UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME   :   CORROSION & PREVENTION

COURSE CODE   :   BDB 40403

PROGRAMME   :   BDD

EXAMINATION DATE   :   JULY/AUGUST 2023

DURATION   :   3 HOURS

INSTRUCTION   :   1. ANSWER **ALL** QUESTIONS

2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.**

3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a)   An ancient bronze sword has corroded under blood stains. Write the chemical reactions between the sword and its environment. You may refer emf series in **Table Q1 (a)**.

(5 marks)

(b)   What are factors that affect corrosion resistance?

(5 marks)

(c)   What are possible damage mechanism caused by Microbiologically Induced Corrosion (MIC)?

(10 marks)

Q2 (a)   **Figure Q2 (a)** depicts crevice corrosion between two metal plates bolted together in aerated seawater. Illustrate and explain the initial development of crevice corrosion, including the reactions involved.

(15 marks)

(b)   According to API 571, give FIVE (5) possible damage mechanisms that will end with lost wall thickness (LOWT).

(5 marks)

Q3 (a)   Identify ONE (1) type of flow assisted corrosion and explain in detail the causes and how to prevent.

(15 marks)

(b)   Calculate the weight of metal if the Pilling Bedworth Ration (PBR) is 20. The weight of oxide is 14, the density of the oxide is 18 and the density of metal is 10.

(5 marks)

Q4　(a)　With an illustration, explain the propagation of hydrogen induced cracking (HIC) until stress oriented hydrogen induced cracking (SOHIC).

(10 marks)

　　(b)　With a sketch, explain how corrosion inhibitor gives protection either by chemiabsorption or physical absorption on metal surface

(10 marks)

Q5　(a)　List factors that contribute to atmospheric corrosion

(5 marks)

　　(b)　What are the advantages and disadvantages of using sacrificial anode cathodic protection (SACP) in protecting structure unit.

(10 marks)

　　(c)　In certain circumstances, a volatile corrosion inhibitor is more efficient than applying a coating. Why is this the case?

(5 marks)

-END OF QUESTION-

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FINAL EXAMINATION

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Table Q1 (a): emf series

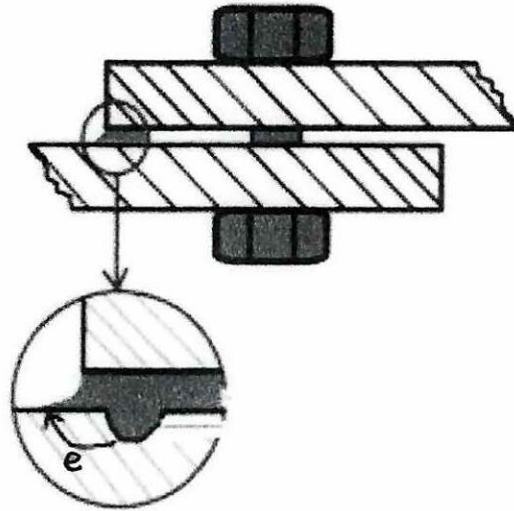| Half-Cell Reaction	E^o (volts)
$F_2 + 2e \longrightarrow 2F^-$	2.87
$Au^+ + e \longrightarrow Au^-$	1.68
$Cl_2 + 2e \longrightarrow 2Cl^-$	1.36
$O_2 + 4H^- + 4e \longrightarrow 2H_2O$	1.229
$O_2 + 4H^- (10^{-7} M) + 4e \longrightarrow 2H_2O$	0.82
$Ag^+ + e \longrightarrow Ag$	0.799
$Fe^{3+} + e \longrightarrow Fe^{2-}$	0.771
$O_2 + 2H_2O + 4e \longrightarrow 4OH^-$	0.48
$Cu^{2+} + 2e \longrightarrow Cu$	0.337
$AgCl(s) + e^- \rightarrow Ag(s) + Cl^-(aq)$	0.22
$2H^+ + 2e \longrightarrow H_2$	0.0000
$Pb^{2+} + 2e \longrightarrow Pb$	-0.126
$Sn^{2+} + 2e \longrightarrow Sn$	-0.14
$Ni^{2+} + 2e \longrightarrow Ni$	-0.25
$Co^{2+} + 2e \longrightarrow Co$	-0.28
$Fe^{2+} + 2e \longrightarrow Fe$	-0.44
$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$	-0.74
$Zn^{2+} + 2e \longrightarrow Zn$	-0.763
$Al^{3+} + 3e \longrightarrow Al$	-1.66
$Mg^{2+} + 2e \longrightarrow Mg$	-2.34
$Na^+ + e \longrightarrow Na$	-2.714
$Ca^{2+} + 2e \longrightarrow Ca$	-2.87
$K^+ + e \longrightarrow K$	-2.925

Figure Q2 (a): Crevice corrosion

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