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CONFIDENTIAL

SET B

UNIVERSITI KUALA LUMPUR

Malaysia France Institute

FINAL EXAMINATION

JANUARY 2011SESSION

SUBJECT CODE	: FTD 11403
SUBJECT TITLE	: MATERIAL SCIENCE
LEVEL	: DIPLOMA
DURATION	: 12.30pm – 2.30pm (2 HOURS)
DATE / TIME	: 05 MAY 2011

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer ALL questions in Section A and FOUR (4) questions only in Section B.
6. Answer all questions in English.

THERE ARE 4 PRINTED PAGES OF QUESTIONS, 1 PAGE OF FORMULAE AND 2 PAGE OF APPENDIX EXCLUDING THIS PAGE.

SECTION A (Total: 20 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

1. The boundary (line) separate between solid phase + liquid phase and solid phase in phase diagram is called _____. (2 marks)

2. The Body Centered Cubic (BCC) unit cell consists of net total of _____ atoms. (2 marks)

3. A vacancy is produced when an atom is _____at a certain crystal lattices position. (2 marks)

4. The simplest or smallest unit representative structure is known as _____. (2 marks)

5. A bonding is the result of electron transferred from one atom to another is referred to _____bonding. (2 marks)

6. Atomic mass (A) is the summation mass of _____ and neutrons in the nucleus. (2 marks)

7. Force divided by area is called _____. (2 marks)

8. In tensile tests, if the deformation is elastic, the stress-strain relationship is called _____. (2 marks)

9. An element that has the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ has _____ electrons? (2 marks)

10. The nucleus of the atom contains protons and _____. (2 marks)

SECTION B (Total: 80 marks)

INSTRUCTIONS: Answer four (4) questions only

Please use the answer booklet provided.

Question 1

a) Sketch and describe **THREE (3)** types of points defects.

(6 marks)

b) Within a cubic unit cell, draw the following directions:

i. $[\bar{1}\,1\,0]$

ii. $[1\,2\,1]$

iii. $[0\,\bar{1}\,2]$

(9 marks)

c) Besides basic cubic, there are other six types of crystal systems in Bravais lattices. List down other five (5) types of crystal systems in Bravais lattices.

(5 marks)

Question 2

a) Name **THREE (3)** groups of basic material in engineering practice.

(6 marks)

b) Describe the characteristics and their applications **TWO (2)** of the above mentioned materials.

(8 marks)

c) What is ionic bonding? Give one example of ionic bonding compounds.

(6 marks)

Question 3

a) Consider a cylindrical titanium wire of 3.0 mm in diameter and 2.5×10^4 mm long. By assuming that the deformation is totally elastic, calculate its stress when a load of 500 N is applied.

(5 marks)

b) The following data (Table 1) were collected from tensile test of a cylindrical specimen of cast iron that having a diameter of 12.8 mm and original gauge length is 50.800 mm.

Table 1: Data for tensile test of cast iron

Strain (mm/mm)	Stress (MPa)
0.0000	0
0.0010	57
0.0020	117.3
0.0030	179.5
0.0040	236.2
0.0050	267.3
0.0100	298.4
0.0200	320.9
0.0400	348.1
0.0600	359
0.0800	367.5
0.1000	369
0.1200	358.2
0.1350	348.1
0.1500	331
0.1650	282.8
	Fracture

i) Plot Stress Strain curve.

(10 marks)

ii) Determine the yield strength by 0.2% offset.

(3 marks)

iii) Determine the maximum tensile strength.

(2 marks)

Question 4

In the Crystal Systems arrangements, Nickel (Ni) has an atomic radius of 0.125 nm, an FCC crystal structure and atomic weight of 58.71 g/mol.

i. Calculate the volume of FCC unit cell in terms of atomic radius R with help of sketch.

(8 marks)

ii. Show that the atomic packing factor for the FCC crystal structure is 0.74.

(6 marks)

iii. Compute the density of Nickel

(4 marks)

Question 5

Refer to equilibrium phase diagram in **APPENDIX 1**, for 40wt% Ag -60wt% Cu at temperature 780^{o}C.

i. determine the maximum solubility of Copper (Cu) in Silver (Ag) and Silver (Ag) in Copper (Cu).

(5 marks)

ii. calculate the amount of each phases present.

(6 marks)

iii. calculate the amount of α and β at 778^{o}C for 40% Ag-60% Cu.

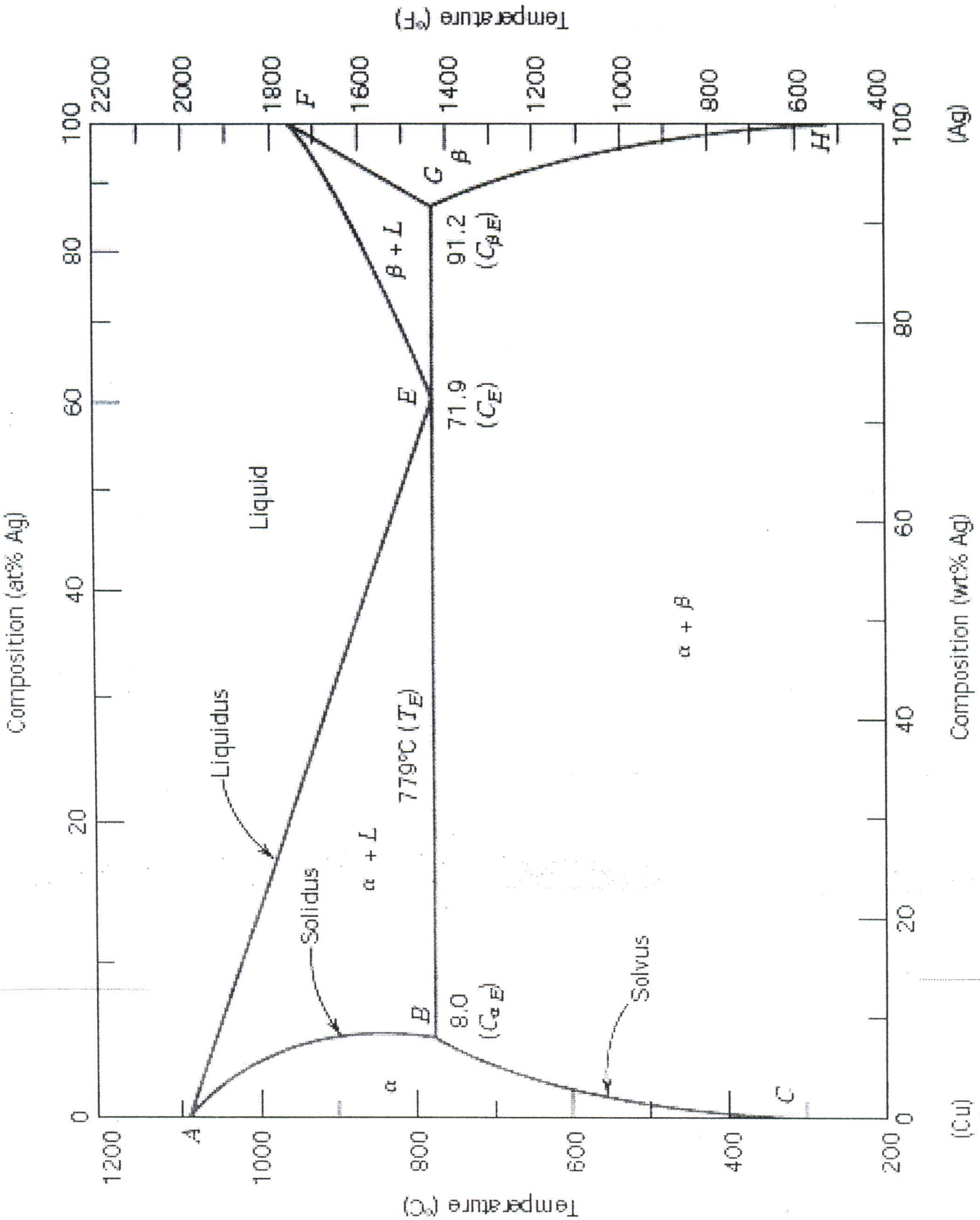
(6 marks)

iv. sketch the microstructure in question (iii).

(3 marks)

END OF QUESTION

APPENDIX 1 Cu-Ag phase diagram



APPENDIX 2 : Periodic Table

THE PERIODIC TABLE

1 IA												13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 **H** 1 1.008 Hydrogen	2 IIA																**He** 2 4.00 Helium
2 **Li** 3 6.94 Lithium	**Be** 4 9.01 Beryllium											**B** 5 10.81 Boron	**C** 6 12.01 Carbon	**N** 7 14.01 Nitrogen	**O** 8 16.00 Oxygen	**F** 9 19.00 Fluorine	**Ne** 10 20.18 Neon
3 **Na** 11 22.99 Sodium	**Mg** 12 24.31 Magnesium	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	**Al** 13 26.98 Aluminum	**Si** 14 28.09 Silicon	**P** 15 30.97 Phosphorus	**S** 16 32.07 Sulfur	**Cl** 17 35.45 Chlorine	**Ar** 18 39.95 Argon
4 **K** 19 39.10 Potassium	**Ca** 20 40.08 Calcium	**Sc** 21 44.96 Scandium	**Ti** 22 47.88 Titanium	**V** 23 50.94 Vanadium	**Cr** 24 52.00 Chromium	**Mn** 25 54.94 Manganese	**Fe** 26 55.85 Iron	**Co** 27 58.93 Cobalt	**Ni** 28 58.69 Nickel	**Cu** 29 63.55 Copper	**Zn** 30 65.39 Zinc	**Ga** 31 69.72 Gallium	**Ge** 32 72.61 Germanium	**As** 33 74.92 Arsenic	**Se** 34 78.96 Selenium	**Br** 35 79.90 Bromine	**Kr** 36 83.80 Krypton
5 **Rb** 37 85.47 Rubidium	**Sr** 38 87.62 Strontium	**Y** 39 88.91 Yttrium	**Zr** 40 91.22 Zirconium	**Nb** 41 92.91 Niobium	**Mo** 42 95.94 Molybdenum	**Tc** 43 (97.9) Technetium	**Ru** 44 101.07 Ruthenium	**Rh** 45 102.91 Rhodium	**Pd** 46 106.42 Palladium	**Ag** 47 107.87 Silver	**Cd** 48 112.41 Cadmium	**In** 49 114.82 Indium	**Sn** 50 118.71 Tin	**Sb** 51 121.76 Antimony	**Te** 52 127.60 Tellurium	**I** 53 126.90 Iodine	**Xe** 54 131.29 Xenon
6 **Cs** 55 132.91 Cesium	**Ba** 56 137.33 Barium	**La** 57 138.91 Lanthanum	**Hf** 72 178.49 Hafnium	**Ta** 73 180.95 Tantalum	**W** 74 183.85 Tungsten	**Re** 75 186.21 Rhenium	**Os** 76 190.2 Osmium	**Ir** 77 192.22 Iridium	**Pt** 78 195.08 Platinum	**Au** 79 196.97 Gold	**Hg** 80 200.59 Mercury	**Tl** 81 204.38 Thallium	**Pb** 82 207.2 Lead	**Bi** 83 208.98 Bismuth	**Po** 84 (209) Polonium	**At** 85 (210) Astatine	**Rn** 86 (222) Radon
7 **Fr** 87 223.02 Francium	**Ra** 88 226.03 Radium	**Ac** 89 227.03 Actinium	**Rf** 104 (261) Rutherfordium	**Db** 105 (262) Dubnium	**Sg** 106 (263) Seaborgium	**Bh** 107 (262) Bohrium	**Hs** 108 (265) Hassium	**Mt** 109 (266) Meitnerium	Unnamed Discovery 110 Nov. 1994	Unnamed Discovery 111 Nov. 1994	Unnamed Discovery 112 1996		Unnamed Discovery 114 1999		Unnamed Discovery 116 1999		Unnamed Discovery 118 1999
	ALKALI METALS	ALKALI EARTH METALS														HALOGENS	NOBLE GASES

H — SYMBOL
1 — ATOMIC NUMBER
1.008 — ATOMIC WEIGHT
Hydrogen — NAME

( ) = ESTIMATES

LANTHANIDES	**Ce** 58 140.12 Cerium	**Pr** 59 140.91 Praseodymium	**Nd** 60 144.24 Neodymium	**Pm** 61 (145) Promethium	**Sm** 62 150.36 Samarium	**Eu** 63 152.97 Europium	**Gd** 64 157.25 Gadolinium	**Tb** 65 158.93 Terbium	**Dy** 66 162.50 Dysprosium	**Ho** 67 164.93 Holmium	**Er** 68 167.26 Erbium	**Tm** 69 168.93 Thulium	**Yb** 70 173.04 Ytterbium	**Lu** 71 174.97 Lutetium
ACTINIDES	**Th** 90 232.04 Thorium	**Pa** 91 231.04 Protactinium	**U** 92 238.03 Uranium	**Np** 93 237.05 Neptunium	**Pu** 94 (240) Plutonium	**Am** 95 243.06 Americium	**Cm** 96 (247) Curium	**Bk** 97 (248) Berkelium	**Cf** 98 (251) Californium	**Es** 99 252.08 Einsteinium	**Fm** 100 257.10 Fermium	**Md** 101 (257) Mendelevium	**No** 102 259.10 Nobelium	**Lr** 103 262.11 Lawrencium

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FORMULAE

$$APF = \frac{V_s}{V_c}$$

$$V_s = (\text{no of atom per unit cell}) \text{x} (\text{Sphere volume})$$

$$V_c = \text{a}^3$$

$$Sphere\ volume = \frac{4}{3}\Pi R^3$$

$$Avogadro's\ number\ N_A = 6.023 \text{ x } 10^{23}$$

$$\rho = \frac{nA}{V_c N_A}$$

$$a = \frac{4r}{\sqrt{2}}$$

$$a = \frac{4r}{\sqrt{3}}$$

$$a = 2r$$

$$l = \sqrt{2}a = 4R$$

$$N_v = N \exp(\frac{-Q}{kT})$$

$$N = \frac{N_A \rho}{A}$$

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

$$\frac{N_v}{N} = \exp\left(\frac{-Q_v}{kT}\right)$$

$$m_\alpha\ phase = \frac{m_\beta - m_x}{m_\beta - m_\alpha} x Total\ Mass$$

$$m_\beta\ phase = \frac{m_x - m_\alpha}{m_\beta - m_\alpha} x Total\ Mass$$

$$\rho_\alpha = \frac{100}{\frac{C_{Sn(\alpha)}}{\rho_{Sn}} + \frac{C_{Pb(\alpha)}}{\rho_{Pb}}}$$

$$\rho_\beta = \frac{100}{\frac{C_{Sn(\beta)}}{\rho_{Sn}} + \frac{C_{Pb(\beta)}}{\rho_{Pb}}}$$

$$V_\beta = \frac{\frac{M_\beta}{\rho_\beta}}{\frac{M_\alpha}{\rho_\alpha} + \frac{M_\beta}{\rho_\beta}}$$

$$V_\beta = \frac{\frac{M_\beta}{\rho_\beta}}{\frac{M_\alpha}{\rho_\alpha} + \frac{M_\beta}{\rho_\beta}}$$