Briefly explain electrochemical corrosion and cite **two (2)** locations where corrosion normally started. (2 marks)
- (b) Briefly explain the following types of corrosion. (10 marks)
- (i) Uniform Attack – General Corrosion
  - (ii) Galvanic Corrosion
  - (iii) Crevice Corrosion
  - (iv) Pitting
  - (v) Intergranular Corrosion
- (c) Discuss **four (4)** steps to controlled or prevent corrosion in a metal. (8 marks)

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**- END OF QUESTION -**

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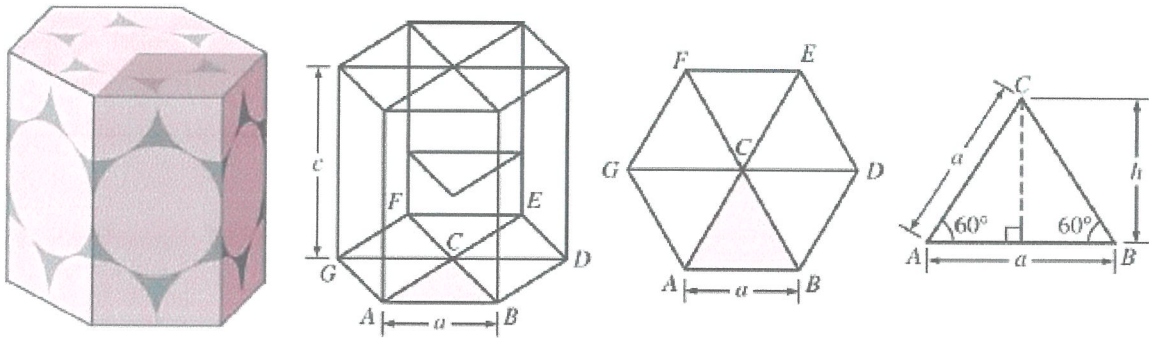
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**Figure Q1(c)**

**Table Q3(c)**

$z$	$erf(z)$	$z$	$erf(z)$	$z$	$erf(z)$
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

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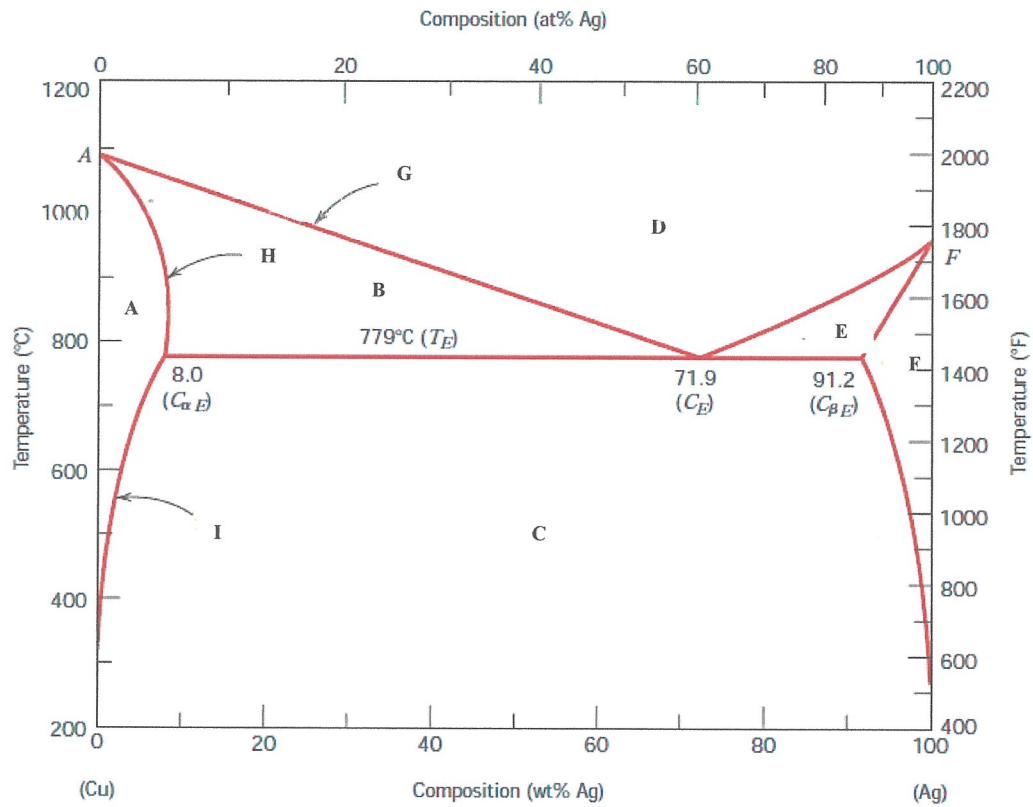


Figure Q5(c)

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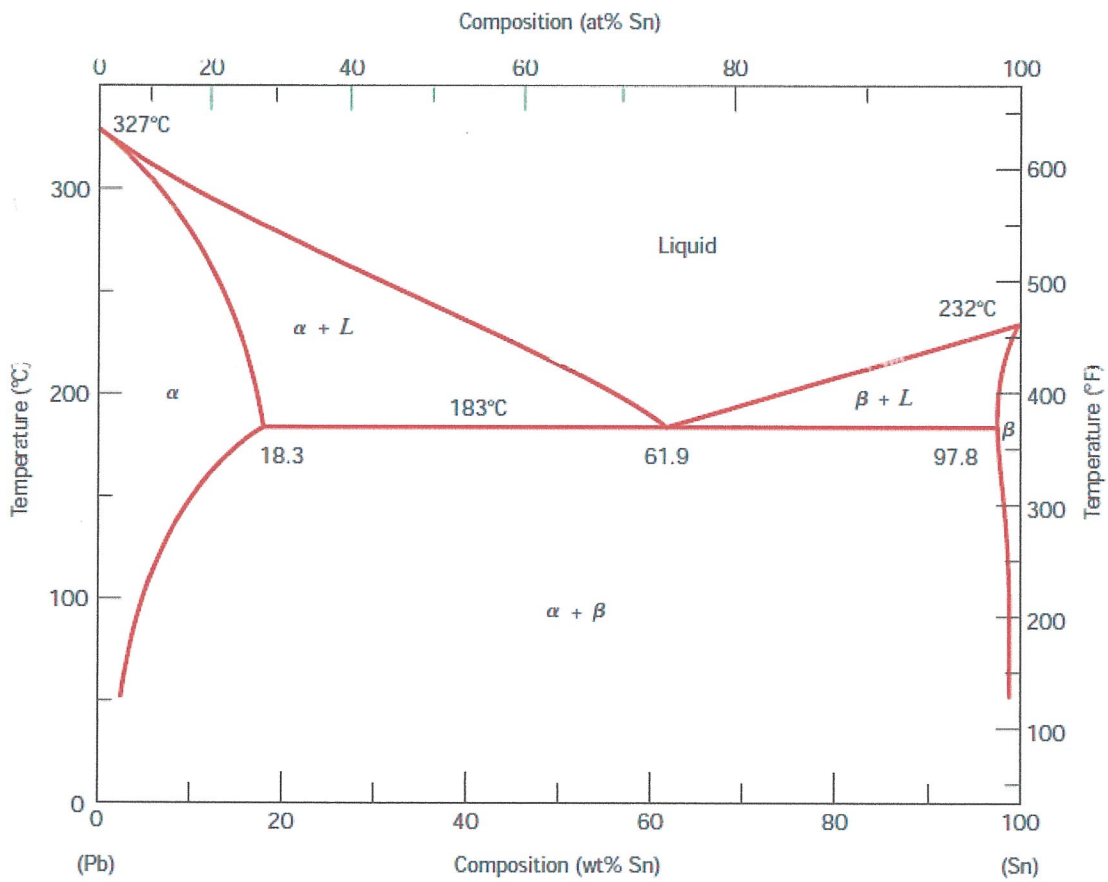


Figure Q5(d)

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STANDARISASI KUALITAS  
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