

## Unit 3 - Week 1

## Course outline

How does an NPTEL online course work?

## Week 0

## Week 1

- Lecture 1: Introduction to the course and corrosion implications

- Lecture 2: Can we predict if a metal corrodes? (Part-I)

- Lecture 3: Can we predict if a metal corrodes? (Part-II)

 Quiz : Assignment 1

- Weekly Feedback

- Download Videos

- Assignment 1 solution

## Week 2

## Week 3

## Week 4

## Week 5

## Week 6

## Week 7

## Week 8

## Week 9

## Week 10

## Week 11

## Week 12

## Live Session

## Text Transcripts

## Assignment 1

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  $E^\circ$  values from appropriate sources, when not mentioned  
(D) Take:  $F = 96500 \text{ C mol}^{-1}$

1) Calculate the standard free energy change for the electrochemical equilibria  $\text{Cu}^{2+}/\text{Cu}$  and  $\text{Zn}^{2+}/\text{Zn}$ , if their standard potentials respectively are  $+0.337 \text{ V}$  and  $-0.763 \text{ V}$  **2 points**

- $-65.04 \text{ kJ mol}^{-1}, +147.26 \text{ kJ mol}^{-1}$
- $-70.51 \text{ kJ mol}^{-1}, +150.32 \text{ kJ mol}^{-1}$
- $+65.04 \text{ kJ mol}^{-1}, -147.26 \text{ kJ mol}^{-1}$
- $+70.51 \text{ kJ mol}^{-1}, -150.32 \text{ kJ mol}^{-1}$

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 $-65.04 \text{ kJ mol}^{-1}, +147.26 \text{ kJ mol}^{-1}$

2) What would be the equilibrium potentials of the following systems with respect to (i) SHE and (ii) SCE? (Standard potentials for  $\text{Cu}^{2+}/\text{Cu}$  and  $\text{Zn}^{2+}/\text{Zn}$  are  $+0.3419 \text{ V}$  (SHE) and  $-0.7618 \text{ V}$  (SHE) respectively) **2 points**

- a.  $\text{Cu}$  in  $10^{-2} \text{ mol l}^{-1}$  of  $\text{Cu}^{2+}$ .  
b.  $\text{Zn}$  in  $10^{-2} \text{ mol l}^{-1}$  of  $\text{Zn}^{2+}$

- $0.3218 \text{ V}$  (SHE) &  $0.0532 \text{ V}$  (SCE) for Cu,  $-0.9229 \text{ V}$  (SHE) &  $-1.2641 \text{ V}$  (SCE) for Zn
- $0.4608 \text{ V}$  (SHE) &  $0.0222 \text{ V}$  (SCE) for Cu,  $-0.6709 \text{ V}$  (SHE) &  $-0.8921 \text{ V}$  (SCE) for Zn
- $0.2828 \text{ V}$  (SHE) &  $0.0416 \text{ V}$  (SCE) for Cu,  $-0.8209 \text{ V}$  (SHE) &  $-1.0621 \text{ V}$  (SCE) for Zn
- $0.5342 \text{ V}$  (SHE) &  $0.0342 \text{ V}$  (SCE) for Cu,  $-0.7450 \text{ V}$  (SHE) &  $-1.1131 \text{ V}$  (SCE) for Zn

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 $0.2828 \text{ V}$  (SHE) &  $0.0416 \text{ V}$  (SCE) for Cu,  $-0.8209 \text{ V}$  (SHE) &  $-1.0621 \text{ V}$  (SCE) for Zn

3) What should be the equilibrium concentration of  $\text{Fe}^{2+}$  species for an iron rod dipped in HCl solution of pH 4 at  $25^\circ\text{C}$  to stop its corrosion? (Given:  $P^{H2} = 1 \text{ atm}$ ,  $E^\circ \text{Fe}^{2+}/\text{Fe} = -0.440 \text{ volt}$ ) **3 points**

- $7.253 \times 10^6 \text{ mol l}^{-1}$
- $7.762 \times 10^6 \text{ mol l}^{-1}$
- $6.254 \times 10^6 \text{ mol l}^{-1}$
- $7.367 \times 10^8 \text{ mol l}^{-1}$

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 $7.762 \times 10^6 \text{ mol l}^{-1}$

4) Ni in 1 M sulfuric acid solution is immersed under two conditions: (a) 0.1 atm hydrogen and (b) 1 atm hydrogen. Which of the two will have a larger tendency to corrode? Assume the concentration of  $\text{Ni}^{2+}$  in solution to be  $10^{-6} \text{ mol/l}$ . (Standard potential for nickel is  $-0.2570 \text{ V}$  (SHE)) **4 points**

- 1 atm
- 0.1 atm
- same tendency
- Hydrogen partial pressure has no effect.

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
 $0.1 \text{ atm}$

5) Zn in 1 N  $\text{ZnSO}_4$  and Zn in 0.01 N  $\text{ZnSO}_4$  are coupled. Which of these two Zn pieces will corrode? (Standard potential for zinc is  $-0.7618 \text{ V}$  (SHE)) **3 points**

- Zn in 1N  $\text{ZnSO}_4$
- both will corrode
- Zn in 0.01N  $\text{ZnSO}_4$
- both won't corrode

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
Zn in 0.01N  $\text{ZnSO}_4$

6) Condition (a) Three metals namely, iron, copper and silver immersed in 0.5 M sulfuric acid solution having unit activity of  $\text{Fe}^{2+}$ ,  $\text{Cu}^{2+}$  and  $\text{Ag}^+$  and 1 atmosphere pressure of hydrogen. Condition (b) the above solution was added with ferric ions at 0.5 M concentration and condition (c) air is continuously bubbled (partial pressure of oxygen in air is 0.33 atmosphere). Which of the following are true? (Standard potentials for iron, copper and silver are  $-0.4470 \text{ V}$  (SHE),  $+0.3419 \text{ V}$  (SHE) and  $+0.7996 \text{ V}$  (SHE) respectively) **6 points**

- (1) Condition 1 only Fe corrodes  
(2) Condition 1 both Fe and Cu corrode  
(3) Condition 2 both Cu and Ag corrode  
(4) Condition 2 both Fe and Ag corrode  
(5) Condition 2 both Fe and Cu corrode  
(6) Condition 2 only Fe corrodes  
(7) Condition 3 all the metals corrode  
(8) Condition 3 only Fe and Cu corrode

- 1,2,4,6,7
- 1,2,5,8
- 1,3,5,7
- 1,5,7

No, the answer is incorrect.  
Score: 0

Accepted Answers:  
1,5,7