

# Unit 11 - Week 9

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## Assignment 9

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

**Due on 2019-10-04, 23:59 IST.**

1) Match the following quantities with their units 1 point

| Quantities            | Units                |
|-----------------------|----------------------|
| A. Molarity           | 1. No units          |
| B. Molality           | 2. mol/lit           |
| C. Mass fraction      | 3. mol/kg            |
| D. Mass concentration | 4. kg/m <sup>3</sup> |

- A-3,B-2,C-4, D-1  
 A-3,B-2,C-1,D-4  
 A-2,B-3,C-1,D-4  
 A-2,B-3,C-4,C-1

No, the answer is incorrect. Score: 0

Accepted Answers: A-2,B-3,C-1,D-4

2) Suppose 2 phases  $\alpha$  and  $\beta$  are present in a system. The chemical potential of element A in  $\alpha$  phase and  $\beta$  phase are  $\mu_A^\alpha$  and  $\mu_A^\beta$ , respectively. What is the condition for element A to diffuse from  $\alpha$  to  $\beta$ ?

- $\mu_A^\alpha < \mu_A^\beta$   
  $\mu_A^\alpha = \mu_A^\beta$   
  $\mu_A^\alpha > \mu_A^\beta$   
  $\mu_A^\alpha \geq \mu_A^\beta$

No, the answer is incorrect. Score: 0

Accepted Answers:  $\mu_A^\alpha > \mu_A^\beta$

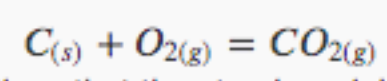
3) Suppose two phases namely,  $\alpha$  and  $\beta$  are present in a system. The chemical potentials of element A in  $\alpha$  phase and  $\beta$  phases are  $\mu_A^\alpha$  and  $\mu_A^\beta$  respectively. What is the condition for both the phases to be in chemical equilibrium?

- $\mu_A^\alpha < \mu_A^\beta$   
  $\mu_A^\alpha = \mu_A^\beta$   
  $\mu_A^\alpha > \mu_A^\beta$   
  $\mu_A^\alpha \geq \mu_A^\beta$

No, the answer is incorrect. Score: 0

Accepted Answers:  $\mu_A^\alpha = \mu_A^\beta$

4) Carbon burns according to the below reaction

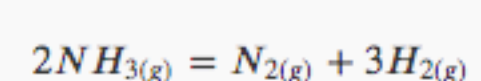


Given that the atomic weights of C = 12g/mol and O = 16g/mol. Find the mass coefficient  $\kappa$  of C (rounded off to 2 decimal places)

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) -0.3,-0.2

5) Ammonia decomposes according to the below reaction.



Given the standard affinity of reaction  $\Delta G^\circ = 87030 - 25.8T \ln T - 31.7TJ$ . Find the equilibrium constant at 700K

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 9500,10000

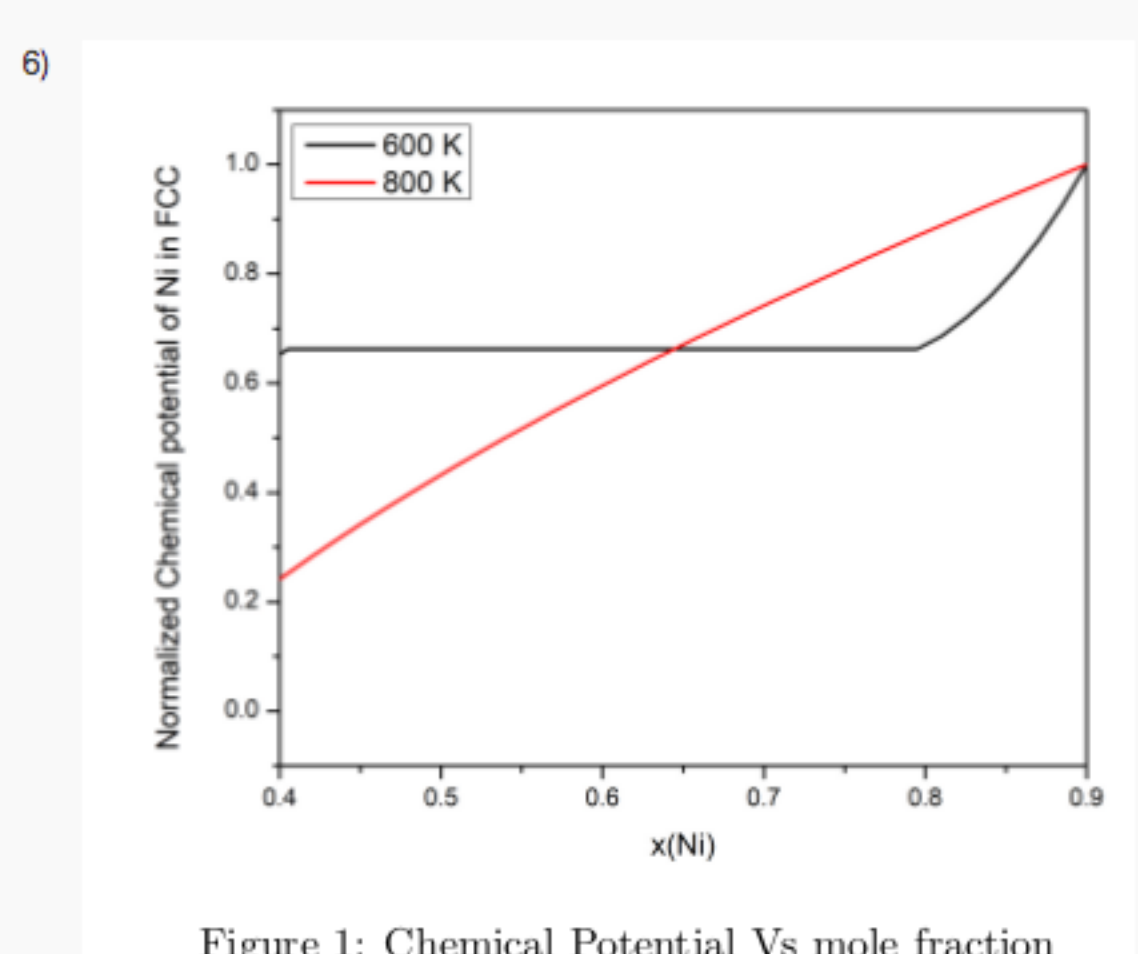


Figure 1: Chemical Potential Vs mole fraction

The given plot shows the chemical potential of Ni in FCC phase versus mole fraction of Nickel for 600K and 800K in Cu - Ni system for a limited range of compositions. An alloy of composition  $x(Ni) = 0.5$  is cast and has microsegregation. What should be suitable heat treatment temperature to homogenize the alloy in a finite time duration.

- 600 K  
 800 K  
 Insufficient data  
 Both 600 K and 800 K

No, the answer is incorrect. Score: 0

Accepted Answers: 800 K

7) The activity coefficient of element A in single phase A-B alloy at 500K can be represented as

$$\ln \gamma_A = 0.753X_A^2 - 0.811X_A^3$$

Estimate the thermodynamic factor of the alloy  $X(A) = 0.3$  at 500K

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 1.0,1.2

8) The activity coefficient of Cu in  $x(Cu) = 0.5$ ,  $X(Ni) = 0.5$  alloy is 0.644. If the saturated vapour pressure of solid copper is given by

$$\ln p_{Cu}^s = \frac{-40920}{T} - 0.86 \ln T + 21.67$$

Calculate the partial pressure ( $\times 10^{-12} atm$ ) of Cu exerted by the alloy at 700°C

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 1.0,1.4

9) For uphill diffusion to take place which of the following terms should be positive?

- $\frac{\partial \mu_i}{\partial x}$   
  $\Omega$   
  $\frac{\partial \ln \gamma}{\partial \ln x}$   
  $\frac{\partial C_i}{\partial x}$

No, the answer is incorrect. Score: 0

Accepted Answers:  $\Omega$

10) The concept of Lagrange method of Multipliers is used in many constrained optimization problems. Use Lagrange method of multipliers concept to find the volume

of the cuboid/cube box with a surface area of  $96cm^2$

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 62,66

11) What is the driving force for diffusion to take place?

- Concentration Gradient  
 Chemical potential gradient  
 Thermal gradient  
 Strain gradient

No, the answer is incorrect. Score: 0

Accepted Answers: Chemical potential gradient

12) A steel sheet of thickness 5 mm has nitrogen atmosphere on both sides at 850°C and a steady-state diffusion of nitrogen is taking place. The diffusion coefficient

of nitrogen in steel at the above temperature is  $1.2 \times 10^{-10} m^2/s$  and the diffusion flux is found to be  $2 \times 10^{-7} kg/m^2$ . If the high pressure side of the steel sheet is maintained at  $2kg/m^3$ . Assuming a linear concentration profile, how far (in mm) from the high pressure side will the concentration of nitrogen be

$$0.7kg/m^3$$

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 0.6,0.8

13) A steel sheet of thickness 3 mm is subjected to a carburizing atmosphere on one side and a decarburizing atmosphere on the other side. Assuming a steady-state

diffusion profile, find the diffusion co-efficient of carbon in steel when the carbon composition on both the surfaces were found to  $1kg/m^3$  and  $0.5kg/m^3$ . Assuming the diffusion flux to be  $8 \times 10^{-9}, kg/(m^2 \cdot s)$ , find the diffusion coefficient (in  $\times 10^{-11} m^2/s$ )

No, the answer is incorrect. Score: 0

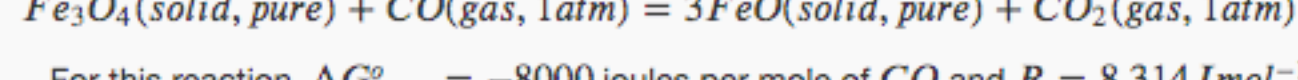
Accepted Answers: (Type: Range) 4,5

14) At 800 K, the activity of Pb is 0.6 in a Pb-Sn alloy with a composition  $x_{Pb} = 0.3$ . Estimate the regular solution parameter  $\Omega$  in joules

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 9300,9500

15) Consider the reaction:



For this reaction,  $\Delta G_{1200}^\circ = -8000$  joules per mole of CO and  $R = 8.314 Jmol^{-1} K^{-1}$ . The equilibrium ratio  $\frac{p_{CO_2}}{p_{CO}}$  for the reaction at 1200 K and 1 atm is

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 2.1,2.3

16) The following experimental data are available for a hypothetical binary liquid system A-B at 1073 K. When the atom fraction of A is 0.4, the activity of A in the liquid

is...

|                             |      |      |      |      |      |
|-----------------------------|------|------|------|------|------|
| Atom fraction of A          | 0.2  | 0.4  | 0.5  | 0.7  | 1.0  |
| Partial pressure of A (bar) | 0.01 | 0.04 | 0.06 | 0.07 | 0.08 |

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 0.49,0.51

17) In primary steel making the dissolved oxygen (O) reacts with carbon (C) to produce CO gas at 1 atm pressure according to the reaction  $C + O = CO(gas)$ .

The equilibrium constant for this reaction is  $\log_{10} K = \frac{1160}{T} + 2.003$ , where T is in Kelvin. Assuming Henrian activity coefficient of both O and C is to be unity, the dissolved oxygen content (in wt%) of a plain carbon steel melt with 0.7 wt% carbon at 1600°C is (answer upto 4 decimal points)

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 0.001,0.005

18) At a temperature of 710K, the vapour pressure of pure liquid Zn is given by the following equation.

$$p_{Zn}(X_{Zn} = 1) = 3.6 \times 10^{-4} atm$$

The Raoultian activity coefficient of  $Zn(\gamma_{Zn})$  in Zn-Cd alloy liquid at 710K is approximated by:

$$\ln(\gamma_{Zn}) = 0.875(1 - X_{Zn})^2$$

The ratio  $\frac{p_{Zn}(X_{Zn} = 0.7)}{p_{Zn}(X_{Zn} = 1)}$  for a liquid alloy with  $X_{Zn} = 0.7$  is (upto 2 decimal places)

No, the answer is incorrect. Score: 0

Accepted Answers: (Type: Range) 0.74,0.78

19) In case of fluids, the number of elements in mobility tensor is...

- One  
 Three  
 Nine  
 Eighty One

No, the answer is incorrect. Score: 0

Accepted Answers: One

20) Determine the correctness (or otherwise) of the following Assertion [A] and the Reason [R].

Assertion [A]: The Diffusion coefficient is always positive.

Reason [R]: The Mobility tensor is always positive.

- Both A and R are true but R is NOT the correct explanation of A  
 Both A and R are true and R is the correct explanation of A  
 A is false but R is true  
 Both A and R are false

No, the answer is incorrect. Score: 0

Accepted Answers: A is false but R is true