Materials Science and Engineering Department
MSE 200, Exam #3

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 (2.5 points each):

1. A phase is defined as a matter with
   A. distinct composition
   B. distinct structure
   C. distinct structure and composition
   D. all of above

2. See the phase diagram of water. On the liquid/solid boundary line, the freedom is
   A. 1
   B. 2
   C. 3
   D. 0

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

4. 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
5. 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 solid phase is

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

6. A peritectoid reaction can be expressed as

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

7. In the phase diagram on the right, 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

8. In the phase diagram on the right, the three phase transition marked as 2 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
9. In the phase diagram on the right, at the three-phase transition the freedom is

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

10. In the phase diagram on the right, the number of component is

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

11. In the phase diagram on the right, the eutectic point is

A. 20%
B. 80%
C. 50%

12. In the phase diagram on the right, 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

13. In the phase diagram on the right, 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%
14. In the phase diagram on the right, an alloy with 40%B is cooled from liquid, calculate weight fraction of α phase in the eutectic structure with respect to the total alloy weight at slightly below the eutectic temperature

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

15. An alloy has a composition of 40%B. The microstructure after slow cooling from liquid to room temperature can be described by

A). Fig. (a)  B). Fig. (b)  C). Fig. (c)

16. In the Pb-Sn phase diagram on the right, an alloy contains 64 wt% proeutectic α and 36 wt% of eutectic α+β at 180°C –ΔT, find the average composition of this alloy

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

17. 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

18. 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

19. See the Al-Ni phase diagram. In area (B) the phases that are present:

20. See the Al-Ni phase diagram. The reaction that occurs at 854°C is
(A) Eutectic  (B) peritectic  (C) peritectoid

21. In the Al-Ni phase diagram, the horizontal line marked as 1 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

22. In the Al-Ni phase diagram, the horizontal line marked as 2 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

23. In the Al-Ni phase diagram, the horizontal line marked as 4 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

24. In the Al-Ni phase diagram, the horizontal line marked as 5 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

25. In the Al-Ni phase diagram, the Al₃Ni is
A. congruently melting stoichiometric compound
B. incongruently melting stoichiometric compound
C. intermediate non-stoichiometric phase
D. intermediate stoichiometric phase

26. In the Al-Ni phase diagram, the Al₃Ni₂ is
A. congruently melting stoichiometric compound
B. incongruently melting stoichiometric compound
C. intermediate non-stoichiometric phase
D. intermediate stoichiometric phase

27. In the Fe-Fe₃C phase diagram, the eutectic point is
A. 0.02% C  B. 0.77% C  C. 2.11% C  D. 4.3% C

28. 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
29. See the Fe-Fe₃C phase diagram (the carbide composition is 6.67%). A steel with 0.4 wt% C is first heated to form austenite, and then cooled down slowly, calculate the weight fraction of pearlite

A. 50.7%
B. 49.3%
C. 40.2%
D. 67.1%

30. 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 carbide at the temperature slightly below 727°C

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

31. 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

32. 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

33. 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

34. The crystal structure of Martensite is

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

35. The transformation of austenite to pearlite is

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

36. The transformation of austenite to ferrite is
A. diffusionless  
B. diffusion controlled  
C. none of the above  

37. The CCT diagram below, cooling curve C will result in  
A. martensite  
B. coarse pearlite  
C. fine pearlite  
D. martensite + pearlite

38. The crystal structure of austenite is  
A. fcc  
B. bcc  
C. bct  
D. hcp  

39. The limitations of plain carbon steel include  
A. low strength  
B. limited hardenability  
C. formation of perlite  
D. both A and B  

40. In an aged Al-4% Cu alloy, the GP2 zone is  
A. Segregation of Cu atoms  
B. Coherent precipitates  
C. Non-coherent precipitates  
D. None of the above

Answers:  