



**UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA**  
**SECOND SEMESTER EXAMINATIONS, MAY 2018**

**COURSE NO:** MC/RN 168

**COURSE NAME:** BASIC MATERIAL SCIENCE

**CLASS:** MC/RN I

**TIME:** 3 HOURS

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Name: \_\_\_\_\_ Index Number: \_\_\_\_\_

**SECTION A (Provide Short Answers)**

- a. List the four main quantum numbers **(4 marks)**
- b. List the three main primary bonds materials form **(3 marks)**
- c. List the three main secondary bonds materials form **(3 marks)**
- d. List the seven crystal systems **(7 marks)**
- e. List the two main types of alloys **(2 marks)**
- f. List the four ways elements in the periodic table can be classified **(4 marks)**
- g. List the three laws of chemical combination **(3 marks)**
- h. List the three laws used in filling orbitals **(3 marks)**
- i. List four periodic properties **(4 marks)**
- j. List three types of crystalline solids **(4 marks)**
- k. What are the three main crystal lattices metallic solids crystallize into **(3 marks)**

**SECTION B (60 marks)**

**Answer all questions from this section**

1. a) Explain the two mechanisms of diffusion with the aid of sketches. **(4 marks)**  
b) State Fick's laws of diffusion and explain all terms and assumptions made. **(10 marks)**  
c) For some applications, it is necessary to harden the surface of a steel (or iron-carbon

alloy) above that of its interior. Consider one such alloy that initially has a uniform carbon concentration of 0.25 wt% and is to be treated at 950 °C. If the concentration of carbon at the surface is suddenly brought to and maintained at 1.20 wt%, how long will it take to achieve a carbon content of 0.80 wt% at a position 0.5 mm below the surface? The diffusion coefficient for carbon in iron at this temperature is  $1.6 \times 10^{-11} \text{ m}^2/\text{s}$ ; assume that the steel piece is semi-infinite. (Find below the error function values) **(10 marks)**

| $z$   | $\text{erf}(z)$ |
|-------|-----------------|
| 0     | 0               |
| 0.025 | 0.0282          |
| 0.05  | 0.0564          |
| 0.10  | 0.1125          |
| 0.15  | 0.1680          |
| 0.20  | 0.2227          |
| 0.25  | 0.2763          |
| 0.30  | 0.3286          |
| 0.35  | 0.3794          |
| 0.40  | 0.4284          |
| 0.45  | 0.4755          |
| 0.50  | 0.5205          |

2. a) What are the Hume-Rothery conditions for solid solution solubility **(4 marks)**
- b) Distinguish between unary and binary phase diagrams **(4 marks)**
- c) Draw a binary eutectic phase diagram and label all its essential parts **(6 marks)**
  
3. a) What is corrosion **(4 marks)**
- b) Distinguish between Dry and Wet Corrosion **(6 marks)**
- c) Explain four strategies to control corrosion **(8 marks)**
- d) List four (4) corrosion monitoring methods. **(4 marks)**

*Examiners: S. Asare-Asher/*