

Materials Science and Engineering Department
MSE 200-002, Exam #3, Spring 2009

ID number _____

First letter of your last name: _____

Name: _____

No notes, books, or information stored in calculator memories may be used. Cheating will be punished severely. All of your work must be written on these pages and turned in. Mark your answer on this paper first, and then copy onto the answer sheet at the end of the test. **Use #2 pencil to mark the answer sheet.**

Fe-Fe₃C phase diagram is given on the last page of the exam.

Multiple choices (3 points each):

__B__ 1. A phase is defined as a matter with

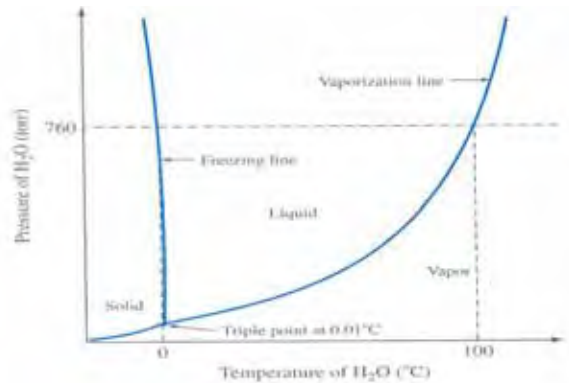
- A. distinct composition
- B. distinct structure
- C. distinct structure and composition
- D. all of above

__B__ 2. A solid phase is a solid with

- A. distinct composition
- B. distinct crystal structure
- C. distinct crystal structure and composition
- D. None of above

__C__ 3. See the phase diagram of water. On the liquid/vapor boundary line, the number of phase is

- A. 0
- B. 1
- C. 2
- D. 3



__B__ 4. Under atmospheric pressure, the Gibbs phase rule can be expressed as

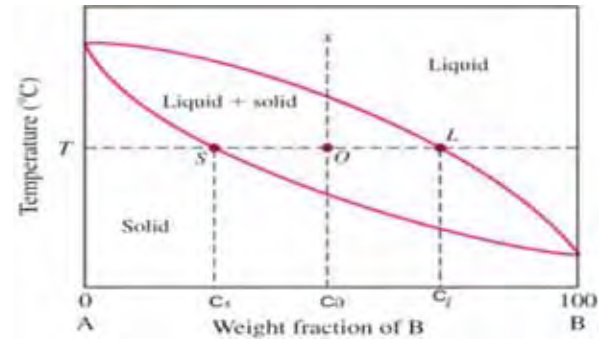
- A. $P+F = C+2$
- B. $P+F = C + 1$
- C. Neither of the above

__A__ 5. As water is cooled from room temperature, ice will start to form when the temperature reaches 0°C, during the transformation of water to ice, the temperature will

- A. remains at 0°C
- B. continue to decrease
- C. start to rise
- D. none of the above

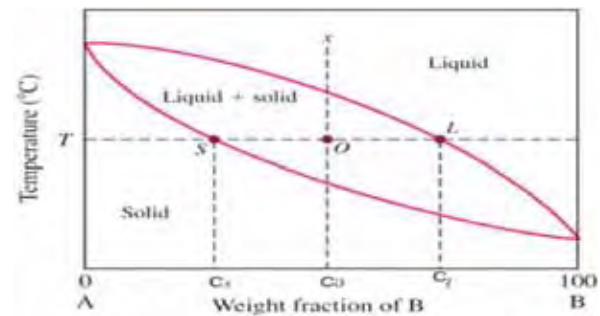
__A__ 6. As shown in the binary phase diagram, an alloy with a composition $C_0 = 48\%$ is cooled down from liquid to form solid. At the temperature T , $C_s = 26\%$, $C_L = 72\%$, the fraction of the liquid phase is

- A. 48%
- B. 52%
- C. 50%



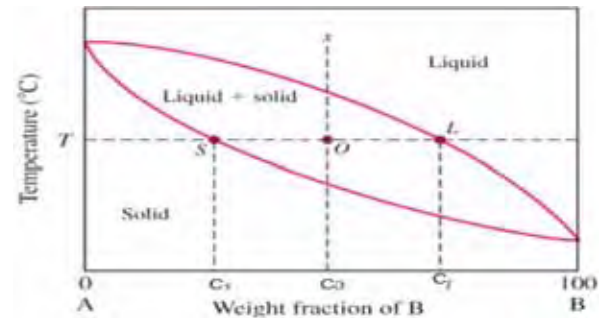
__A__ 7. As shown in the binary phase diagram, 8 kg of an alloy with a composition $C_0 = 48\%$ is cooled down from liquid to form solid. At the temperature T , $C_s = 26\%$, $C_L = 72\%$, the weight of the liquid phase is

- A. 3.83 kg
- B. 4.17 kg
- C. 4 kg



__B__ 8. As shown in the binary phase diagram, 8 kg of an alloy with a composition $C_0 = 48\%$ is cooled down from liquid to form solid. At the temperature T , $C_s = 26\%$, $C_L = 72\%$, the weight of the solid phase is

- A. 3.83 kg
- B. 4.17 kg
- C. 4 kg



__A__ 9.  represents

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction

__B__ 10.  represents

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction

__A__ 11. An eutectic reaction can be expressed as

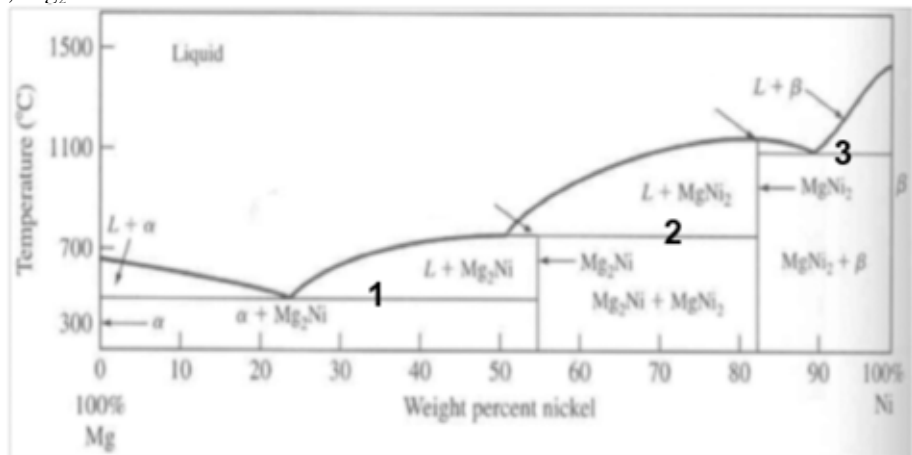
- A. $L \rightarrow \alpha + \beta$
- B. $\alpha \rightarrow \beta + \gamma$
- C. $L + \alpha \rightarrow \beta$
- D. $\alpha + \beta \rightarrow \gamma$

__B__ 12. An eutectoid reaction can be expressed as

- A. $L \rightarrow \alpha + \beta$
- B. $\alpha \rightarrow \beta + \gamma$
- C. $L + \alpha \rightarrow \beta$
- D. $\alpha + \beta \rightarrow \gamma$

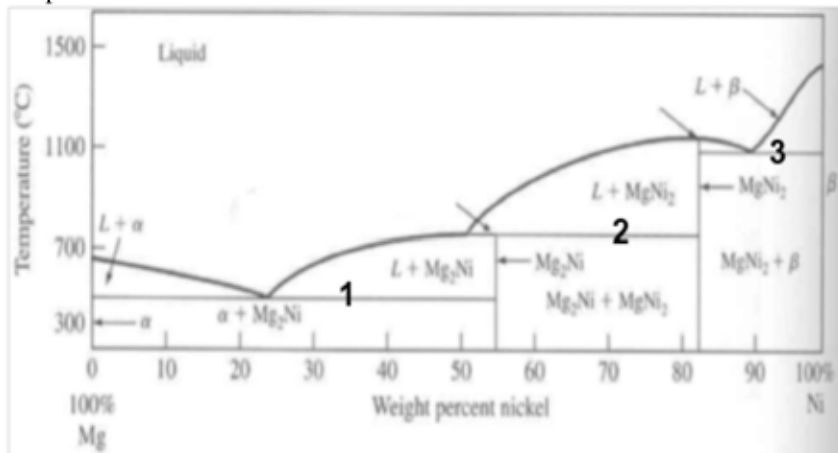
__D__ 13. In the phase diagram below, Mg_2Ni is

- A. congruently melting compound
- B. incongruently melting compound
- C. Stoichiometric compound
- D. Both B and C



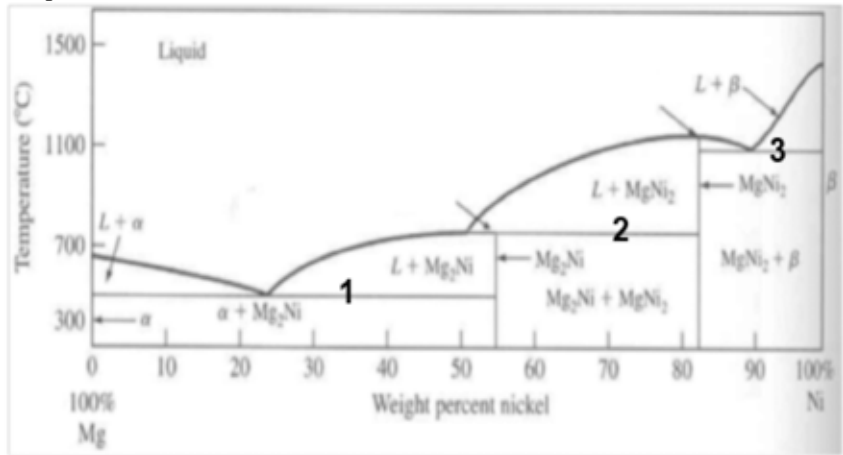
__A__ 14. In the phase diagram below, the three phase transition marked as 1 is

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction



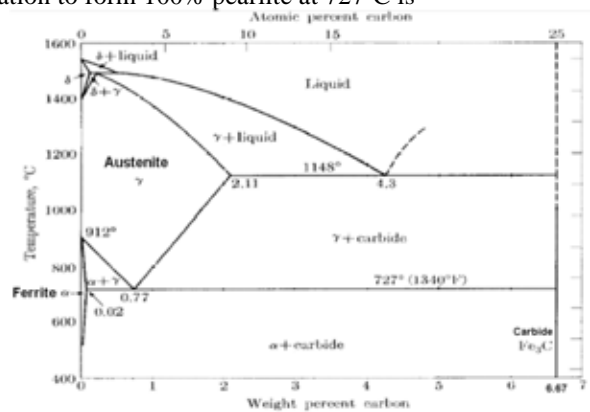
__A__ 15. In the phase diagram below, the three phase transition marked as 3 is

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction

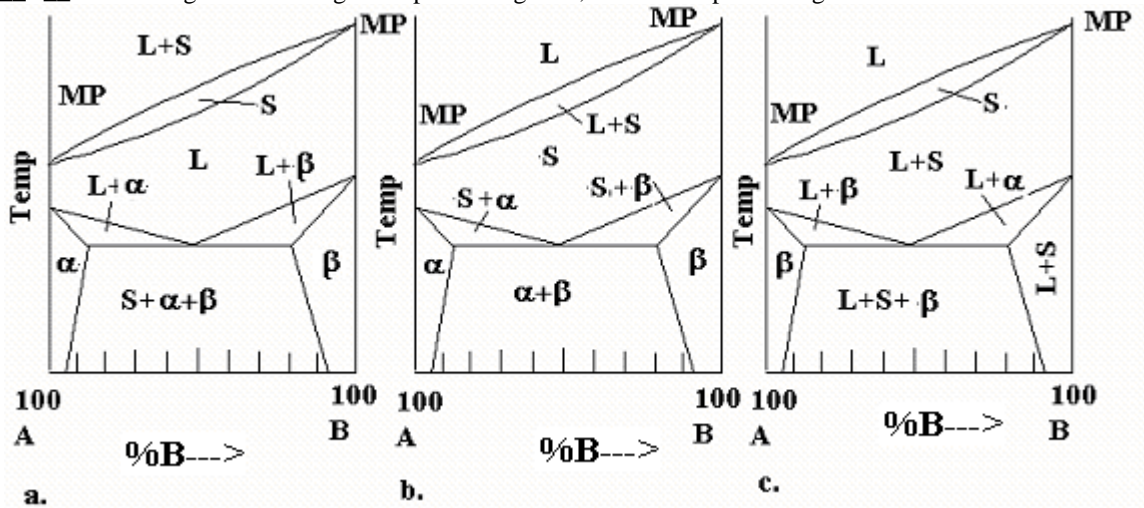


__B__ 16. In the Fe-Fe₃C phase diagram below, the phase transformation to form 100% pearlite at 727°C is

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction



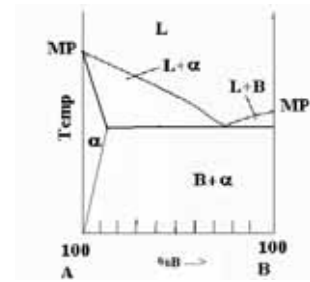
__B__ 17. Among the following three phase diagrams, the correct phase diagram is



- A. a;
- B. b;
- C. c;
- D. none of the above

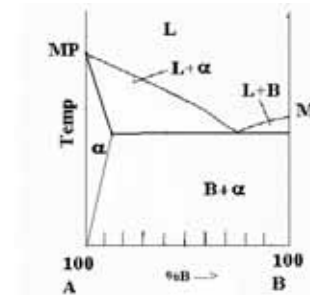
__A__ 18. In the phase diagram below, the three phase transition is

- A. an eutectic three phase reaction
- B. an eutectoid three phase reaction
- C. a peritectic three phase reaction
- D. a peritectoid three phase reaction



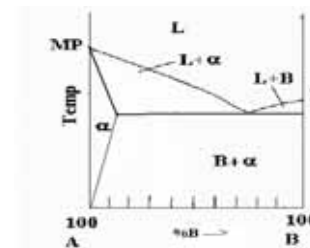
__A__ 19. In the phase diagram below, at the three-phase transition the freedom is

- A. 0
- B. 1
- C. 2
- D. 3



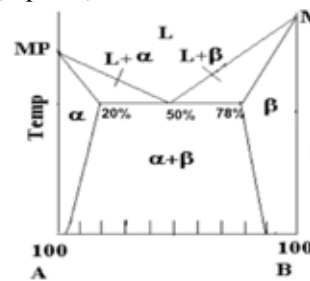
__C__ 20. In the phase diagram below, the number of component is

- A. 0
- B. 1
- C. 2
- D. 3



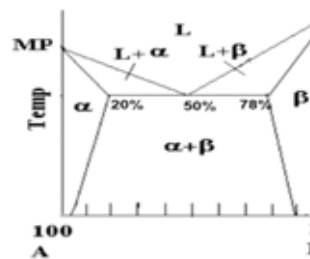
__A__ 21. In the phase diagram below, the maximum solid solubility of B in A (α phase) is

- A. 20%
- B. 80%
- C. 50%
- D. 78%



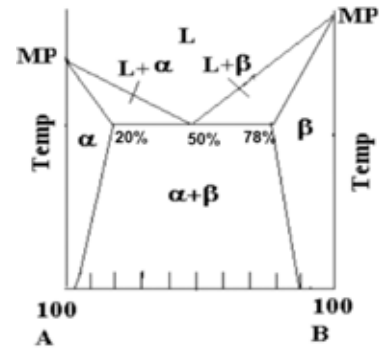
__A__ 22. In the phase diagram below, an alloy with 30%B is cooled from liquid, calculate weight fraction of α phase at just above the eutectic temperature

- A. 2/3
- B. 1/3
- C. 1/2
- D. 2/5



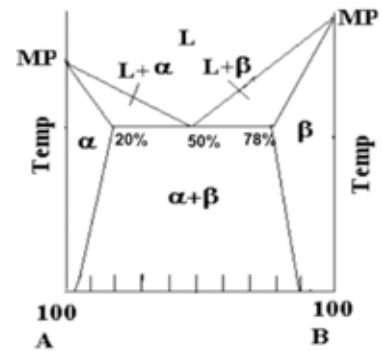
C 23. In the phase diagram below, an alloy with 30%B is cooled from liquid, calculate weight fraction of α phase at slightly below the eutectic temperature

- A. 17%
- B. 26%
- C. 83%
- D. 64%



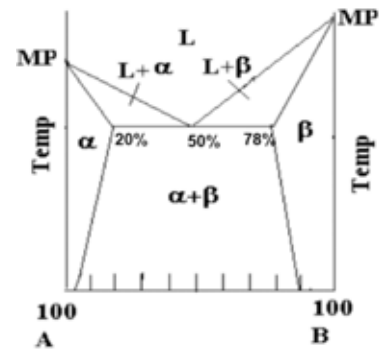
D 24. In the phase diagram below, an alloy with 50%B is cooled from liquid, calculate weight fraction of α phase at slightly above the eutectic temperature

- A. 38%
- B. 48%
- C. 26%
- D. 0%



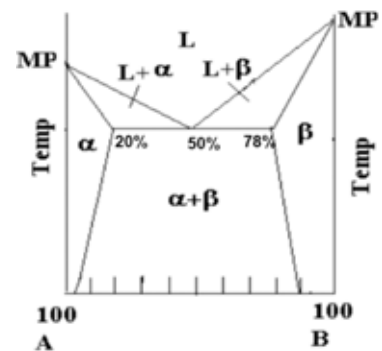
C 25. In the phase diagram below, an alloy with 40%B is cooled from liquid, calculate weight fraction of α phase in the eutectic structure at slightly below the eutectic temperature

- A. 38%
- B. 48%
- C. 32%
- D. 0%



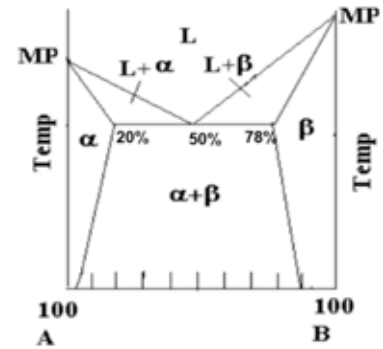
B 26. In the phase diagram below, an alloy with 40%B is cooled from liquid, calculate weight fraction of β phase in the eutectic structure at slightly below the eutectic temperature

- A. 38%
- B. 34%
- C. 32%
- D. 0%



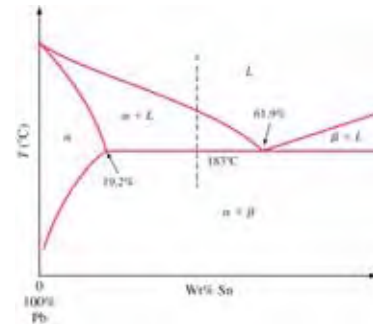
C 27. In the phase diagram below, 5 kg of an alloy with 40%B is cooled from liquid, calculate weight of α phase in the eutectic structure at slightly below the eutectic temperature

- A. 1.9kg
- B. 2.4 kg
- C. 1.6 kg
- D. 0kg



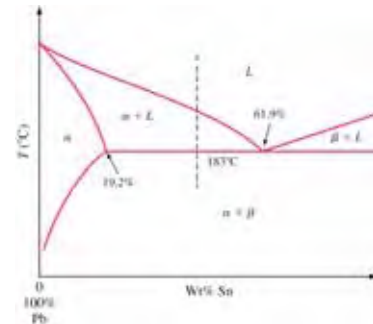
A 28. In the Pb-Sn phase diagram below, an alloy contains 64 wt% proeutectic α and 36 wt% of eutectic $\alpha+\beta$ at 180°C $-\Delta T$, find the average composition of this alloy

- A. 34.6% Sn
- B. 65.4 % Sn
- C. 64 % Sn
- D. 27.3% Sn



A 29. In the Pb-Sn phase diagram below, an alloy contains 60 wt% proeutectic α and 40 wt% of eutectic $\alpha+\beta$ at 180°C $-\Delta T$, find the average composition of this alloy

- A. 36.3% Sn
- B. 65.4 % Sn
- C. 64 % Sn
- D. 27.3% Sn



A 30. In a eutectic reaction, on cooling

- A. a liquid reacts to form two solid phases
- B. a solid phase reacts to form two different solid phases
- C. two solid phases react to form a liquid
- D. a solid phase reacts to form a liquid and a different solid phase

B 31. In a eutectoid reaction, on cooling

- A. liquid reacts to form two solid phases
- B. a solid phase reacts to form two different solid phases
- C. two solid phases react to form a liquid
- D. a solid phase reacts to form a liquid and a different solid phase

C 32. In a peritectoid reaction, on cooling

- A. liquid reacts to form two solid phases
- B. a solid phase reacts to form two different solid phases

- C. two solid phases react to form a solid phase
- D. a solid phase reacts to form a liquid and a different solid phase

__C__ 33. In a peritectic reaction, *on cooling*

- A. liquid reacts to form two solid phases
- B. a solid phase reacts to form two different solid phases
- C. a solid phase and a liquid react to form a solid
- D. a solid phase reacts to form a liquid and a different solid phase

__B__ 34. In the Fe-Fe₃C phase diagram, the eutectoid point to form pearlite is

- A. 0.02% C
- B. 0.77% C
- C. 2.11% C
- D. 4.3% C

__A__ 35. In the Fe-Fe₃C phase diagram, the maximum solubility of the carbon in ferrite is

- A. 0.02% C
- B. 0.77% C
- C. 2.11% C
- D. 4.3% C

__C__ 36. In the Fe-Fe₃C phase diagram, the maximum solubility of the carbon in austenite is

- A. 0.02% C
- B. 0.77% C
- C. 2.11% C
- D. 4.3% C

__B__ 37. See the Fe-Fe₃C phase diagram (the carbide composition is 6.67%). A steel with 1 wt% C is first heated to form austenite, and then cooled down slowly, calculate the weight fraction of pearlite

- A. 3.9%
- B. 96.1%
- C. 14.7%
- D. 85.3%

__C__ 38. See the Fe-Fe₃C phase diagram (the carbide composition is 6.67%). A steel with 1 wt% C is first heated to form austenite, and then cooled down slowly, calculate the weight fraction of ferrite at the temperature slightly below 727°C

- A. 3.9%
- B. 96.1%
- C. 85.3%
- D. 14.7%

__A__ 39. See the Fe-Fe₃C phase diagram. At a temperature slightly higher than 727°C a steel with 1 wt% C consists of

- A. austenite + carbide
- B. ferrite + carbide
- C. austenite + ferrite

D. none of the above

__C__ 40. See the Fe-Fe₃C phase diagram. At a temperature slightly higher than 727°C a steel with 0.4 wt% C consists of

- A. austenite + carbide
- B. ferrite +carbide
- C. austenite + ferrite
- D. none of the above

__B__ 41. See the Fe-Fe₃C phase diagram. At a temperature slightly lower than 727°C a steel with 0.4 wt% C consists of

- A. austenite + carbide
- B. ferrite +carbide
- C. austenite + ferrite
- D. none of the above

__A__ 42. See the Fe-Fe₃C phase diagram. Cast iron has a composition of

- A. 4.3 wt% C
- b. 0.77 wt% C
- c. 2.11 wt% C

__C__ 43. The crystal structure of Martensite is

- A. fcc
- B. bcc
- C. bct
- D. hcp

__B__ 44. The crystal structure of Ferrite is

- A. fcc
- B. bcc
- C. bct
- D. hcp

__A__ 45. The martensitic transformation is

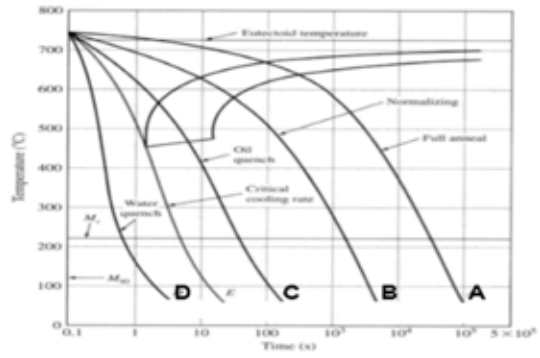
- A. diffusionless
- B. diffusion controlled
- C. none of the above

__A__ 46. The TTT diagram is for

- A. for isothermal phase transformation
- B. diffusion controlled transformation
- C. both A and B
- D. none of the above

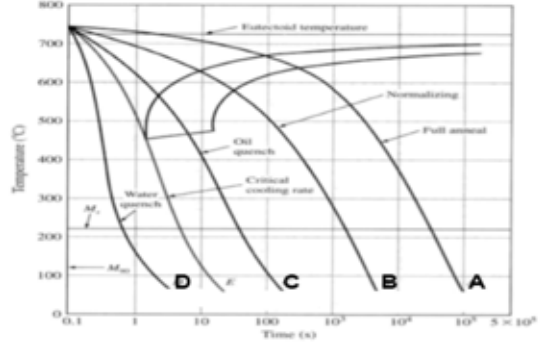
__B__ 47. The CCT diagram below, cooling curve A will result in

- A. martensite
- B. coarse pearlite
- C. fine pearlite
- D. martensite + pearlite



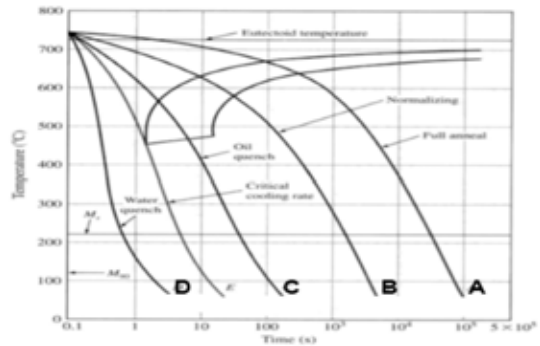
__C__ 48. The CCT diagram below, cooling curve B will result in

- A. martensite
- B. coarse pearlite
- C. fine pearlite
- D. martensite + pearlite



__D__ 49. The CCT diagram below, cooling curve C will result in

- A. martensite
- B. coarse pearlite
- C. fine pearlite
- D. martensite + pearlite



__C__ 50. Solution treatment is

- A. to dissolve an alloy into a liquid solution
- B. to put an alloy part into a heating solution
- C. to heat an alloy to a temperature and hold at the temperature to form a solid solution
- D. none of the above

