

EXAMINATION AND EVALUATION DIVISION
DEPARTMENT OF POLYTECHNIC EDUCATION
(MINISTRY OF HIGHER EDUCATION)

MECHANICAL ENGINEERING DEPARTMENT

FINAL EXAMINATION
DECEMBER 2011 SESSION

J3022 : MATERIAL TECHNOLOGY 1

DATE : 23 APRIL 2012 (MONDAY)
DURATION : 2 HOURS (11.15 AM - 1.15 PM)

This paper consists of **FIVE (5)** pages including the front page.
Structured/Essay (6 questions – answer any **4 question**)

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THE CHIEF INVIGILATOR

Instruction : Answer **FOUR** Questions Out Of **SIX** Questions

QUESTION 1

a) Give the definitions of the following terms:-

- i. Atom
- ii. Element
- iii. Mixture
- iv. Solid solution

(4 Marks)

b) The diagram below shows an atom in an element periodic table. By referring to the diagram below.

12	24.3
Mg	
2:8:2	

i. Explain the meaning of the numbers 12, 24.3 the letters; Mg and the ratio 2:8:2.

(4 Marks)

ii. Sketch the electron configuration for the atom

(3 Marks)

c) Sketch and state the numbers of atoms for the structure below;

- i. Face Centre Cubic (FCC).
- ii. Body Centre Cubic (BCC).
- iii. Hexagonal Close-Packed (HCP).
- iv. Simple Cube (SC).

(8 Marks)

- d) The **Figure S1** below represent an electron configuration for 2 types of element.

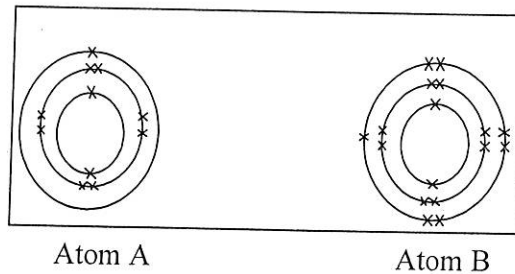


Figure S1

- i. Determine the group number in the element periodic table for atom A and atom B.
- ii. Identify the most suitable chemical bonding between atom A and atom B.
- iii. Based on your answer in (ii), explain how the chemical bonding occurred between atom A and atom B. (6 Marks)

QUESTION 2

- a) Explain the meaning of carbon steel and give **THREE (3)** types of carbon steel (6 Marks)
- b) Give **FOUR (4)** advantages of using electric arc furnace. (4 Marks)
- c) Give **FIVE (5)** reasons for alloying steel. (5 Marks)
- d) Explain the process of steel production using basic oxygen furnace. (10 Marks)

QUESTION 3

- a) i. Give the definition of cold working and hot working
ii. Give **TWO (2)** example of cold working and **TWO (2)** example of hot working. (6 Marks)
- b) Give **TWO (2)** advantages and **TWO (2)** disadvantages of cold working. (4 Marks)
- c) What is the definition of casting. State **FOUR (4)** types of castings. (5 Marks)
- d) What is the definition of annealing. State **THREE (3)** reasons why annealing should be done for steel. (5 Marks)
- e) State **FIVE (5)** types of medium used in quenching process. (5 Marks)

QUESTION 4

- a) State **FOUR (4)** reasons why materials should be tested. (4 Marks)
- b) What is the definition of destructive testing and non-destructive testing (4 Marks)
- c) Briefly describe the hardness testing below:
i. Brinell Hardness Testing
ii. Vickers Hardness Testing (10 Marks)
- d) A material is used as a specimen for tensile test using a Universal Machine. The specimen should be checked to ensure that no defects such as hair cracks on the surface of the specimen so that the results obtained are correct and accurate. Suggest an appropriate non-destructive test which is easiest and cheapest to check this specimen and describe the steps to carry out the test. (7 Marks)

QUESTION 5

- a) List **FOUR (4)** non metallic coatings for corrosion control. (4 Marks)
- b) What are the differences between ferrous and non-ferrous metals. (3 Marks)
- c) List **THREE (3)** types of non-ferrous metals that commonly used in the industry. (3 Marks)
- d) List out **THREE (3)** uses of copper no a days. (3 Marks)
- e) Explain methods of corrosion control below: (12 Marks)
- i. Sacrificial coating
 - ii. Cathodic protection
 - iii. Design considerations and practices

QUESTION 6

- a) Define the following terms: (3 Marks)
- i. Monomer
 - ii. Polymer
- b) List **THREE (3)** types of thermoset and **THREE (3)** types of thermoplastic. (6 Marks)
- c) Describe with diagram the extrusion process of thermoplastic. (10 Marks)
- d) List **THREE (3)** advantages and **THREE (3)** disadvantages of plastic. (6 Marks)