UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	MATERIAL SCIENCE
COURSE CODE	:	BDA 1602
PROGRAMME	:	1 BDD/2 BDD/3 BDD/4 BDD
EXAMINATION DATE	:	NOVEMBER / DECEMBER 2010
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** OUT OF **SIX (6)** QUESTIONS

THIS PAPER CONTAINS SIX (6) PAGES

Q1 (a) Give THREE (3) main classifications of a polymer material. Explain briefly about each type of the polymer to differentiate them.

(7 marks)

(b) Sketch the following planes and directions:

(i) $(2\bar{1}2)$

(ii) (301)

(iii) $[2\bar{1}2]$

(iv) [301]

(16 marks)

(c) What is the definition of the mechanical properties of a material?

(2 marks)

Q2 (a) (i) What is the atomic packing factor of a body centered cube? Show calculation with the assistance of appropriate sketches.

(8 marks)

(ii) Rearrange the atomic packing values of the following according to increasing manner:
Body centered cubic, Simple cubic, Face centered cubic

(3 marks)

(b) Define the following terms:

(i) Crystal structure

(ii) Unit cell

(iii) Lattice point

(6 marks)

(c) What is hardness of a material? Describe about how the materials hardness testing is performed and the interpretation of the tests result.

(8 marks)

Q3 (a) Sketch the engineering stress-strain curve and true stress-strain curve in a stress-strain diagram to differentiate them.

(4 marks)

(b) Describe SIX (6) information that could be obtained from an engineering stress-strain diagram.

(10 marks)

(c) Explain about Frenkel and Schottky imperfection in crystal by including the appropriate illustrations.

(6 marks)

(d) 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 beneath the carburizing surface are 1.2 and 0.8 kg/m^3, respectively. Assume a diffusion coefficient of 3 x 10-11 m^2/s at this temperature.

(5 marks)

Q4 (a) List of the types of dislocation and explain with picture TWO (2) types of dislocation.

(10 marks)

(b) A gear made of 1020 steel (0.40 wt % C) is to be gas-carburized at 927°C (1700°F). Calculate the carbon content at 1.80 mm below the surface of the gear after a 8.0-hour carburizing time. Assume the carbon content at the surface of the gear is 2.00 wt %. D (C in γ iron) at 927°C = 1.28×10^{-11} m^2/s. Error function is given in **TABLE Q4(b)**.

(12 marks)

(c) Give **ONE (1)** reason why the diffusion process in based center cubic (BCC) structure is faster compared to face center cubic (FCC) structure.

(3 marks)

Q5 (a) List the types of invariant reactions and explain TWO (2) of them with equation.

(10 marks)

(b) **FIGURE Q5(b)** is a common phase diagram for the Lead-Tin (Pb-Sn) system. Based on the system,

(i) Give the range of composition for a hypoeutectoid alloy.

(2 marks)

(ii) What is/are the composition of phase/phases present at point A?

(5 marks)

(iii) What is/are the proportion of the phase/phases in weight percent at point A?

(8 marks)

S6 (a) Describe the THREE (3) properties of metal, semiconductor and insulator.

(9 marks)

(b) Give TWO (2) important information that we can found from phase diagram.

(3 marks)

(c) Explain about heat treatment.

(4 marks)

(d) Describe the heat treatment that are listed below;

i) Annealing
ii) Quenching
iii) Normalizing

(9 marks)

FINAL EXAM

SEMESTER /SESI : SEMESTER I/ 2010/11
KURSUS : SAINS BAHAN
PROGRAM : 1
KOD KURSUS : BDA 1602

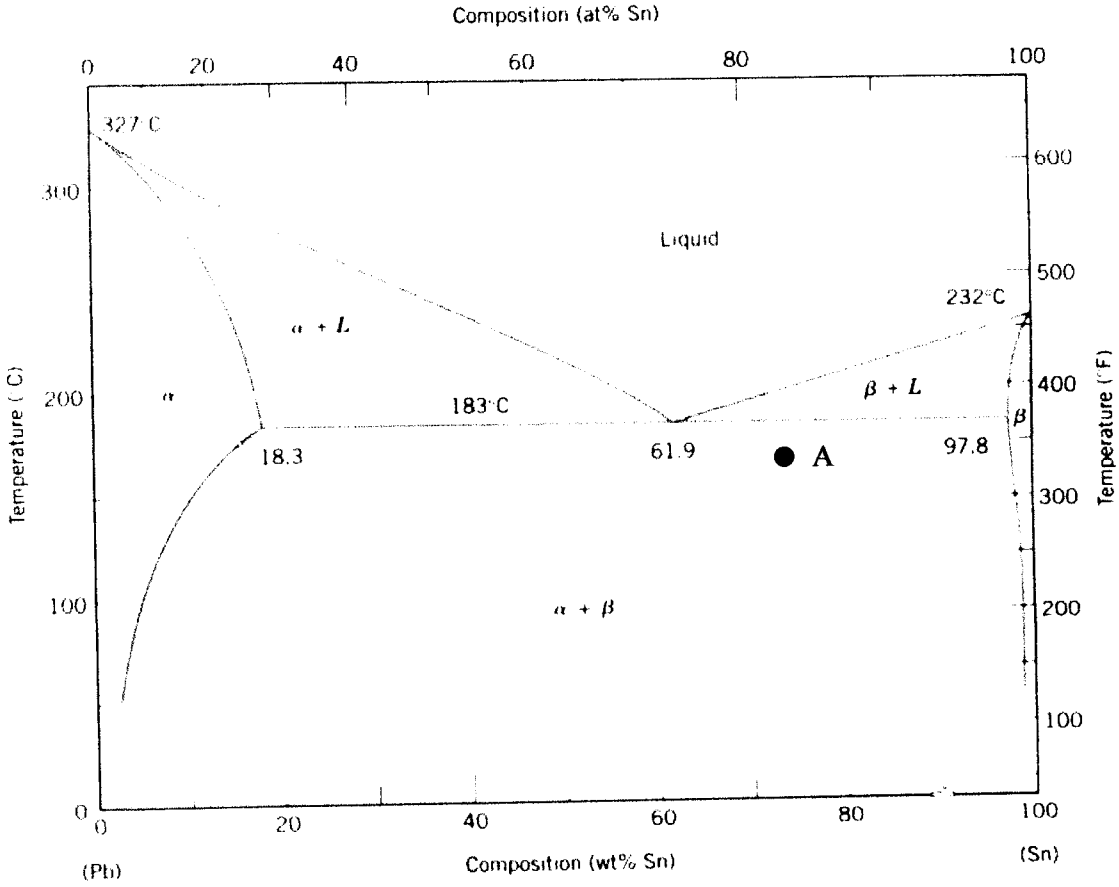

Figure Q5 (b)

FINAL EXAM

SEMESTER /SESI : SEMESTER I/ 2010/11
KURSUS : SAINS BAHAN
PROGRAM : 1
KOD KURSUS : BDA 1602

TABLE Q4(b)

TABULATION OF ERROR FUNCTION

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	0.9253
0.5	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

EQUATION

$$J = -D\frac{dC}{dx}$$

$$\frac{C_x - C_o}{C_s - C_o} = 1 - \text{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

$$D = D_o \exp\left(-\frac{Q_d}{RT}\right)$$

$$\ln D = \ln D_o - \frac{Q_d}{R}\left(\frac{1}{T}\right)$$

$$\log D = \log D_o - \frac{Q_d}{2.3R}\left(\frac{1}{T}\right)$$