



**UNIVERSITI KUALA LUMPUR
Malaysia France Institute**

**FINAL EXAMINATION
SEPTEMBER 2014 SESSION**

SUBJECT CODE : FTB33103
SUBJECT TITLE : CORROSION
LEVEL : BACHELOR
**TIME / DURATION : 3.30 PM – 6.00 PM
(2 HOURS)**
DATE : 6 JANUARY 2015

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. For Section B, answer TWO (2) questions only.**
- 6. Answer all questions in English.**

THERE ARE 4 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)**INSTRUCTION: Answer ALL questions.****Please use the answer booklet provided.****Question 1**

- (a) Corrosion engineering is the application of science and art to prevent or control corrosion damage economically and safely. In order to perform their function properly, they must be well versed in the practices and principles of corrosion. Instead of the destruction or deterioration of a material because of the reaction with its environment, some insist that the definition should be restricted to materials. Explain briefly the factors listed below that need to be consider in corrosion aspects instead of environment.

(i) Contamination of products,

(4 marks)

(ii) Effects on safety and reliability, and

(4 marks)

(iii) Appearance

(4 marks)

- (b) In corrosion, it is suggested that the higher the temperature, the faster a given chemical reaction will proceed. Quantitatively this relationship between the rate a reaction proceeds and its temperature is determined by the Arrhenius Equation. At higher temperatures, the probability that two molecules will collide is higher. This higher collision rate results in a higher kinetic energy, which has an effect on the activation energy of the reaction. The activation energy is the amount of energy required to ensure that a reaction happens. The equation is as below:

$$k = A \exp (- E_a / RT)$$

where k is the rate coefficient, A is a constant, E_a is the activation energy, R is the universal gas constant, and T is the temperature (in kelvin). R has the value of $8.314 \times 10^{-3} \text{ kJ mol}^{-1}\text{K}^{-1}$.

(i) Derive the equation in logarithmic form.

(2 marks)

(ii) Arrhenius plot is useful in extracting activation energy and pre-exponential factor from experimental kinetic data. Sketch and relate the Arrhenius equation in linear plot.

(6 marks)

Question 2

- (a) A potential difference usually exists between two dissimilar metals when they are immersed in a corrosive or conductive solution. Because of the electric currents and dissimilar metals involved, it is called galvanic, or two-metal corrosion. Construct the illustration and explain briefly the mechanism involved in galvanic corrosion. (15 marks)

- (b) Define Electromotive Force Series (EMF series). (5 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer TWO (2) questions only.

Please use the answer booklet provided.

Question 1

- (a) Figure 1 shows a schematic diagram of the corrosion mechanism.

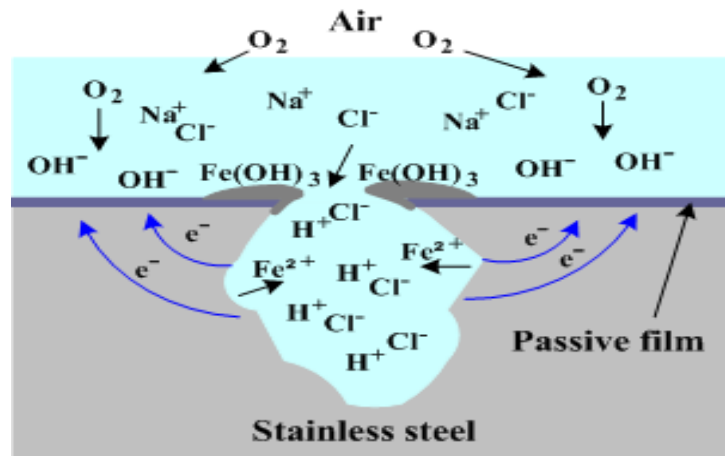


Figure 1

- (i) Identify the type of corrosion according to the schematic diagram shown in Figure 1. (2 marks)

- (ii) List **FOUR (4)** environmental conditions that could promote corrosion shown in Figure 1. (8 marks)

(iii) Explain how to prevent corrosion shown in Figure 1.

(10 marks)

(c) From a practical standpoint, most pitting failures are caused by chloride and chlorine-containing ions. Explain the phenomena in terms of industry's viewpoint.

(10 marks)

Question 2

(a) Identify Cathodic Protection?

(5 marks)

(b) Briefly explain the principle of the following techniques, using the suitable schematic diagram.

(i) Sacrificial anode technique.

(10 marks)

(ii) Impressed current technique.

(10 marks)

(c) Describe the advantages and disadvantages of sacrificial anode against impressed current techniques.

(5 marks)

Question 3

(a) Define Protective Coating.

(2 marks)

(b) List **FOUR (4)** types of protective coating which used for corrosion control.

(4 marks)

(c) Hot dip coating is one of the method used to withstand the corrosion attack. Briefly define and explain the process of this technique.

(8 marks)

(d) Altering the environment provides a versatile means for reducing corrosion. Typical changes in the medium that are often employed are as follows. Discuss how these changes can significantly reduce corrosion.

(i) Lowering temperature,

(4 marks)

(ii) Decreasing velocity,

(4 marks)

(iii) Removing oxygen or oxidizers, and

(4 marks)

(iv) Changing concentrations

(4 marks)

END OF QUESTIONS