physical metallurgy

PHYSICAL METALLURGY ASSIGNMENT- 1

* Required

1. Email *

2. For an ideal hexagonal-closed packed structure, the c/a ratio and packing efficiency respectively are 1 point

Mark only one oval.

- (A) 1.633 and 52%
- (B) 1.633 and 74%
- (C) 1.733 and 68%
- (D) 1.733 and 74%

3. Iron has an atomic radius of 0.124 nm (1.24 Å) and a BCC structure, with an atomic weight of 55.85 g/mol. Calculate the density of iron. 1 point

Mark only one oval.

- 7.897 g/cc
- 5.00 g/cc
- 6.32 g/cc
- none of the above

4. The Miller indices of a set of parallel planes,which make intercepts in the ratio of 3a:4b on the x and y axis and are parallel to z-axis(with a, b and as lattice parameters) are 1 point

Mark only one oval.

- (a) [0 4 3]
- (b) [4 3 0]
- (c) [3 3 0]
- (d) [3 4 0]

5. Calculate the planar density of (1 1 0) plane of FCC structure(in percentage) 1 point

Mark only one oval.

- 55.536
- 88.880
- 20
- 30

6. Ratio of packing factor of an FCC crystal to the packing factor of a single cubic crystal is 1 point

Mark only one oval.

- (a) 1.0
- (b) 1.423
- (c) 0.702
- (d) None of these

7. In a unit cell of silver, the atoms occupy what percentage space per unit cell 1 point

Mark only one oval.

- (a) 80%
- (b) 68%
- (c) 74%
- (d) 52%

8. How many carbon atoms are there in a unit cell of diamond? 1 point

Mark only one oval.

- 12
- 8
- 2
- 6

9. Pure iron transforms from body centered cubic (BCC) to face centered cubic (FCC) crystal structure at 912 C. If the lattice parameter of the BCC phase is 0.293 nm and that of the FCC phase is 0.363 nm, the associated volume change is _____ (in % to one decimal place) 1 point

Mark only one oval.

- -4.92
- -1.2
- 0
- 2.36

10. l f 2 moles of Au and 3 moles of Ag are mixed to form a single-phase ideal solid solution, the total entropy of mixing is _____ (on J/ K to one decimal place) Given: Gas constant R = 8.314 J/ K/mol 1 point

Mark only one oval.

- 8.314
- 2.358
- 27.977
- 0

11. 1 point

The table (see options below) providing correct information about crystal structure, co-ordination number and packing fraction is _____.

[Note: FCC: Face centered cubic; BCC: Body centered cubic; DC: Diamond cubic.
CN: Coordination number; PF: Packing fraction]

(A)

Crystal structure	CN	PF
FCC	12	0.74
BCC	8	0.68
DC	4	0.34

(B)

Crystal structure	CN	PF
FCC	8	0.74
BCC	4	0.68
DC	6	0.34

(C)

Crystal structure	CN	PF
FCC	8	0.52
BCC	12	0.68
DC	12	0.74

(D)

Crystal structure	CN	PF
FCC	12	0.74
BCC	8	0.68
DC	4	0.74

Mark only one oval.

- A
- B
- C
- D

12. Find out the indices of the direction joining points in a cubic lattice: 1,1,1 with 1,1,2 1 point

Mark only one oval.

- [1 2 3]
- [2 0 3]
- [0 0 1]
- [1 -1 0]

13. Two metals A (melting point 800C) and B (melting point 600C) form a binary isomorphous system. An alloy having 35% B has 75% solid and rest liquid whereas an alloy having 55%B has 25% solid at 700C. what are the compositions of solid and liquid at the above temperature respectively 1 point

Mark only one oval.

- 0.85 & 0.15
- 0.65 &0. 25
- 0.50 & 0.50
- none of the above

14. In a pearlitic structure, ratio of thickness of ferrite layer to thickness of cementite layer is 0 points

Mark only one oval.

- (a) 4
- (b) 2
- (c) 1
- (d) None of these

15. What is the fraction of proeutectoid cementite in 1.4 per cent C steel(assume eutectoid composition to be 0.77%c (wt)) 1 point

Mark only one oval.

- 0.107
- 0.25
- 0.1340
- none of the above

16. 0 points

A 0.6 wt.% C steel sample is slowly cooled from 900 °C to room temperature.
The fraction of proeutectoid ferrite in the microstructure is: _____
(round off to 2 decimal places).

Given: Eutectoid composition: 0.8 wt.% C
Maximum solubility of carbon in α-Fe: 0.025 wt.% C

Mark only one oval.

- 0.77
- 0.9
- 0.258
- none of the above

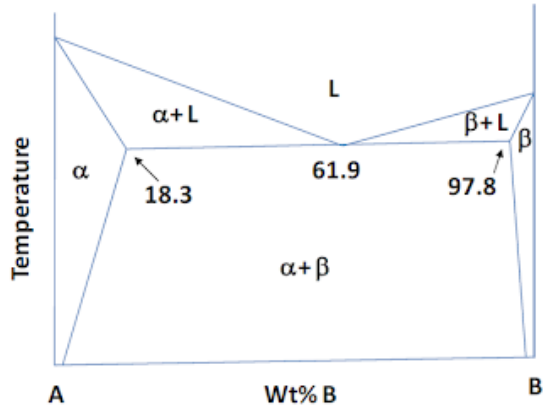
17. A slowly cooled plain carbon steel has pro eutectoid ferrite to be 10% of its eutectoid ferrite .What is the carbon content of the steel

Mark only one oval.

- Option 1

18. 1 point

Q.46 A binary phase diagram is shown in the schematic.



Upon complete solidification of a binary alloy system A-B, the fraction of pro-eutectic α-phase present is 0.50. The alloy composition in terms of wt%. B is _____

Mark only one oval.

- 30.3%
- 40.1%
- 55%
- 45%

19. For a bcc metal the ratio of the surface energy per unit area of the (100) plane to that of the(110) plane is _____ 1 point

Mark only one oval.

- 1.732
- 0.225
- 1.414
- 1.633

20. 1 point

For homogeneous nucleation of solid in a liquid of a pure metal, the critical edge length (in nm) of a cube shaped nucleus is _____ *(answer up to two decimal places)*

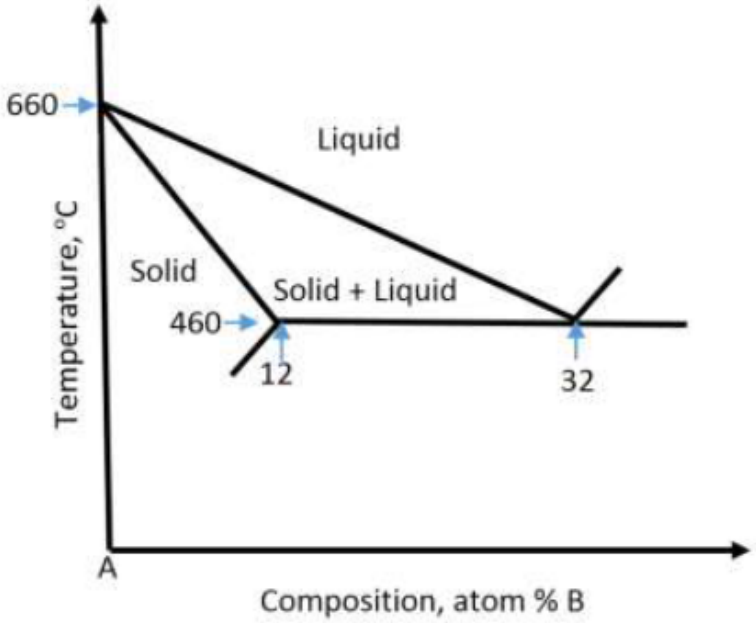
(Given: surface energy $\gamma = 0.177\ J.m^{-2}$; change in volume free energy $\Delta G_V = -2.8 \times 10^8\ J.m^{-3}$)

Mark only one oval.

Option 1

21. 1 point

In the A-rich end of the A-B binary eutectic phase diagram (shown below), the solidus and liquidus are straight lines.



The freezing range of the alloy with 16% B is _____ (in °C *to one decimal place*)

Mark only one oval.

- 50
- 20
- 100
- none

22. 1 point

Consider homogeneous nucleation of a spherical solid in liquid. For a given undercooling, if surface energy of a nucleus increases by 20 %, the corresponding increase (in percent) in the critical radius of the nucleus is: _____ (round off to nearest integer).

Mark only one oval.

- 20
- 40
- 10
- 25

23. 1 point

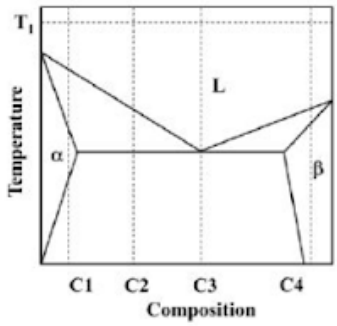
The lattice parameter of face-centered cubic iron (γ-Fe) is 0.3571 nm. The radius (in nm) of the octahedral void in γ-Fe is _____

Mark only one oval.

- Option 1

24. 1 point

Four alloys, C1, C2, C3, C4, shown in the phase diagram are poured at temperature T_1 in a mold. During solidification, which one of these alloys is expected to have the highest fluidity?



(A) C1 (B) C2 (C) C3 (D) C4

Mark only one oval.

- A
- B
- C
- D

25. 1 point

At equilibrium, the maximum number of phases in a three-component system at CONSTANT PRESSURE is:

(A) 1 (B) 2 (C) 3 (D) 4

Mark only one oval.

- A
- B
- C
- D

26. 1 point

Consider homogeneous nucleation of a spherical solid in liquid. For a given undercooling, if surface energy of a nucleus increases by 20 %, the corresponding increase (in percent) in the critical radius of the nucleus is: _____ (round off to nearest integer).

Mark only one oval.

Option 1

27. 1 point

Match the phase transformation in **Column I** with the corresponding reaction in **Column II**.

[Note: α, β, γ are solid phases; L, L_1, L_2 are liquid phases.]

Column I: Phase transformation	**Column II: Reaction**
(P) Peritectic	1. $\gamma \rightarrow \alpha + \beta$
(Q) Monotectic	2. $L_1 + L_2 \rightarrow \alpha$
(R) Eutectoid	3. $L_1 \rightarrow L_2 + \alpha$
(S) Syntectic	4. $L + \alpha \rightarrow \beta$

(A) P-4, Q-3, R-1, S-2

(B) P-3, Q-4, R-2, S-1

(C) P-1, Q-3, R-4, S-2

(D) P-4, Q-2, R-3, S-1

Mark only one oval.

- A
- B
- C
- D

28. 1 point

The critical radius (in **nm**, rounded off to one decimal place) of nickel nucleus during solidification at 1673 K is _____.

Given: Enthalpy of fusion of nickel = $2.65 \times 10^9\ J.m^{-3}$;

Liquid-solid interfacial energy = $0.5\ J.m^{-2}$, and

Equilibrium melting temperature of nickel = 1728 K.

Mark only one oval.

- Option 1

29. 1 point

What is the composition, in weight percent, of an alloy that consists of 5 at% Cu and 95 at% Pt?

A 5% and 95 %
B 95 % and 5 %
C 1.68 % and 98.32 %
D 2 % and 98 %

Mark only one oval.

- A
- B
- C
- D

30. 1 point

2) The number of ways of arranging 6 Copper atoms and 2 aluminium atoms on 8 lattice sites and 8 copper atoms on 8 lattices are _____, _____.

Mark only one oval.

- 24,1
- 28,1
- 6,2
- 8,8

31. 1 point

In the eutectic phase diagram of Ag-Cu system, the solubility limit at 500° C of copper is 3% in the Ag-rich phase and of Ag is 2% in the Cu-rich phase. In sterling silver(92.5% Ag - 7.5% Cu), the percent of copper in the Ag-rich phase at 500° C is:

Mark only one oval.

- 95.26
- 4.74
- 3
- 98

32. 1 point

Which of the following relation is correct ?

Mark only one oval.

- crystal= lattice + basis
- lattice = crystal + basis
- lattice = crystal
- basis = crystal

33. 1 point

The unit cell has a=5Å, b=6Å, c=8Å, α =90°, β=90°, γ=90°. What is the space lattice for this unit cell?

Mark only one oval.

- MONOCLINIC
- CUBIC
- TRICLINIC
- ORTHORHOMBIC

34. 1 point

The angle between [111] and $[11\bar{2}]$ directions in a cubic crystal is:

Mark only one oval.

- 0 DEGREE
- 90 DEGREE
- 45 DEGREE
- 180 DEGREE

35. 1 point

The **t** vector is perpendicular to the **b** vector in a dislocation of the type:

Mark only one oval.

- SCREW
- MIXED
- EDGE DISLOCATION
- NONE OF THESE

36. 1 point

Which of the following statements is true regarding vacancy concentration in crystalline materials ?

Mark only one oval.

- it increases linearly with temperature
- it doesn't change with temperature
- it decreases exponentially with temperature
- it increases exponentially with temperature

37. 1 point

Single Phase Mixture is?

Mark only one oval.

- ice water
- sugar-water
- soap bubbles
- Fog

38. 1 point

Cu -Ni forms---------- type phase diagram.

Mark only one oval.

- ISOMORPHOUS SYSTEM
- EUTECTIC
- MONOTECTIC
- PERITECTIC

39. 1 point

At melting temperature which of the following is true?

Mark only one oval.

- GIBB'S FREE ENERGY OF LIQUID > GIBB'S FREE ENERGY OF SOLID
- GIBB'S FREE ENERGY OF LIQUID < GIBB'S FREE ENERGY OF SOLID
- GIBB'S FREE ENERGY OF LIQUID = GIBB'S FREE ENERGY OF SOLID
- NONE

40. 1 point

What is the effect on the shape of the free-energy curve for a solution if its interaction parameter is positive

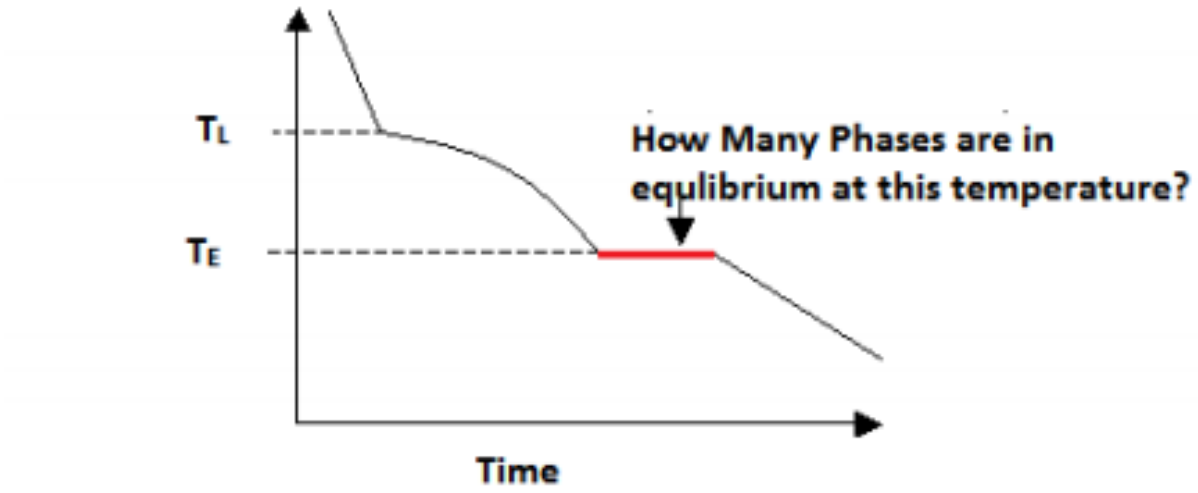
A Produces a curve which has one minimum
B Produces a curve with no minimum and one maximum
C Produces a curve which contains a maximum at low T
D Produces a curve which contains a maximum at high T

Mark only one oval.

- A
- B
- C
- D

41. 0 points

Cooling curve for a binary system:



A 4 phases
B 2 phases
C 3 phases
D 1 phase

Mark only one oval.

- A
- B
- C
- D

42. 1 point

What is a hypoeutectic alloy?

A An alloy which has a solute content lower than that of the eutectic
B An alloy which has solute content greater than that of the eutectic.
C An alloy whose solute content is such that it contains no eutectic.
D An alloy whose final microstructure is wholly eutectic.

Mark only one oval.

- A
- B
- C
- D

43. 1 point

The mass fractions of total ferrite and total cementite in an iron-carbon alloy are 0.88 and 0.12, respectively. Which type of alloy is this?

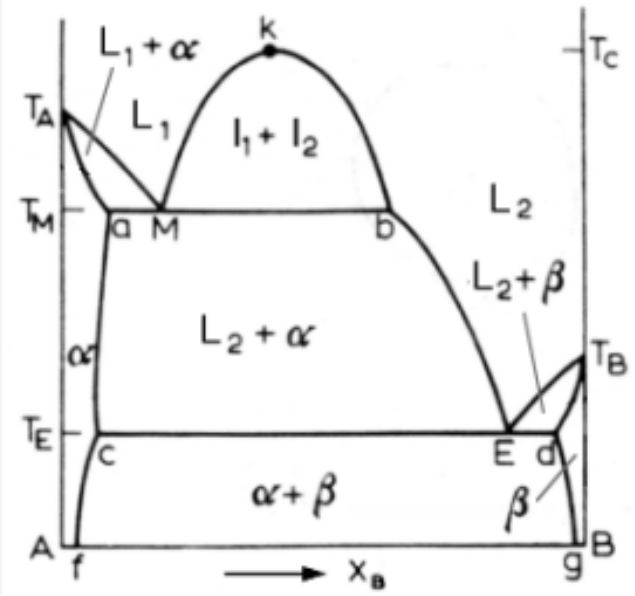
A It is a hypo-eutectoid alloy
B It is a hyper-eutectoid alloy
C It is a eutectoid alloy
D None of these

Mark only one oval.

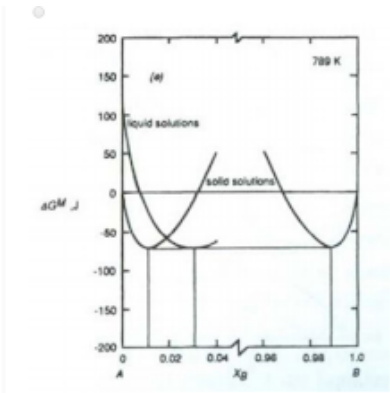
- A
- B
- C
- D

44.

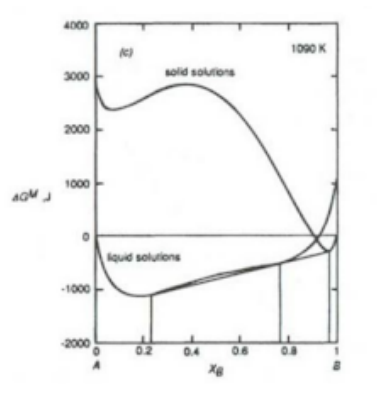
What will be the free-energy vs composition diagram at Te for the following phase diagram.



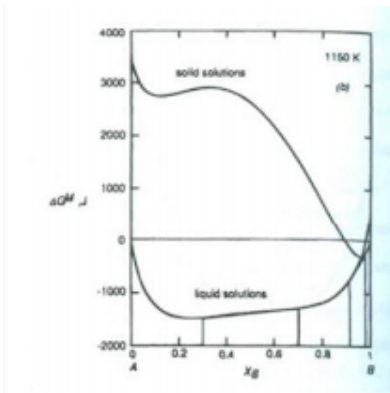
Mark only one oval.



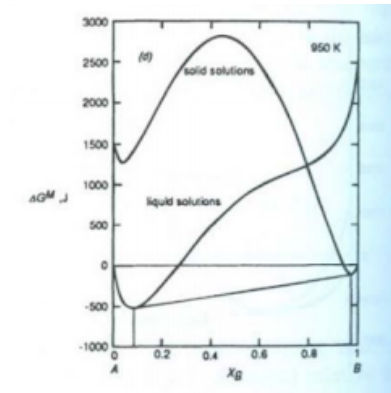
Option 1



Option 2

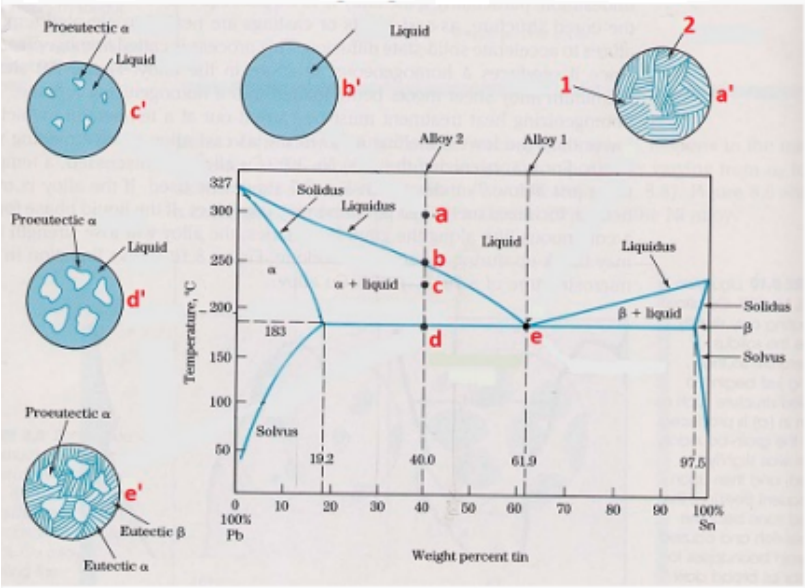


Option 3



Option 4

45. 1 point



Match the expected phases present at points a,b,c,e,f with the schematic microstructures shown against b',c',d',e',f'

A a-b', b-d', c-e', d-c'. e-a'
B a-b', b-c', c-d', d-e'. e-a'
C a-b', b-e', c-d', d-d'. e-a'
D a-b', b-b', c-e', d-c'. e-a'

Mark only one oval.

- A
- B
- C
- D

46. 1 point

Both nucleation and growth require change in free energy to be _____

A –ve
B zero
C +ve
D Any

Mark only one oval.

- A
- B
- C
- D

47. 1 point

All body diagonals of a conventional unit cell of a tetragonal crystal with *c*/*a* ratio=2 is given by:

A [111]
B <111>
C <112>
D (111)

Mark only one oval.

- A
- B
- C
- D

48. 1 point

The combinations of which of the following elements are likely to have complete solid solubility based on the Hume-Rothery rules?
A (ccp, 1.3 Å radius); B (hcp, 1.3 Å radius); C (hcp, 1.4 Å radius)
Assume that the valencies and electronegativities are the same.

A A and B
B B and C
C A and C
D None of the above

Mark only one oval.

- A
- B
- C
- D

49. 1 point

Find the magnitude of the Burgers vector (in Å) of a dislocation in a CCP crystal with a = 3.24 Å.

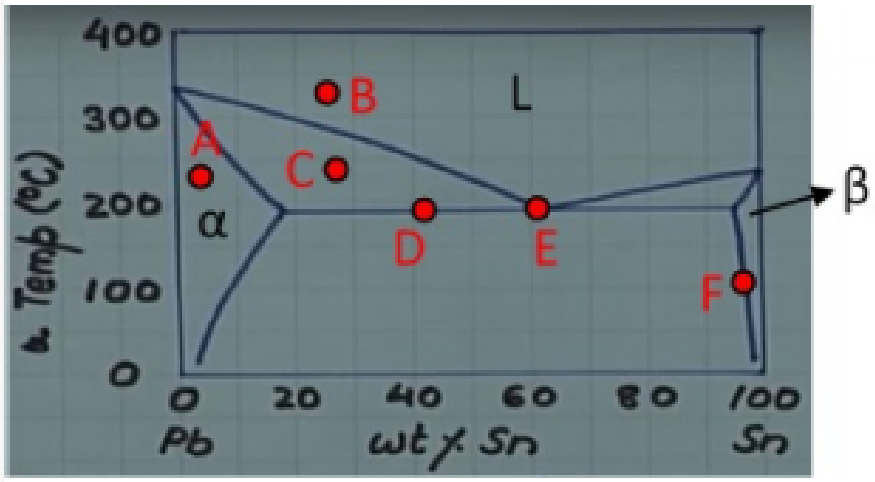
A 2.81
B 2.29
C 1.41
D 1.73

Mark only one oval.

- A
- B
- C
- D

50. 1 point

Which of the constitution points shown in the diagram have two degrees of freedom?



A A, B and C

B D, E and F

C D and F

D A and B

Mark only one oval.

A

B

C

D

51. 1 point

The lever rule is based on _____.

A momentum balance
B heat balance
C energy balance
D mass balance

Mark only one oval.

A
B
C
D

52. 1 point

Vacancies play an important role in which of the following diffusion mechanisms?

A interstitial diffusion only.
B substitutional diffusion only.
C Both interstitial and substitutional diffusion.
D Neither interstitial nor substitutional diffusion.

Mark only one oval.

A
B
C
D

53. 1 point

Which of the following is true regarding homogeneous nucleation? ***1 point***

A With increasing undercooling, nucleation rate decreases
B With increasing undercooling (lowering of temperature), critical size of the nucleus decreases
C With increasing undercooling, homogeneous nucleation becomes less and less probable
D With increasing undercooling, ΔG^* increases

Mark only one oval.

- A
- B
- C
- D

54. 1 point

Under equilibrium solidification condition, we assume_____ ***1 point***

A. Complete homogenization in liquid
B. Complete homogenization in solid (i.e. infinite or complete diffusion in solid)
C. At any particular temperature, liquid and solid formed have composition predicted by phase diagram

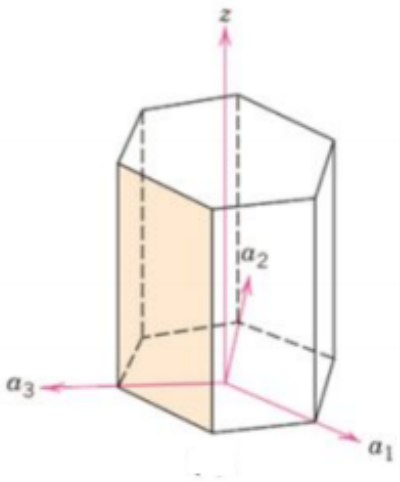
A All A, B and C are false
B A and B are true, but C is false
C All A, B and C are true
D A is true, but B and C are false

Mark only one oval.

- A
- B
- C
- D

55. 1 point

Identify the Miller-Bravais indices of the plane highlighted in the figure given below.

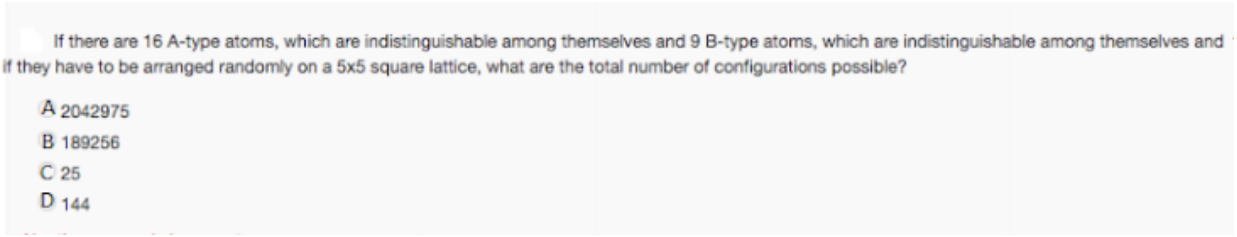


A
$(0\ \bar{1}\ 2\ 0)$
B $(0\ 1\ 1\ 0)$
C
$(0\ 0\ \bar{1}\ 1)$
D
$(0\ \bar{1}\ 1\ 0)$

Mark only one oval.

- A
- B
- C
- D

56. 1 point



Mark only one oval.

- A
- B
- C
- D

57. 1 point

An array of point in space in which the environment of each point is identical is called

Mark only one oval.

- MOTIF
- LATTICE
- UNIT CELL
- CRYSTAL

58. 1 point

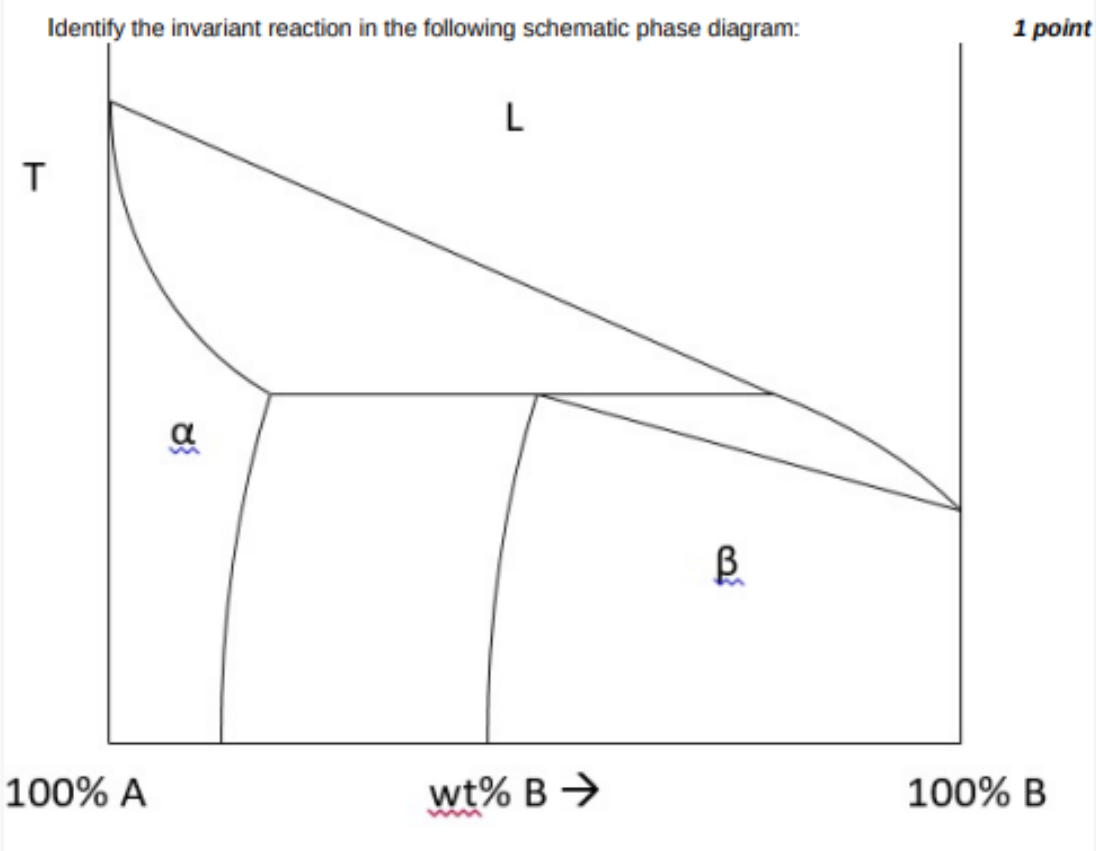
If the two crystals across a boundary are related to each other by a mirror reflection, then the boundary is called a _____.

A stacking fault
B phase boundary
C twin boundary
D grain boundary

Mark only one oval.

- A
- B
- C
- D

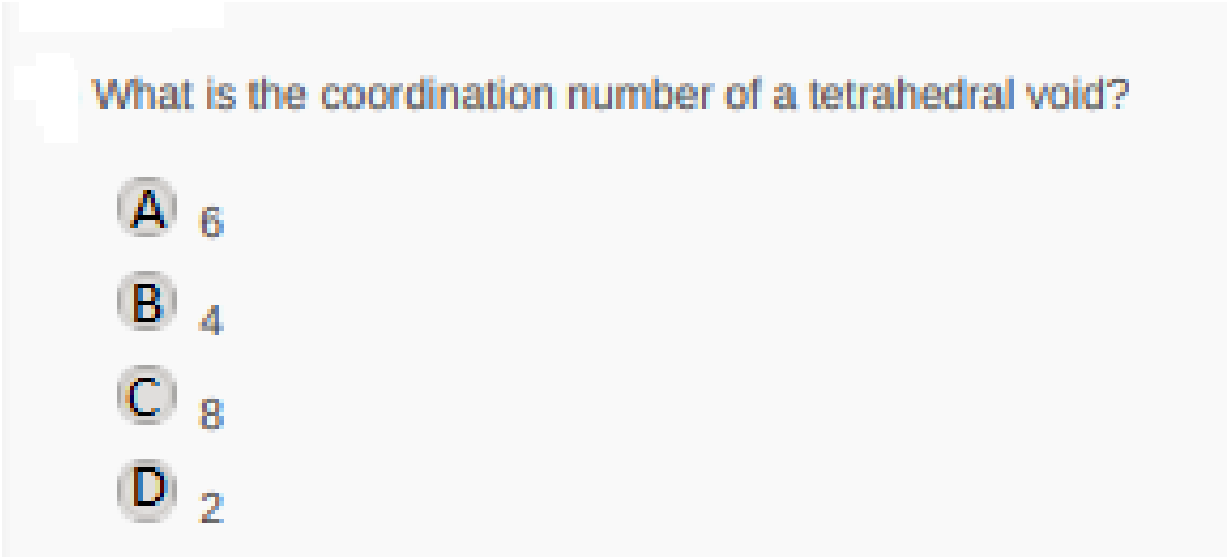
59. 1 point



Mark only one oval.

- EUTECTIC
- PERITECTIC
- EUTECTOID
- PERITECTOID

60. 1 point



Mark only one oval.

- A
- B
- C
- D

61. 1 point

What is the coordination number of an octahedral void?

A 8

B 4

C 6

D 2

Mark only one oval.

- A
- B
- C
- D

62. 1 point

If burger vector of a screw dislocation is given as $\vec{b}$ =[0 I $\bar{1}$] which is gliding on (I I I) plane, then it can cross-slip to which one of the following planes?

A (I I $\bar{1}$)
B ($\bar{1}$ I I)
C (I $\bar{1}$ I)
D (0 I $\bar{1}$)

Mark only one oval.

- A
- B
- C
- D

63. What is the effect of plastic deformation on lattice parameter? 1 point

Mark only one oval.

- A.plastic deformation INCREASES lattice parameter
- B.plastic deformation DECREASES lattice parameter
- C.lattice parameter REMAINS THE SAME before and after plastic deformation
- D.both A & B

64. Cooling curve of a binary alloy looks exactly similar to that of a pure metal. Is this possible? 1 point

Mark only one oval.

- YES
- NO

65. 1 point

The configurational entropy, S_c in an ideal solid solution is given by: $S_c = -R[x \ln x + (1-x)\ln(1-x)]$, where x is the mole fraction of solute. The limit of S_c, as x tends to zero ($\lim_{x \to 0} S_c$) is

(A) ∞ (B) $R \ln 2$ (C) R (D) 0

Mark only one oval.

- A
- B
- C
- D

66. 1 point

The [100] and [110] directions in a cubic crystal are coplanar with

(A) [101] (B) [001] (C) [120] (D) [111]

Mark only one oval.

- A
- B
- C
- D

67. 1 point

The maximum amount of proeutectic austenite that can form in an iron-carbon alloy containing 3.5% carbon is
[Given: The maximum solubility of carbon in γ-iron is 2.11%]

(A) 24.80% (B) 36.53% (C) 67.87% (D) 72.52%

Mark only one oval.

- A
- B
- C
- D

68. 1 point

When one mole of copper is quenched from 1000 K to 300 K, the amount of heat released is
[Given: the specific heat capacity of copper in J K^{-1} mol^{-1}
$C_p = 22.68 + 6.3 \times 10^{-3} T$, where T is temperature]

(A) 9.37 kJ (B) 15.87 kJ (C) 18.74 kJ (D) 22.68 kJ

Mark only one oval.

- Option 1

69. 1 point

According to Hume-Rothery rules, extensive solid solubility between elements X and Y is promoted by the two factors in the following list :

P. Same crystal structure of X and Y

Q. Large atomic size difference (> 20 %) between X and Y

R. Same valence of X and Y

S. Large difference in melting points of X and Y

(A) P, Q (B) P, R (C) Q, S (D) P, S

Mark only one oval.

- A
- B
- C
- D

70. 1 point

In case of homogeneous nucleation, the critical edge length for a cube shaped nucleus is (γ : Energy per unit area of the interface between the product and the parent phase; Δg : Gibbs free energy change per unit volume)

(A) $-4\gamma/\Delta g$ (B) $-2\gamma/\Delta g$ (C) $\gamma/\Delta g$ (D) $-3\gamma/\Delta g$

Mark only one oval.

- A
- B
- C
- D

71. 1 point

For a fcc unit cell, the ratio of the number of tetrahedral voids to the number of atoms is

(A) 2:1 (B) 3:1 (C) 4:1 (D) 5:1

Mark only one oval.

- A
- B
- C
- D

72. 1 point

One mole of element P is mixed with one mole of element Q. The entropy of mixing at 0 K is

(A) 0 (B) –R ln 0.5 (C) infinity (D) –R ln 2

Mark only one oval.

- A
- B
- C
- D

73. 1 point

The angle between the line vector and the burgers vector of an edge dislocation is

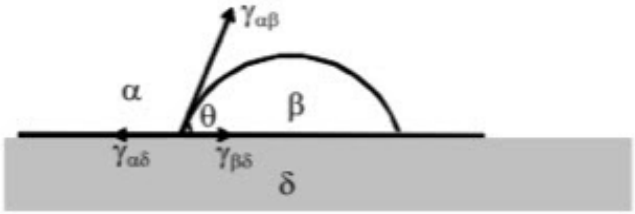
(A) 0 degree (B) 90 degrees (C) 120 degrees (D) 180 degrees

Mark only one oval.

- A
- B
- C
- D

74. 1 point

A liquid droplet (β) is on a substrate (δ) and is surrounded by air (α), as shown below. The angle of contact (θ) is determined using the following expression:



(A) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\alpha\beta}}\right)$ (B) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\alpha\beta}}{\gamma_{\alpha\beta}}\right)$

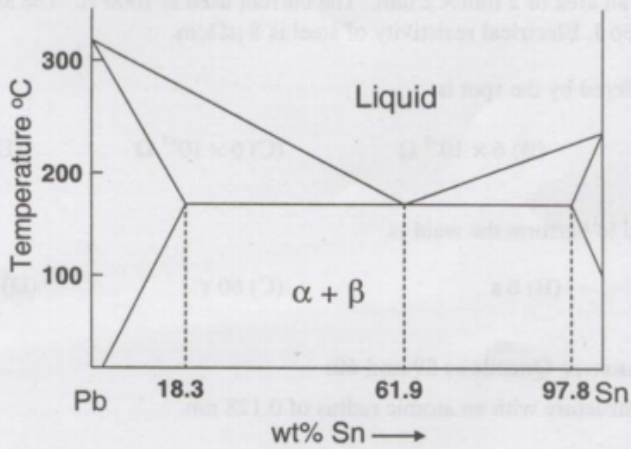
(C) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\alpha\delta}}\right)$ (D) $\theta = \cos^{-1}\left(\frac{\gamma_{\alpha\delta} - \gamma_{\beta\delta}}{\gamma_{\beta\delta}}\right)$

Mark only one oval.

- A
- B
- C
- D

75. 1 point

Schematic of the Pb-Sn phase diagram at atmospheric pressure is shown below.



A Pb-Sn hypo-eutectic alloy is slowly cooled from the liquid state to room temperature. The composition of the alloy whose microstructure consists of 25 wt% lamellar constituent is

(A) Pb - 29.2 wt % Sn
(B) Pb - 35.5 wt % Sn
(C) Pb - 40.8 wt % Sn
(D) Pb - 61.9 wt % Sn

Mark only one oval.

- A
- B
- C
- D

76. 1 point

In Cu-Al phase diagram, the solubility of Al in Cu at room temperature is about 10% and that of Cu in Al is less than 1%. The Hume-Rothery rule that justifies this difference is

(A) size factor
(B) electro-negativity
(C) structure
(D) valency

Mark only one oval.

- A
- B
- C
- D

77. 1 point

The planar density for (111) plane in a fcc crystal is

(A) 0.68 (B) 0.74 (C) 0.85 (D) 0.91

Mark only one oval.

- A
- B
- C
- D

78. 1 point

An annealed hypoeutectoid steel has 10% of proeutectoid ferrite at room temperature. The eutectoid carbon content of the steel is 0.8%. The carbon content in the steel in percent is

(A) 0.58 (B) 0.68 (C) 0.72 (D) 0.78

Mark only one oval.

- A
- B
- C
- D

79. 1 point

The melting point and latent heat of fusion of copper are 1356 K and 13 kJ mol^{-1}, respectively. Assume that the specific heats of solid and liquid are same. The free energy change for the liquid to solid transformation at 1250 K in kJ mol^{-1} is

(A) –4 (B) –3 (C) –2 (D) –1

Mark only one oval.

- A
- B
- C
- D

80. 1 point

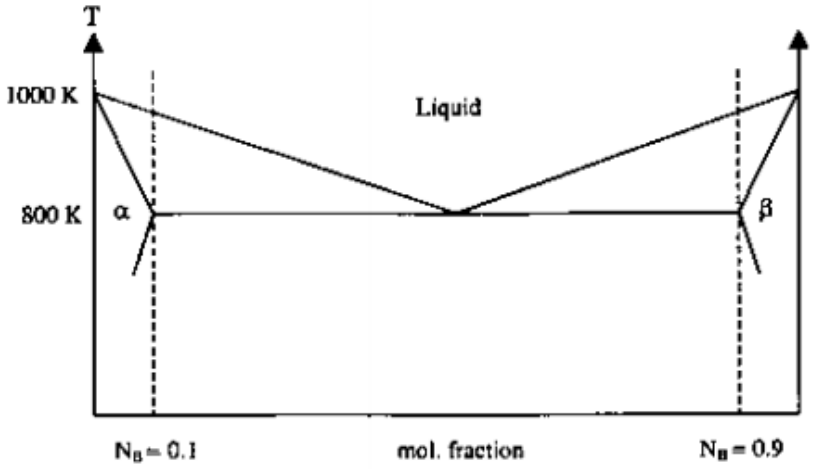
The miller indices of the direction common to the planes (111) and (110) in a cubic system is

(A) [111] (B) [110] (C) $[\bar{1}10]$ (D) $[\bar{1}11]$

Mark only one oval.

- A
- B
- C
- D

81. 1 point



In the above hypothetical phase diagram, the melting point of each pure component is 1000 K and the eutectic temperature is 800 K. The eutectic is located at the equi-atomic composition. The maximum solid solubility in α phase is given by mole fraction $N_B = 0.1$.

The freezing range (in K) of the alloy with composition $N_B = 0.1$ is
(A) 100 (B) 130 (C) 160 (D) 190

Mark only one oval.

- A
- B
- C
- D

82. 1 point

At 910°C, γ-Fe transforms to α-Fe resulting in a percentage volume expansion of

(A) 5.6 (B) 7.1 (C) 7.6 (D) 8.8

Mark only one oval.

- A
- B
- C
- D

83. 1 point

In a homogeneous system (with c as the number of components) in equilibrium the total number of independent intensive thermodynamic variables is

(A) $c-1$ (B) c (C) $c+1$ (D) $c+2$

Mark only one oval.

- A
- B
- C
- D

84. 0 points

A unit cell of an element has maximum linear density along the [110] direction. The packing density of its (100) plane is

(A) 0.68 (B) 0.74 (C) 0.79 (D) 0.91

Mark only one oval.

- A
- B
- C
- D

85. 1 point

When a liquid is cooled down to its freezing point, it completely solidifies instantly." True/False?

- A True
- B False

Mark only one oval.

- A
- B

86. 0 points

20000 stable solid nuclei have formed within 200 mL of a liquid in 10 s. Calculate the nucleation rate in ($m^{-3}s^{-1}$).

A 200
B 10^5
C 10
D 10^7

Mark only one oval.

- A
- B
- C
- D

87. 1 point

Choose the correct statement(s): P: When the radius of a solidifying nucleus is equal to the critical radius, it is in stable equilibrium. Q: When a liquid has risen/fallen within a capillary tube, it is in unstable equilibrium.

A Both P and Q are wrong
B Only P is true
C Only Q is true
D Both P and Q are true

Mark only one oval.

- A
- B
- C
- D

88. 1 point

If the ratio of the volumes of the nuclei formed during heterogeneous nucleation to that which formed during homogeneous nucleation is 0.6, which of the following is the contact angle θ between the substrate and the liquid?

A 90.2°
B 97.7°
C 117.7°
D 151°

Mark only one oval.

- A
- B
- C
- D

89. 1 point

The Burgers vector is a constant for which of the following types of dislocations?

A Edge dislocations alone
B Mixed dislocations alone
C Screw dislocation alone
D All the above

Mark only one oval.

- A
- B
- C
- D

90. 1 point

Polycrystalline materials necessarily have _____.

A phase boundaries
B twin boundaries
C grain boundaries
D stacking faults

Mark only one oval.

- A
- B
- C
- D

91. 1 point

The line energy (in J/m) of a dislocation in a BCC crystal with a = 3.8 Å and a shear modulus of 50 GPa is _____.

A 2.71×10^{-9}

B 1.81×10^{-9}

C 3.61×10^{-9}

D 1.81×10^{-10}

Mark only one oval.

- A
- B
- C
- D

92. 1 point

White cast iron contains carbon in the form of

A free carbon
B flakes
C cementite
D ferrite

Mark only one oval.

- A
- B
- C
- D

93. 1 point

Which of the following is a correct description of pearlite.

A It is a mixture of two phases: α ferrite and Fe_3C

B It is a separate phase different from α ferrite and Fe_3C

C It is a mixture of two phases: α ferrite and γ austenite

D None of these

Mark only one oval.

- A
- B
- C
- D

94. 1 point

For ideal solution-

A delta $G_{mix} = 0$

B delta $H_{mix} = 0$

C both above

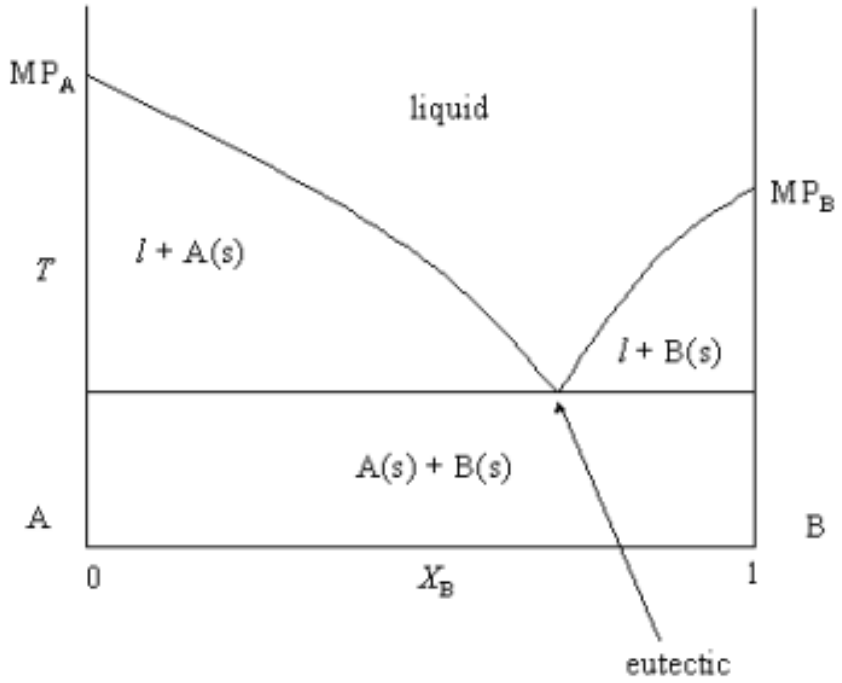
D none

Mark only one oval.

- A
- B
- C
- D

95. 1 point

Which of the following is true for the following phase diagram?



A complete liquid but zero solid solubility
B complete liquid and limited solid solubility
C A is completely soluble but not B
D B is completely soluble but not A

Mark only one oval.

- A
- B
- C
- D

96. 1 point

The melting point of the eutectic alloy is ------- than that of the components.

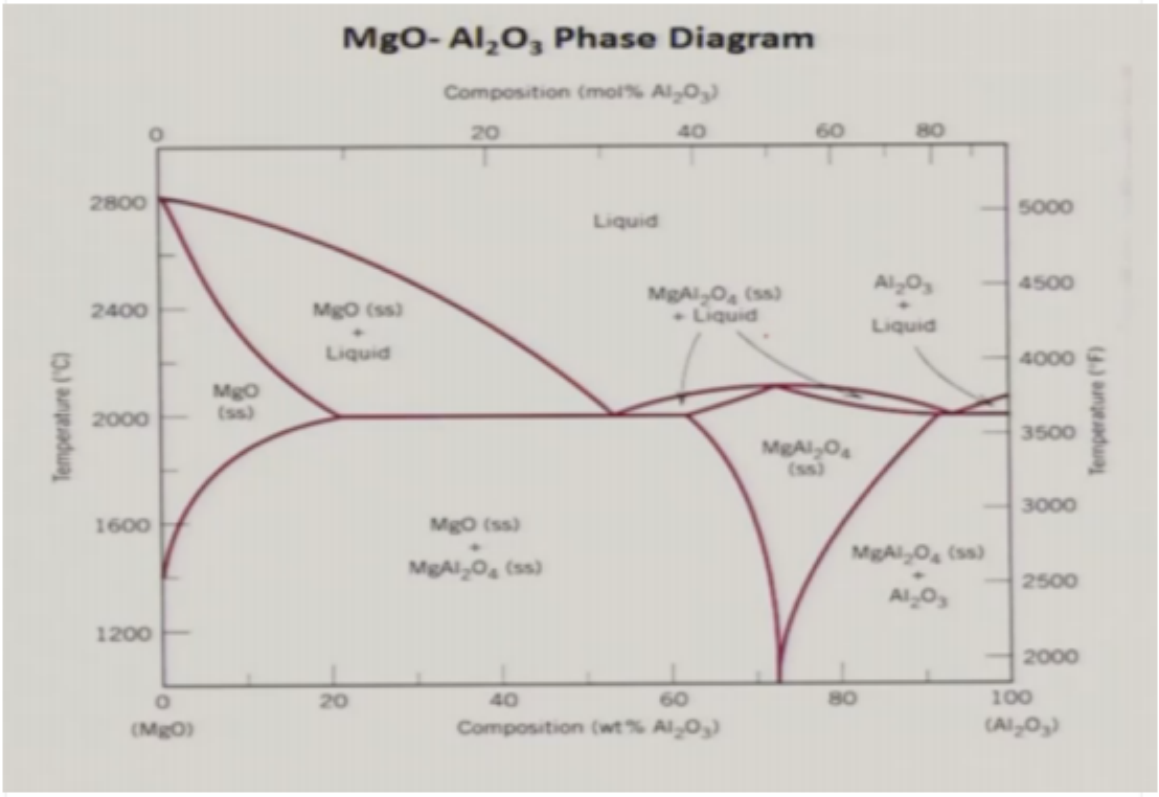
A higher
B lower
C same
D can't say

Mark only one oval.

A
B
C
D

97. 1 point

10) How many eutectic reactions exist in the following phase diagram?



A 1
B 2
C 3
D 4

Mark only one oval.

- A
- B
- C
- D

98. 1 point

With the increase in the degree of supercooling, the growth rate of a nucleus follows which one of the following trends?

(A) First increases and then decreases
(B) First decreases and then increases
(C) Only increases
(D) Only decreases

Mark only one oval.

- A
- B
- C
- D

99. Two Cu-Ni alloys, one with 47 wt.% Ni and the other with 53 wt.% Ni, are kept in separate crucibles and are allowed to equilibrate at the same temperature T1 between the liquidus and the solidus. The two alloys have 1 point

Mark only one oval.

- (A) the same weight fraction of the liquid but the liquid compositions are different.
- (B) the same composition of the liquid but the weight fractions of the liquid are different
- (C) the same weight fractions of the liquid and the solid
- (D) different compositions and weight fractions of the liquid.

100.

Pure orthorhombic sulfur transforms to stable monoclinic sulfur above 368.5 K. Applying Third law of thermodynamics, the value of entropy (in $J.K^{-1}$) of transformation at 368.5 K is

_____

Given:
i. Entropy change associated with heating orthorhombic sulfur from 0 K to 368.5 K is 36.86 J. K^{-1}.
ii. Entropy change associated with cooling monoclinic sulfur from 368.5 K to 0 K is –37.8 $J.K^{-1}$.

Mark only one oval.

◯ Option 1