Unit 12 - Week 10

Assignment 10

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

Due on 2019-10-16, 23:59 IST.

1) Consider a steady state solidification process of $Al-Cu$ alloy. Which of the following relations gives the concentration of liquid during plane front solidification with no diffusion in solid and complete diffusion in liquid? Notations have their usual meaning *1 point*

- $C_L = C_0(1-f_L)^{k-1}$
- $C_L = C_0(1+f_L)^{k-1}$
- $C_L = C_0 f_L^{k-1}$
- $C_L = f_L^{k-1}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$C_L = C_0 f_L^{k-1}$

2) Consider the following statements *1 point*

S1. No diffusion in solid
S2. Complete diffusion in liquid
S3. Finite diffusion in liquid
S4. Finite diffusion in solid

Which of the statements listed above are correct assumptions in deriving Scheil equation?

- S2 and S4
- S1 and S3
- S3 and S4
- S1 and S2

No, the answer is incorrect.
Score: 0
Accepted Answers:
S1 and S2

3) It has been observed that during solidification (steady state) of aluminum alloys welded with the electron beam welding process show 'no solid diffusion, limited liquid diffusion'.The steady state region of the case of 'no solid diffusion, limited liquid diffusion' can be expressed by following differential equation: *1 point*

$$-V\frac{\partial C}{\partial x} = D\frac{\partial^2 C}{\partial x^2}$$

Which of the following boundary conditions are needed to solve this differential equation? (Notation have their usual meaning)

$B1. C_L(x \to 0) = \frac{C_0}{k}$
$B2. C_L(x \to \infty) = C_0$
$B3. C_L(x \to 0) = kC_0$
$B4. C_L(x \to \infty) = \frac{C_0}{k}$

- B3 and B4
- B1 and B4
- B2 and B3
- B1 and B2

No, the answer is incorrect.
Score: 0
Accepted Answers:
B1 and B2

4) During solidification of a binary alloy, it can be assumed that equilibrium between the solid and the liquid is maintained at the solid-liquid (S/L) interface throughout the process. The composition of liquid is 0.2 at % and the composition of solid is 0.05 at %. What is the value of partition coefficient? *1 point*

- 0.05
- 0.15
- 0.20
- 0.25

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.25

5) Which of the following phenomena can be attributed to solute segregation resulting from fluctuations in growth rate caused by thermal fluctuations during weld pool solidification? *1 point*

- Lamellar morphology
- Banding
- Coring
- Cellular morphology

No, the answer is incorrect.
Score: 0
Accepted Answers:
Banding

6) An alloy that has a freezing range of $120K$ is being welded with a traverse rate such that growth rate can be considered as 1 mm/min. The solute diffusivity can be taken as $5 \times 10^{-5} cm^2/s$. What is the minimum thermal gradient necessary to maintain for planar solidification? *1 point*

- 100 K/mm
- 400 K/mm
- 4000 K/mm
- 5000 K/mm

No, the answer is incorrect.
Score: 0
Accepted Answers:
400 K/mm

7) A rod of Al-2% Cu alloy is normally solidified under the condition of no diffusion in solid and complete mixing in liquid. It is given that melting temperature of Al is $660\,^{\circ}C$, Eutectic temperature $T_E = 548\,^{\circ}C$, maximum solubility of Cu in Al is $C_{LM} = 5.65$ and Eutectic composition is $C_E = 33$. Assuming constant K over the temperature range of interest.The concentration of first formed solid is?(in % Cu) *1 point*

- 0.014
- 0.342
- 0.881
- 0.966

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.342

8) From the Al-Mg phase diagram, the equilibrium freezing range of 5052 aluminum (essentially Al-2.5Mg) is about $40\,^{\circ}C$.If alloy is solidified with no mixing in solid and prefect mixing in the liquid and a planer solid/liquid interface at $5\mu m/s$.Given that the diffusion coefficient D_L is $3 \times 10^{-9} m^2/s$.The value of diffusion layer thickness will be *1 point*

- $3 \times 10^{-2} m$
- $6 \times 10^{-4} m$
- $2 \times 10^{-6} m$
- $12 \times 10^{-8} m$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$6 \times 10^{-4} m$

9) Let C_E and C_{SM} be respectively 35% and 15% Mg, and both the solidus and liquidus lines are essentially straight in the Al-Mg system. The melting point of pure Al is $660\,^{\circ}C$, and the eutectic temperature is $451\,^{\circ}C$. Assume that the alloy is solidified with no mixing in solid and complete mixing in the liquid. *1 point*

What will be the fraction of eutectic in an alloy of composition $C_0 = 12$ % Mg ?

- 0.23
- 0.15
- 0.22
- 0.85

No, the answer is incorrect.
Score: 0
Accepted Answers:
0.15

10) Which of the following is a reason for solutal Marangoni convection as a driving force for fluid flow in an alloy weld pool? *1 point*

- Gradient in temperature along the free surface
- Gradient in temperature in the bulk
- Gradient in composition along the free surface
- Gradient in composition in the bulk

No, the answer is incorrect.
Score: 0
Accepted Answers:
Gradient in composition along the free surface

11) Consider the following assumptions: *1 point*

S1. Diffusion is negligible in solid
S2. Diffusion is finite in solid
S3. Diffusion is finite in liquid
S4. Diffusion is complete in liquid

Which of the above assumptions are made in the solute segregation model?

- S1 and S4
- S1 and S3
- S2 and S3
- S2 and S4

No, the answer is incorrect.
Score: 0
Accepted Answers:
S1 and S3

12) Consider the following statements. Assume that the partition coefficient k is less than unity. Here, f_L is liquid fraction, C_L is liquid composition at the interface and C_0 is the composition of the alloy. *1 point*

S1. As $f_L \to 0, C_L \to \infty$
S2. As $f_L \to 0, C_L \to C_0$
S3. As $f_L \to 1, C_L \to \infty$
S4. As $f_L \to 1, C_L \to C_0$

Which of the above statements is true about the Scheil's equation?

- S1 and S3
- S1 and S4
- S2 and S3
- S2 and S4

No, the answer is incorrect.
Score: 0
Accepted Answers:
S1 and S4

13) During processing of metallic alloys such as welding, which of the following assumptions is reasonable? *1 point*

- Solutal field has evolved while thermal field is evolving
- There are no thermal gradients in the domain
- Thermal field has evolved while solutal field is evolving
- There are no solute gradients in the domain

No, the answer is incorrect.
Score: 0
Accepted Answers:
Thermal field has evolved while solutal field is evolving

14) Which of the following statements is not a consequence of the processing of a binary alloy following the Scheil regime? *1 point*

- Coring in the solid region
- Deviation of phase fractions from phase diagram
- Appearance of eutectic fraction even in dilute alloys
- Compositions at the solid/liquid interface deviate from phase diagram

No, the answer is incorrect.
Score: 0
Accepted Answers:
Compositions at the solid/liquid interface deviate from phase diagram

15) Consider a 1D steady state solidification as discussed in the course with the example of welding.When the growth rate is suddenly decreased, how does composition profiles get modified? *1 point*

- To achieve steady state, composition of liquid increases
- To achieve steady state, composition of liquid decreases
- To achieve steady state, composition of solid increases
- Composition of solid and liquid do not change

No, the answer is incorrect.
Score: 0
Accepted Answers:
To achieve steady state, composition of liquid decreases