

Unit 4 - Week 2

Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Lecture 4: Can we calculate the rate of corrosion: Electrochemical kinetics- Tafel relation?

Lecture 5: Can we calculate the rate of corrosion: Electrochemical kinetics- diffusion & mixed potential theory?

Quiz : Assignment 2

Weekly Feedback

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Assignment 2 solution

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Assignment 2

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-09-30, 23:59 IST.

INSTRUCTIONS:

- (A) The marks that each question carries is marked against the question.
(B) There is only one correct answer for a question.
(C) Take the E° values from appropriate sources, when not mentioned
(D) Take: $F = 96500 \text{ C mol}^{-1}$

1) Hg, Zn and Pt immersed in 0.01 N HCl have been subjected to a potential of -0.4 V(SHE), what current do these electrodes show if $i_{oH^+/H}$ of these metals respectively are taken as $10^{-12} \text{ A cm}^{-2}$, $10^{-8} \text{ A cm}^{-2}$ and $10^{-2} \text{ A cm}^{-2}$ and all of them have a cathodic Tafel slope of 120 mV decade-1 **4 points**

- $6.25 \times 10^{-10} \text{ A cm}^{-2}$, $6.25 \times 10^{-6} \text{ A cm}^{-2}$, 6.25 A cm^{-2}
- $6.93 \times 10^{-10} \text{ A cm}^{-2}$, $6.93 \times 10^{-6} \text{ A cm}^{-2}$, 6.93 A cm^{-2}
- $7.28 \times 10^{-10} \text{ A cm}^{-2}$, $7.28 \times 10^{-6} \text{ A cm}^{-2}$, 7.28 A cm^{-2}
- $6.10 \times 10^{-10} \text{ A cm}^{-2}$, $6.10 \times 10^{-6} \text{ A cm}^{-2}$, 6.10 A cm^{-2}

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $6.93 \times 10^{-10} \text{ A cm}^{-2}$, $6.93 \times 10^{-6} \text{ A cm}^{-2}$, 6.93 A cm^{-2}

2) A zinc electrode of 5 cm^2 area has been immersed in zinc ions of $10^{-4} \text{ mol l}^{-1}$. If zinc has to (a) corrode and (b) deposit on its surface with a current of 3 points 500 mA in each case, what will be the required applied potential in each of the two cases. Given, $E_{Zn^{2+}/Zn}^\circ$, i_o , β_c and β_a are respectively -0.763 V, $10^{-6} \text{ A cm}^{-2}$, 120 mV decade⁻¹ and 60 mV decade⁻¹

- 0.5521 V, -1.2345 V
- 0.5812 V, -1.4812 V
- 0.6841 V, -1.6453 V
- 0.3367 V, -1.2967 V

No, the answer is incorrect.
Score: 0

Accepted Answers:
-0.5812 V, -1.4812 V

3) Given the data that O_2 diffusion coefficient is $2 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$ at 200 °C; the solubility of O_2 in water is 6 ppm; the diffusion layer thickness in solution for O_2 reduction reaction is 50 μm , what will be the limiting current density for the cathodic reaction? **3 points**

- $30.10 \mu\text{A cm}^{-2}$
- $32.33 \mu\text{A cm}^{-2}$
- $25.62 \mu\text{A cm}^{-2}$
- $28.95 \mu\text{A cm}^{-2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
 $28.95 \mu\text{A cm}^{-2}$

4) A metal with standard potential of -0.7 V(SHE) immersed in 1 N acid solution undergoes corrosion. If the cathodic reaction is assumed to be completely nonpolarisable, what would be the corrosion potential of this in this solution? (Assume p^{H_2} to be 1 atm and the concentration of metallic ions to be $1 \times 10^{-6} \text{ M}$) **3 points**

- 0.25 V (SHE)
- 0.50 V (SHE)
- 0.00 V (SHE)
- 0.30 V (SHE)

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.00 V (SHE)

5) Determine E_{corr} and i_{corr} for iron in 1 N H_2SO_4 solution, Given: Exchange current densities for hydrogen evolution on iron and for the equilibrium $Fe^{2+} + 2e^- = Fe$ are 10^{-2} A m^{-2} and 10^{-4} A m^{-2} respectively. Anodic and cathodic Tafel slope are $0.12 \text{ V decade}^{-1}$ and $0.059 \text{ V decade}^{-1}$ respectively and assume the concentration of Fe^{2+} to be $10^{-6} \text{ mol l}^{-1}$ and p^{H_2} to be 1 atm, standard potential for iron is -0.4470 V(SHE). **4 points**

- 0.12 V(SHE), 1.40 A m^{-2}
- 0.12 V(SHE), 6.123 A m^{-2}
- 0.24 V(SHE), 1.40 A m^{-2}
- 0.24 V (SHE), 6.564 A m^{-2}

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.12 V(SHE), 1.40 A m^{-2}

6) The corrosion rate of a metal increases by 200 times. What is the change in corrosion potential at a given pH. Assume $\beta_a = 60 \text{ mV decade}^{-1}$. **3 points**

- 0.562 V
- 0.234 V
- 0.138 V
- 0.436 V

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.138 V