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Courses » Introduction to Materials Science and Engineering

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## Unit 11 - Week 8 - Phase Diagrams II + Diffusion

Register for  
Certification exam

### Course outline

How to access  
the portal

Supplementary  
Materials

Week 1 -  
Crystallography  
I

Week 2 -  
Crystallography  
II + Structure of  
Solids I

Week 3 -  
Structure of  
Solids II

Week 4 -  
Structure of  
Solids III

Week 5 - Defects  
in Crystalline  
Solids I

Week 6 - Defects  
in Crystalline  
Solids II

Week 7 - Phase  
Diagrams I

### Assignment 8

The due date for submitting this assignment has passed.

As per our records you have not submitted this **Due on 2019-03-27, 23:59 IST.**  
assignment.

1) If the activation energy for diffusion is 80 kJ/mol, at what temperature will the depth of diffusion be 5 times that at 25°C for the same diffusion time? **1 point**

- 58°C  
 331°C  
 68°C  
 302°C

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**  
58°C

2) Which of the following plain carbon steels does not have any proeutectoid microconstituent in its microstructure at room temperature? **1 point**

- hypoeutectoid steel  
 hypereutectoid steel  
 eutectoid steel  
 eutectic steel

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**  
eutectoid steel

3) "In a plain carbon steel in equilibrium at room temperature, the proeutectoid ferrite has the same chemical composition as the ferrite lamellae that constitute pearlite." True/False? **1 point**

True

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## Reading List

- 8.1 Eutectoid, Hypoeutectoid and Hypereutectoid steels
- 8.2 Microstructure of a Hypoeutectoid Steel
- 8.3 Microstructure of a Hypereutectoid Steel
- 8.4 Diffusion: Introduction
- 8.5 Fick's First Law
- 8.6 Fick's Second Law
- 8.7 Error function solution of Fick's second law
- 8.8 Atomic Mechanisms of Diffusion
- 8.9 Substitutional Diffusion Revisited
- 8.10 Diffusion Paths
- 8.11 Steady and Unsteady State Diffusion
- Quiz : Assignment 8

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**Week 9 - Phase Transformations I**


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**Week 10 - Phase Transformations II + Mechanical Behaviour of Materials I**


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**Week 11 - Mechanical Behaviour of Materials II**


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**Week 12 - Mechanical Behaviour of Materials III +**

4) Find the diffusivity (in  $\text{m}^2\text{s}^{-1}$ ) of a material with  $D_0 = 2.5 \times 10^{-3} \text{ m}^2\text{s}^{-1}$  and activation energy,  $Q = 24.942 \text{ kJ/mol}$  at  $78^\circ\text{C}$ . (Take gas constant  $R = 8.314 \text{ J K}^{-1}\text{mol}^{-1}$ ) **1 point**

- $8.42 \times 10^{-6}$
- $2.43 \times 10^{-7}$
- $4.85 \times 10^{-7}$
- $3.48 \times 10^{-7}$

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
 $4.85 \times 10^{-7}$

5) Determine the composition (in wt.% C) of proeutectoid ferrite in a steel with 0.5 wt.% carbon at the eutectoid temperature. **1 point**

- 0.8
- 0.5
- 0.02
- 0.1

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
 $0.02$

6) Find the composition of steel in which the amount of proeutectoid ferrite is half the amount of total ferrite. Use eutectoid composition = 0.8 wt% C for calculations. **1 point**

- 0.25
- 0.43
- 0.67
- 0.8

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
 $0.43$

7) In plain carbon steel samples P (wt.% C = 0.9) and Q (wt.% C = 1.1). At any given temperature below the eutectoid temperature, the amount of total cementite is greater in sample \_\_\_\_ and the amount of proeutectoid cementite is greater in sample \_\_\_\_\_. **1 point**

- P, Q
- Q, P
- P, P
- Q, Q

**No, the answer is incorrect.**  
**Score: 0**

**Accepted Answers:**  
Q, Q

8) At  $912^\circ\text{C}$ , what is the time required to carburize a steel with an initial composition of 0.29 wt% C to a carbon concentration of 1.11 wt% C at a depth of 0.1 mm? A carburizing atmosphere provides a constant surface concentration of 2% C. The diffusivity of C in gamma Fe is given by  $D = D_0 \exp\left(\frac{-Q}{RT}\right)$  **1 point**

## Fracture

Interactive  
Session

with  $D_0=7 \times 10^{-5} \text{ m}^2 \text{ s}^{-1}$  and  $Q=150 \text{ kJ mol}^{-1}$ . The Error function table is given below:

$z$	0.25	0.3	0.35	0.4	0.45	0.5
$\text{Erf}[z]$	0.276	0.329	0.379	0.428	0.475	0.520

6230 s

585 s

121 s

293 s

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

585 s

9) Vacancies play an important role in which of the following diffusion mechanisms? **1 point**

interstitial diffusion only.

substitutional diffusion only.

Both interstitial and substitutional diffusion.

Neither interstitial nor substitutional diffusion.

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

substitutional diffusion only.

10) A plain carbon steel has 1.6 wt.% carbon. Find the percentage of vacant octahedral sites in austenite in equilibrium at 1150°C. **1 point**

90.6

8.7

9.4

91.3

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

91.3

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