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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPT 2013 SESSION

SUBJECT CODE	:	**FTD 11403**
SUBJECT TITLE	:	**MATERIALS SCIENCE**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**(2 HOURS)**
DATE	:	

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.**
7. **Candidates are allowed to bring laminated Phase Diagram in the examination hall.**

THERE ARE 6 PRINTED PAGES OF QUESTIONS, AND 3 PAGE OF APPENDIX EXCLUDING THIS PAGE.

SECTION A (Total: 20 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

1. The directions of [100], [100], [010], [010], [$\bar{0}$01], [00$\bar{1}$] can be classified as _____ family. (2 Marks)

2. A bonding that is the result from interaction of atomic or molecular dipoles is referred to _____. (2 Marks)

3. All solids are elastic for small enough deformations or strains, but if the stress exceeds a certain amount known as the _____**,** a permanent deformation is produced**.** (2 Marks)

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

5. The Face Centered Cubic (FCC) unit cell consists of a net total of _____ atoms (2 marks)

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

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

8. _____ is defined as a ratio of increase in length to original length. (2 marks)

9. A vacancy is produced when an atom is _____from normal site. (2 marks)

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

SECTION B (Total: 80 marks)

INSTRUCTIONS: Answer FOUR (4) questions only

Please use the answer booklet provided.

Question 1

a.) Name **FIVE (5)** groups of material.

(5 marks)

b.) Predict the chemical formula Al_xO_y of the compound that results from the reaction between the elements Al and O.

(4 marks)

c.) Use energy level diagram to show how electrons of Potassium Atom (K) atom are distributed in a ground-state and state the electron-configuration notation.

(5 marks)

d.) Briefly cite the main differences between ionic, covalent and metallic bonding.

(6 marks)

Question 2

a.) In the Crystal Systems arrangements, Iriduim (Ir) atom, has an Face Centered Cubic (FCC) crystal structure, a density of 22.4 g/cm^3, and an atomic weight of 192.2 g/mol

i. **Show** that the unit cell edge length 'a' for face-centered cubic crystal structure (FCC) and the atomic radius R is related through $a = \frac{4R}{\sqrt{2}}$ with help of sketches.

(5marks)

ii. Calculate their atomic radius(R).

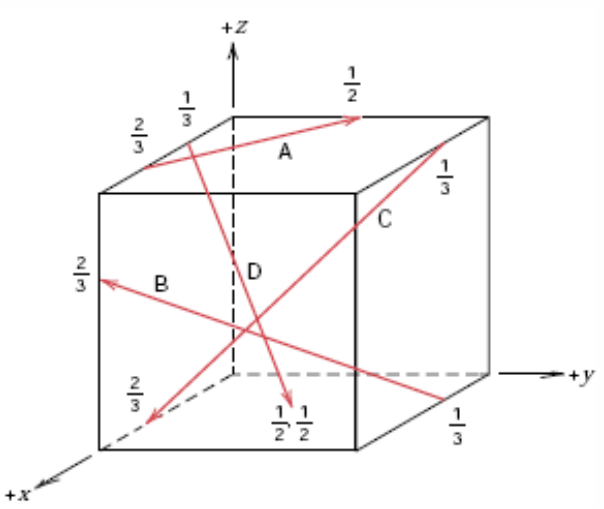
(10 marks)

b.) 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 3

a.) Determine the miller indices for the direction shown in the following unit cell;



(12 marks)

b.) **Show** that the atomic packing factor APF for FCC is 0.74.

(8 marks)

Question 4

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

(4 marks)

b) The following data for tensile test of cast iron (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.

i) Plot Stress Strain curve.

(10 marks)

ii) Determine the yield strength by 0.2% offset.

(2 marks)

iii) Calculate its ductility.

(4 marks)

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

Question 5

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

a.) Determine the maximum solubility of Copper (Cu) in Silver (Ag) and Silver (Ag) in Copper (Cu).

(3 Marks)

b.) Determine the eutectic composition and write the eutectic reaction, and show it in the phase diagram given in appendix 1.

(3 Marks)

c.) Calculate the amount of each phases present

(5 Marks)

d.) Calculate the amount of α and β at $778^{O}C$ for 40% Ag-60% Cu.

(5 Marks)

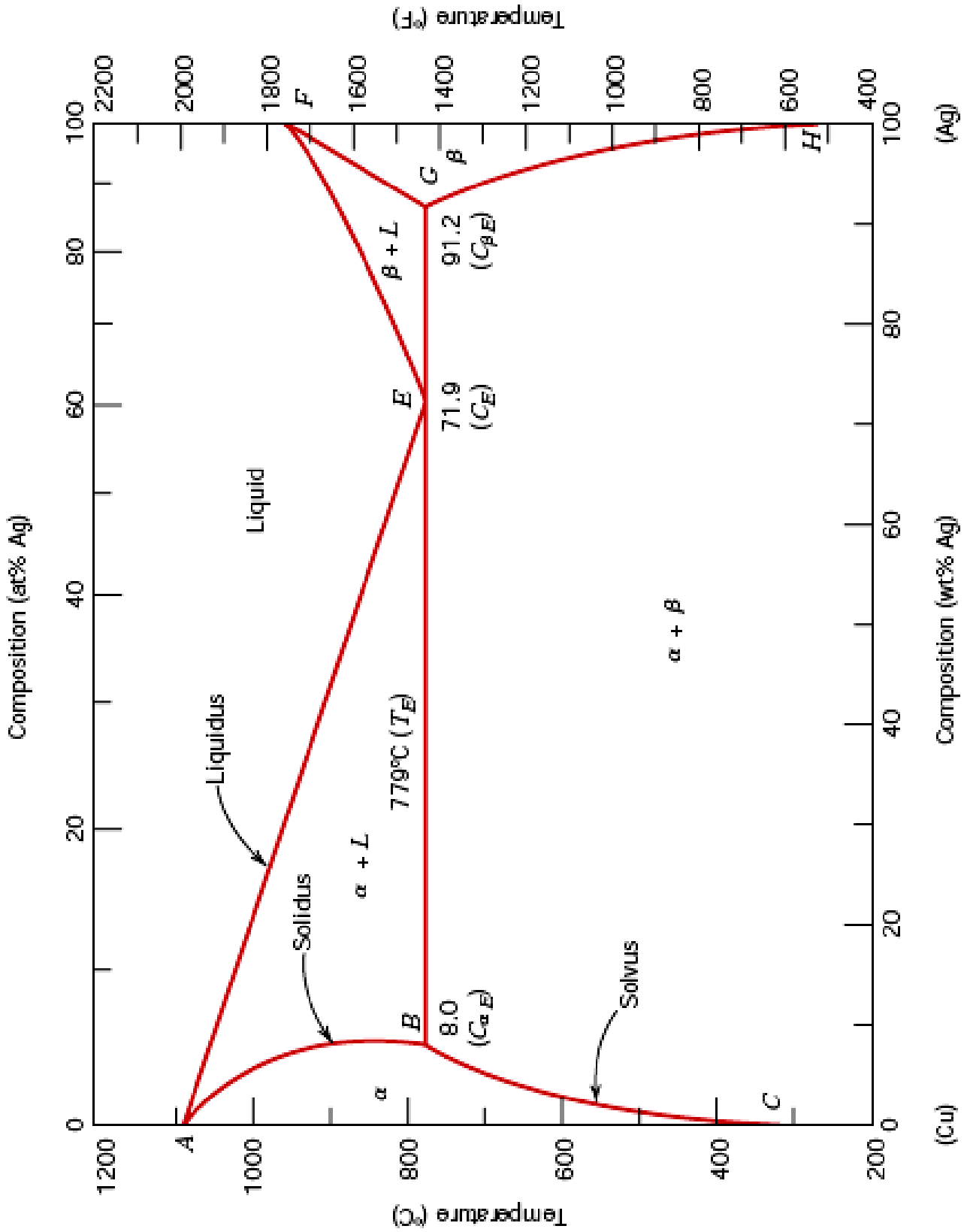
e.) Sketch the microstructure of question (d).

(4 Marks)

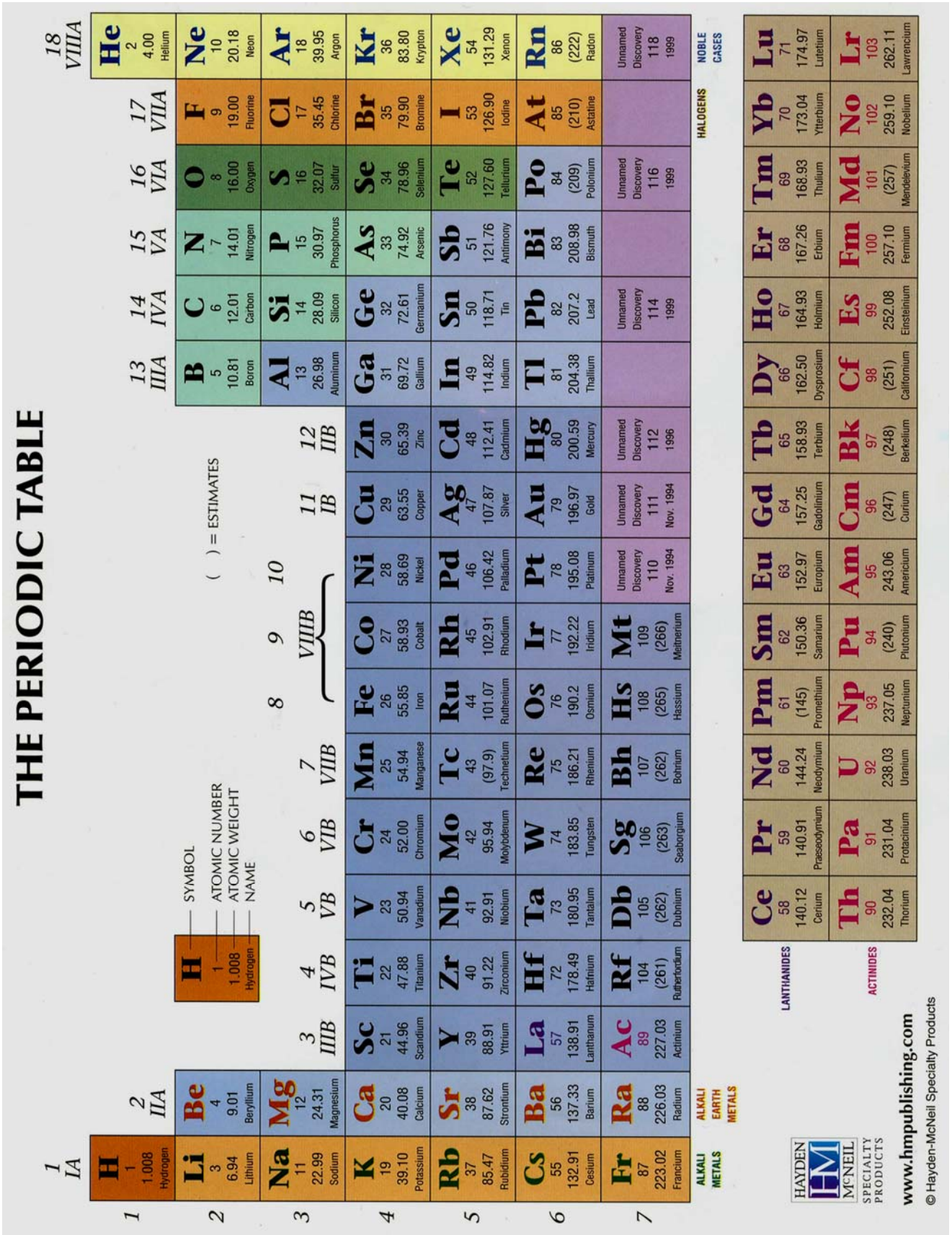
END OF QUESTION

APPENDIX 1 Cu-Ag phase diagram

ANSWER SCREPT



APPENDIX 2 (Phase diagram)


THE PERIODIC TABLE
( ) = ESTIMATES
SYMBOL
ATOMIC NUMBER
ATOMIC WEIGHT
NAME
ALKALI METALS
ALKALI EARTH METALS
LANTHANIDES
ACTINIDES
HALOGENS
NOBLE GASES
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APPENDIX 3

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

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

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

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

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

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

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

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

$$a = 2r$$

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

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

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

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

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

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

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

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

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

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

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