

Unit 9 - Week 7

Course outline

How does an NPTEL online course work?

Week 0

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

- Electrical Double Layer and Polarization
- Correlation between Current Density and Overvoltage
- Introduction to Butler-Volmer Equation
- Derivation of Tafel Equation
- Tafel Plot and Activation Polarization
- Quiz : Assignment 7**
- Corrosion - Part I: Week 7 Feedback
- Assignment 7_Solution

Week 8

Download Videos

Assignment 7

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

Due on 2020-03-18, 23:59 IST.

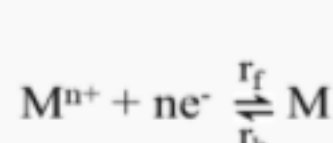
1) A piece of iron is immersed in an acidic electrolyte under standard conditions. The activation energy barrier for the transfer of iron metal ions from metal surface to the bulk solution is 80 kJ/mol. The vibrational frequency and the number of moles per unit area on the metal surface are 10^{12} s^{-1} and 10^{-5} mol/cm^2 , respectively. The value of exchange current density (in A/cm^2) is; (Given $n = 2$)

- (1.2 to 2.6) $\times 10^{-2}$
- (0.2 to 1.2) $\times 10^{-5}$
- (2.6 to 4.5) $\times 10^{-3}$
- (12.4 to 13.5) $\times 10^{-4}$

No, the answer is incorrect. Score: 0

Accepted Answers: (1.2 to 2.6) $\times 10^{-2}$

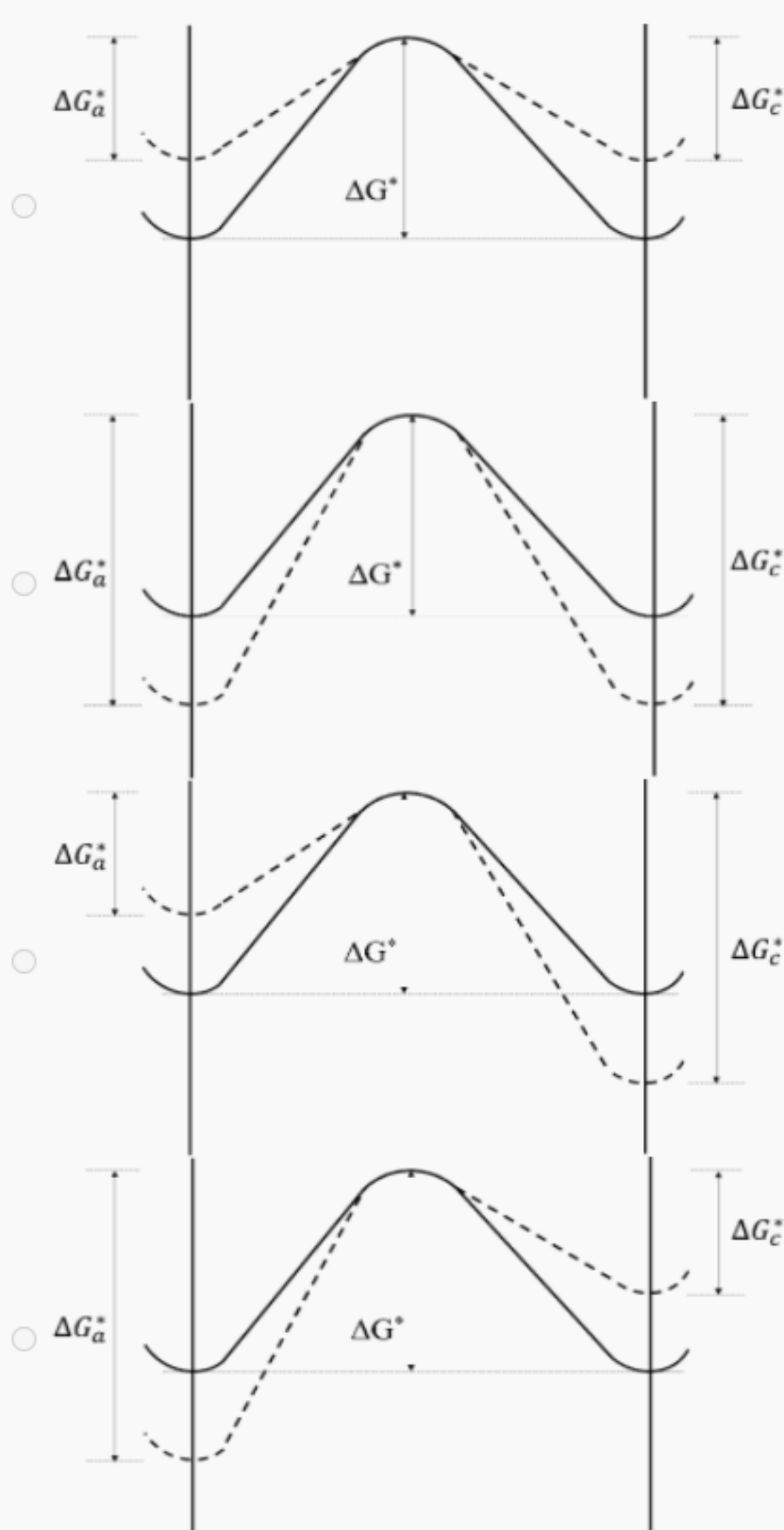
2) Consider the reaction



If the rate of backward reaction (r_b) is greater than the rate of forward reaction (r_f), which of the following energy distribution diagrams correctly illustrates the given condition.

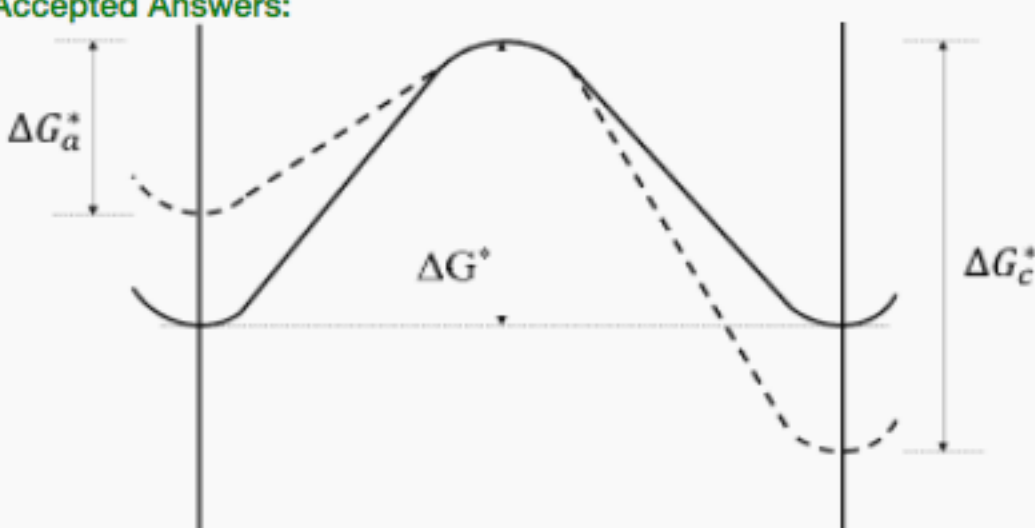
(Given: ΔG^\ddagger is the activation barrier at equilibrium, ΔG_a^\ddagger is the activation barrier for anodic reaction, ΔG_c^\ddagger is activation barrier for cathodic reaction)

(Note: Solid line in the plot represents the energy distribution when $r_b = r_f$ and dotted line represents when $r_b \neq r_f$)



No, the answer is incorrect. Score: 0

Accepted Answers:



3) Which of the following statements is correct? (The over-potential is marked as η , i_c : cathodic current density and i_a : anodic current density)

- $\eta > 0$, $i_a > i_c$ and system experiences cathodic polarization
- $\eta < 0$, $i_c > i_a$ and system experiences cathodic polarization
- $\eta < 0$, $i_a > i_c$ and system experiences anodic polarization
- $\eta > 0$, $i_c > i_a$ and system experiences anodic polarization

No, the answer is incorrect. Score: 0

Accepted Answers: $\eta < 0$, $i_c > i_a$ and system experiences cathodic polarization

4) Which of the following parameters is not related to Butler-Volmer equation in the activation controlled mode?

- Electrode potential
- Faradic current (i_{appl})
- Exchange current density
- Turbulence in the electrolyte

No, the answer is incorrect. Score: 0

Accepted Answers: Turbulence in the electrolyte

5) Anodic over-voltage of 0.25 V is applied to nickel electrode dipped in an acidic solution at 298 K. If the exchange current density for hydrogen evolution on the surface of nickel and symmetry factor (α) are $5.5 \times 10^{-9} \text{ A/cm}^2$ and 0.5, respectively. The value of anodic current density (i_a) in $\mu\text{A/cm}^2$ is; (Given: $n = 2$)

- (0.30 to 0.55)
- (60.5 to 62.2)
- (3.0 to 5.0)
- (13.5 to 14.2)

No, the answer is incorrect. Score: 0

Accepted Answers: (0.30 to 0.55)

6) The exchange current density of Zn on the surface of Zn and symmetry factor (α) for a Zn electrode dipped in an acidic solution at 298 K are $2.5 \times 10^{-11} \text{ A/cm}^2$ and 0.5, respectively. If the cathodic current density (i_c) is $0.5 \mu\text{A/cm}^2$, the value of cathodic over-potential (in V) with respect to standard hydrogen electrode applied to the Zn electrode is; (Given: $n = 2$)

- (0.15 to 0.32)
- (0.05 to 0.10)
- (0.35 to 0.43)
- (0.05 to 0.10)

No, the answer is incorrect. Score: 0

Accepted Answers: - (0.15 to 0.32)

7) A piece of iron is corroding in a deaerated HCl solution of pH 3 at 298 K. The corrosion current density (i_{corr}) is $3 \times 10^{-6} \text{ A/cm}^2$. If the exchange current density for hydrogen evolution on iron surface and Tafel slopes are $5.5 \times 10^{-9} \text{ A/cm}^2$ and 0.18 V/decade of current density, respectively. The value of E_{corr} (in V) with respect to standard hydrogen electrode is;

- (0.65 to 0.82)
- (0.05 to 0.15)
- (0.32 to 0.40)
- (0.55 to 0.75)

No, the answer is incorrect. Score: 0

Accepted Answers: - (0.55 to 0.75)

8) A piece of magnesium is corroding in an acidic electrolyte having Mg ion activity of 0.006. Anodic Tafel slope is 0.18 V/decade of current density. The corrosion current density of Mg is $4.5 \times 10^{-6} \text{ A/cm}^2$. The exchange current density of Mg on the surface of Mg is $3 \times 10^{-10} \text{ A/cm}^2$. The value of anodic over-potential (in V) with reference to standard hydrogen electrode is;

(Given: $E_{\text{Mg}^{2+}/\text{Mg}}^0 = -2.38 \text{ V}$ and $n = 2$)

- (0.70 to 0.85)
- (0.70 to 0.85)
- (1.03 to 1.21)
- (1.03 to 1.21)

No, the answer is incorrect. Score: 0

Accepted Answers: (0.70 to 0.85)

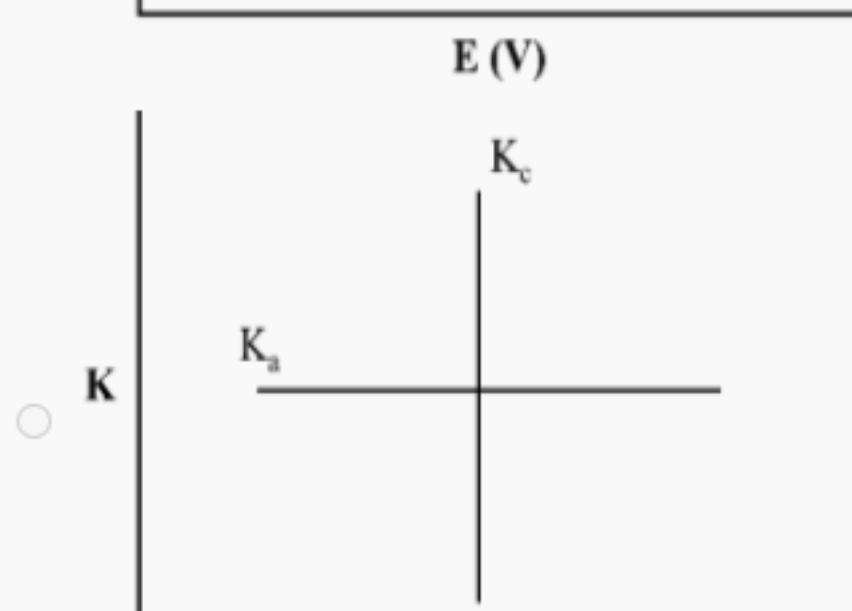
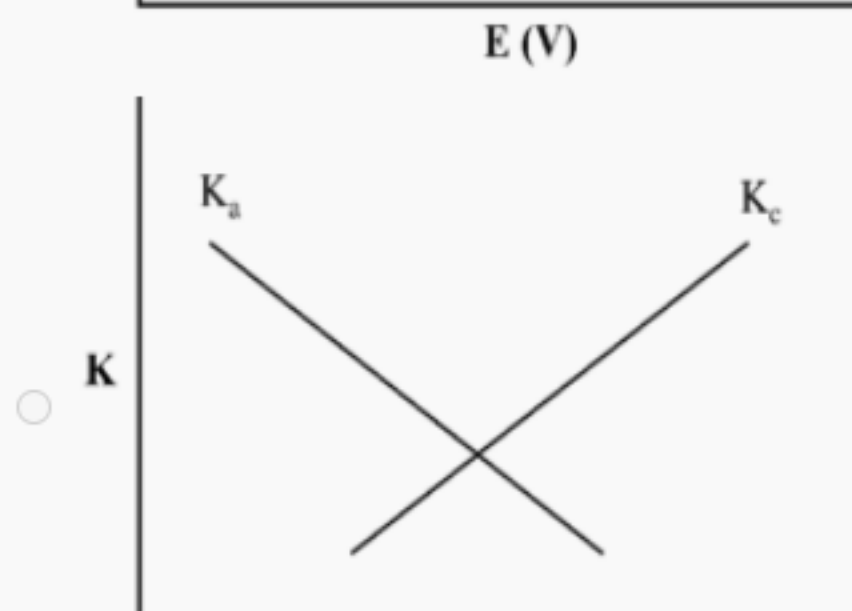
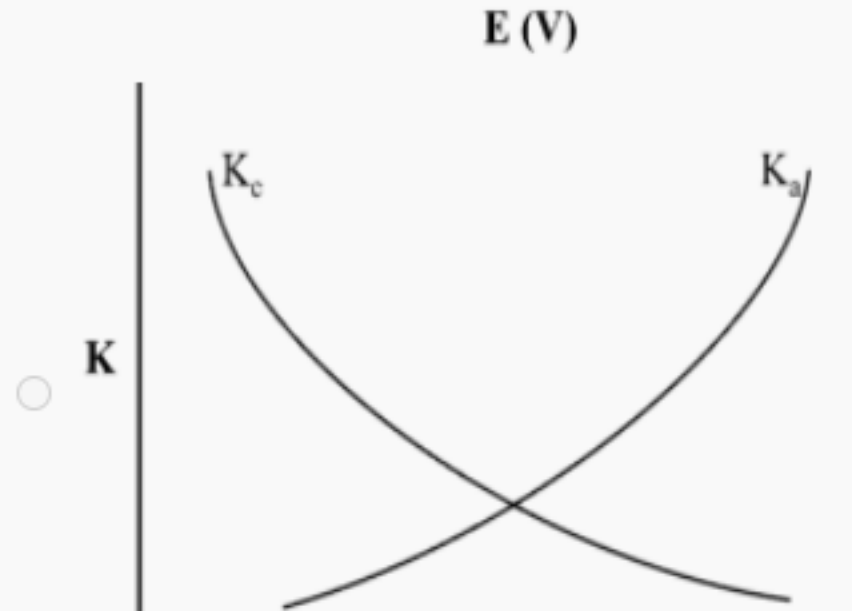
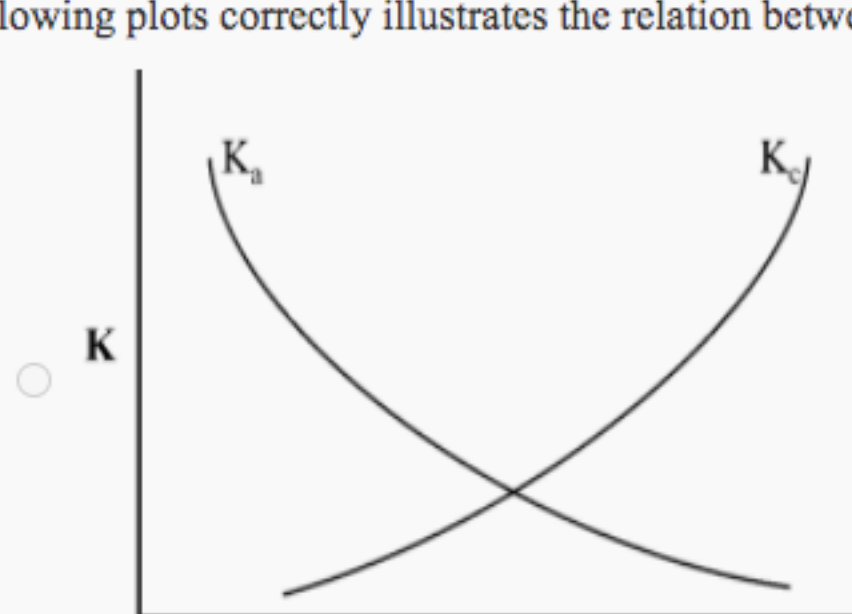
9) Based on Q8, the value of E_{corr} (in V) with reference to standard hydrogen electrode is;

- (2.30 to 2.45)
- (1.02 to 1.23)
- (2.30 to 2.45)
- (1.60 to 1.75)

No, the answer is incorrect. Score: 0

Accepted Answers: - (1.60 to 1.75)

10) Consider that K_a and K_c are the equilibrium rate constant for the anodic and cathodic reactions respectively. Which of the following plots correctly illustrates the relation between rate constant and electrode potential (E);



No, the answer is incorrect. Score: 0

Accepted Answers:

