INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

| | | |
|---|---|---|
| Session | : | **August 2018** |
| Programme | : | Diploma in Electrical and Electronic Engineering (DEEI)<br>Diploma in Mechanical Engineering (DMEN) |
| Course | : | **EGM1182/1184 : Structures and Properties of Materials** |
| Date of Examination | : | December 7, 2018 (Friday) |
| Time | : | 5:00 pm – 7:00 pm Reading Time : Nil |
| Duration | : | 2 Hours |
| Special Instructions | : | |

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :
Calculator

Material provided :
Periodic Table and List of Formula

Examiner : **Iylia Elena Abdul Jamil** & Aaron Edward Teo Sheng Jye

Moderator : Mr Abdolreza Toudehdehghan

*This paper consists of 7 printed pages, including the cover page.*

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
DIPLOMA IN MECHANICAL ENGINEERING (DMEN)
EGM1182/1184: STRUCTURES AND PROPERTIES OF MATERIALS
FINAL EXAMINATION: AUGUST 2018 SESSION

**Instructions:** This paper consists of SIX **(6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

**Question 1**

(a) Write down the electron configuration of Neon, Na and $Na^+$.

(6 marks)

(b) Given Avogadro's number is $6.022 \times 10^{23}$ atoms/mol. How many atoms are there in:

(i) One gram of sulfur (S)

(ii) One gram of lead (Pb)

(4 marks)

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

(6 marks)

(d) What is the composition, in atom percent, of an alloy that contains 45.2 kg copper (Cu), 46.3 kg zinc (Zn), and 0.95 kg lead (Pb)?

(9 marks)

**Question 2**

(a) For a FCC crystal structure, how many atoms are there per unit cell and what is the coordination number?

(4 marks)

(b) Calculate the atomic packing factor (APF) for FCC structure.

(5 marks)

(c) Determine the Miller indices for the planes A & B shown in the unit cell in Figure Q2 (b).

(6 marks)

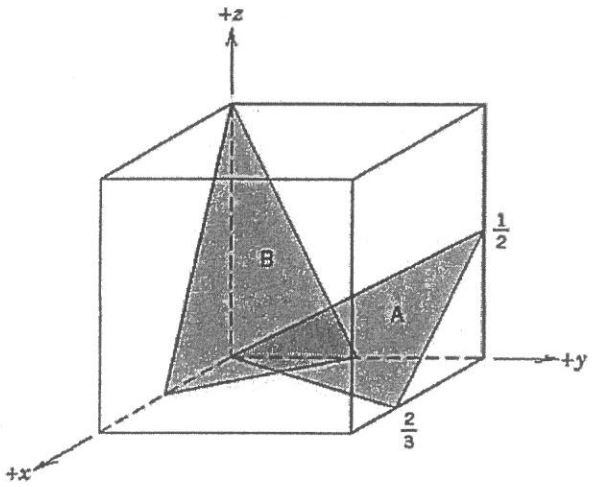



Figure for Q2 (b)

(d) Determine the indices for directions A and B in the cubic unit cell in Figure Q2c.

(6 marks)

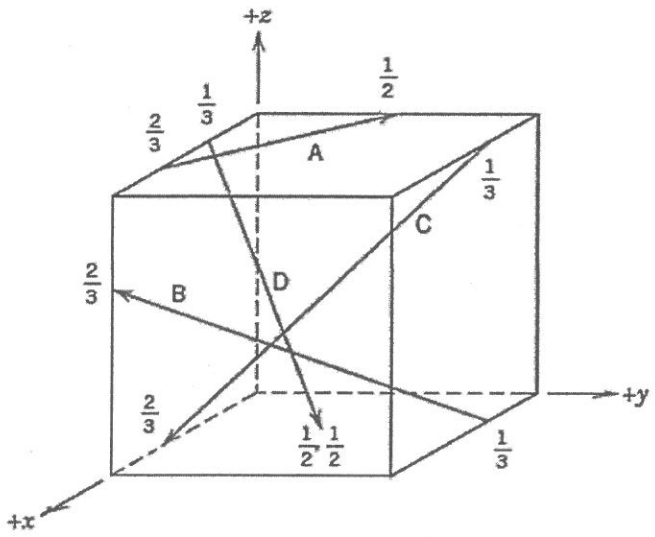



Figure for Q2 (c)

(e) Dislocations are line defects. Name two types of dislocation.

(4 marks)

**Question 3**

(a) What is the composition, in atom percent, of an alloy that contains 100 g tin and 68 g of lead?

(6 marks)

(b) If there are 600 grains per square inch on a photomicrograph of a metal at 100x, what is its ASTM grain-size number?

(3 marks)

(c) Briefly explain the following terms: (Include drawing/illustration of your answer)

(i) Vacancies

(ii) Self-interstitials

(6 marks)

(d) Figure Q3 (d) shows the phase diagram of Ag-Cu alloy. If an alloy of 88 wt% Ag – 12 wt% Cu is cooled from 1000°C, determine:

(i) The phase present at 780°C + $\Delta T$ and the amount (wt %) of each phase.

(ii) The phase present at 780°C - $\Delta T$ and the amount (wt %) of each phase.

(10 marks)

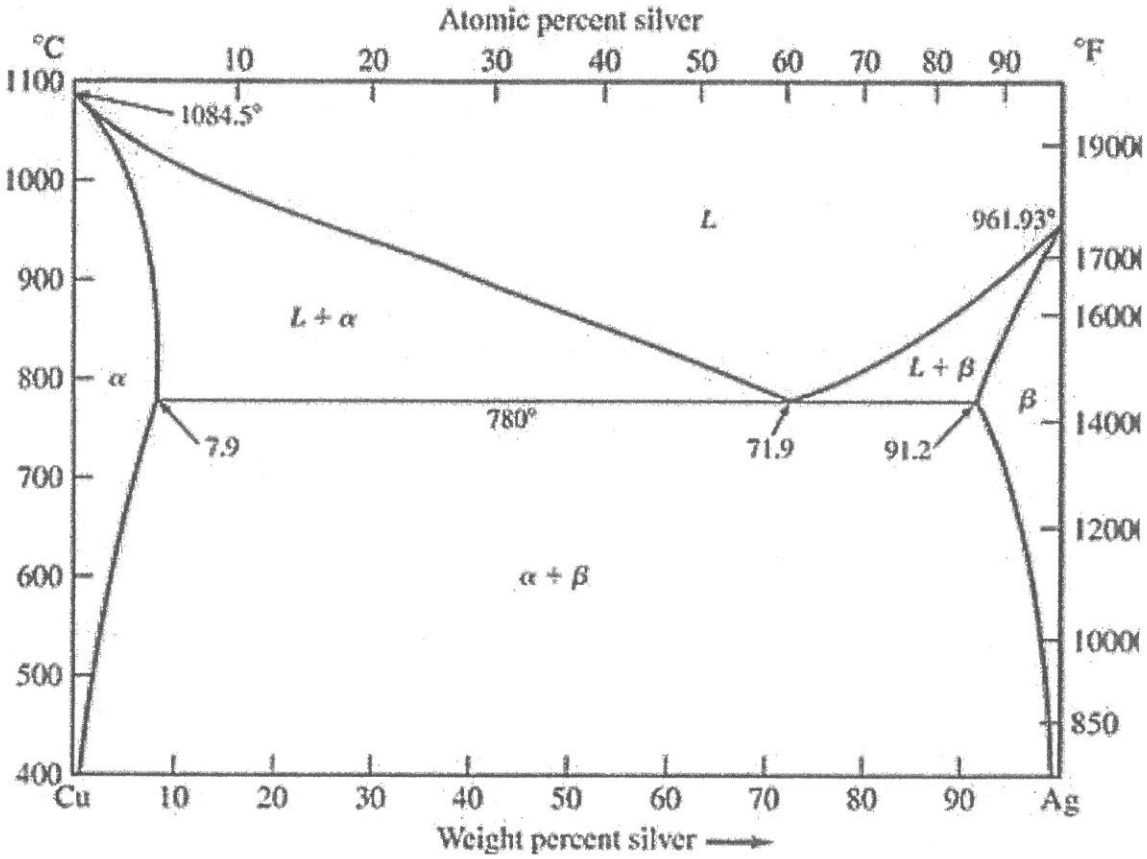



Figure for Q3 (d)

**Question 4**

(a) What is the formula for mean stress, stress amplitude, stress range and stress ratio.

(8 marks)

(b) A fatigue test is made with a maximum stress of 172 MPa and a minimum stress of -27.6 MPa. Calculate:

(i) the stress range

(ii) the stress amplitude

(iii) the mean stress

(iv) the stress ratio

(8 marks)

(c) Briefly explain the difference between elastic and plastic deformation.

(4 marks)

(d) Briefly explain the difference between engineering stress and true stress. Which has a larger magnitude?

(5 marks)

**Question 5**

(a) Define the modulus of elasticity. Does a stiffer material have higher or lower modulus of elasticity compared to a softer material?

(3 marks)

(b) A steel bar 100 mm long and having a square cross section 20 mm x 20mm is pulled in tension with a load of 89,000 N. The bar experiences an elongation of 0.10 mm. Calculate the modulus of elasticity of the steel assuming that the deformation is entirely elastic.

(6 marks)

(c) When a strain hardened metal is heated at high temperature where recovery takes place, describe how the following characteristics are affected:

(i) internal residual stresses

(ii) strength

(iii) ductility

(iv) hardness

(8 marks)

(d) List down **FOUR (4)** common properties of most ceramic materials.

(8 marks)

**Question 6**

(a) Briefly explain what tempered glass is. Name **ONE (1)** application for tempered glass.

(4 marks)

(b) Briefly explain the difference between thermoplastic and thermosetting plastic and name **TWO (2)** products made from each material.

(8 marks)

(c) At what temperature will the electrical resistivity of an iron wire be $25.0 \times 10^{-8}$ $\Omega$ cm (Resistivity for iron at $0°C = 9.0 \times 10^{-6}$ $\Omega$ cm, coefficient of resistivity = $0.0045°C^{-1}$)

(4 marks)

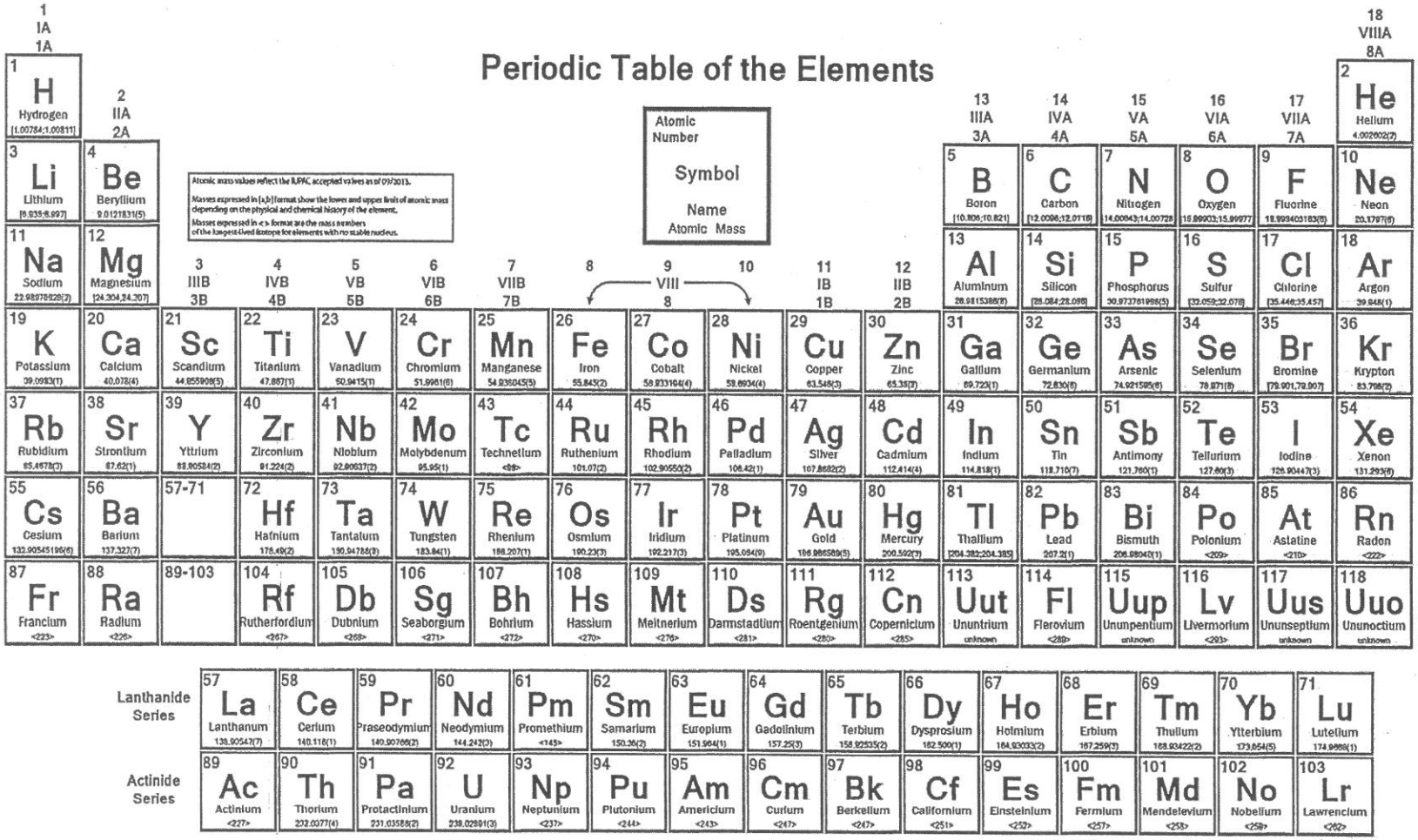
(d) A 5.0 mm diameter, 50 mm long cylindrical silicon specimen has a current of 0.1 A passing in axial direction. A voltage of 12.5 V is measured across two probes that are separated by 38 mm.

(i) Find the electrical conductivity of the specimen.

(ii) Compute the resistance over the entire 50 mm of the specimen.

(9 marks)

# Periodic Table of the Elements




-THE END-

EGM 1182 / 1184

LIST OF FORMULA

1. Atomic packing factor, $APF = \frac{volume\ of\ atoms\ in\ a\ cell}{volume\ of\ cubic\ cell}$
2. Number of grains in 100x magnification, $N = 2^{n-1}$
3. Stress, $\sigma = \frac{F_o}{A}$
4. Strain, $\varepsilon = \frac{\Delta l}{l_o}$
5. Modulus of elasticity, $E = \frac{\sigma}{\varepsilon}$
6. Resistivity, $\rho = \frac{VA}{Il}$
7. Resistivity at specified temperature, $\rho_T = \rho_{0°C}(1 + \alpha_T T)$
8. Conductivity, $\sigma = \frac{1}{\rho}$
9. Resistance, $R = \frac{\rho l}{A}$
10. Lever Rule:
    a. Weight fraction of Phase A, $X_A = \frac{w_B - w_O}{w_B - w_A}$
    b. Weight fraction of Phase B, $X_B = \frac{w_O - w_A}{w_B - w_A}$