THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 5
FINAL EXAMINATION – 2008/09

MEX 5272 – MATERIALS & MANUFACTURING TECHNOLOGY
DATE : 08TH APRIL 2009
TIME : 0930-1230 HRS
DURATION : 3 HOURS

049

ANSWER (05) QUESTIONS ONLY.

1. (a) What is the difference between Hardness and Hardenability?

(b) A cylindrical component of diameter 75 mm will be made with alloy steel. The candidate materials are 8660, 8640, 8630 and 8620 alloys. The component will be Austenized and quenched in moderately agitated water or oil and the surface and centre hardnesses must be at least 50 and 40 HRC respectively.

(i) What is the carbon content in each of these 4 alloys?

(ii) Determine the hardeness values of these alloys at the surface and centre, if they were quenched in moderately agitated water. Comment on the alloys that satisfy the requirements. (Show your calculations).

(iii) Determine the hardness of these alloys at the surface and centre, if they were quenched in moderately agitated oil. Comment on which of the alloys satisfy the requirement. (Show your calculations)

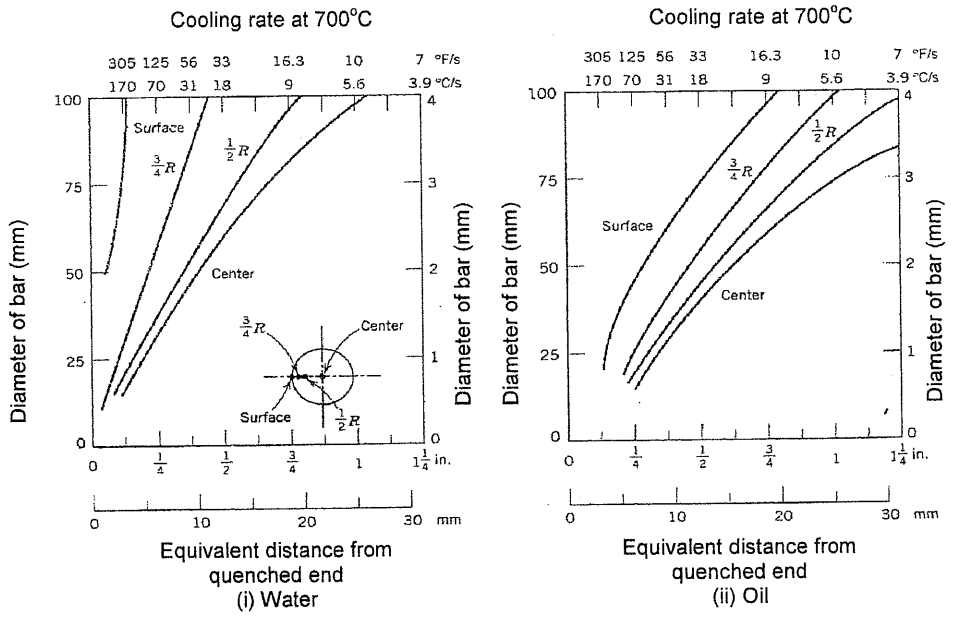


Fig.1(a) – Cooling rate as a function of diameter at surface, three-quarter radius (3/4R), mid radius (1/2R) and center positions for cylindrical bars quenched in moderately agitated (i) water and (ii) oil. Equivalent jominy positions are included in bottom axis.

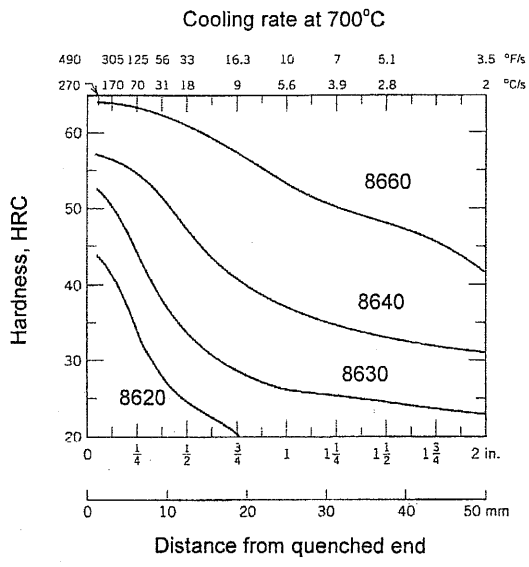


Fig.1(b) –Hardenability curves for four 8600 series alloys

2. (a) Label the phases present in each region in the given Iron-Carbon phase diagram (Phase diagram is attached herewith).

   (b) Identify and describe all invariant reactions found in the diagram.

   (c) Using lever rule, calculate the amount of phases present just above the eutectoid temperature for steel containing 0.15 wt% carbon.

3. (a) What is cast iron?

   Compare and contrast gray cast iron and nodular cast iron.

   (b) List and briefly describe the heat treatments that are used to increase the strength of materials.

   (c) What are the various effects on alloying elements in steel?

4. (a) What is meant by 'solid-state' welding? List out, the advantages of solid state welding over other welding processes.

   (b) Explain the similarities and differences between non-consumable and consumable electrode type arc welding processes.

   (c) Explain the process of diffusion welding. State its applications and limitations.

5. (a) What are the major types of errors that occur in engineering measurements. Briefly describe with appropriate examples the sources and the method of rectifying the above discussed errors.

   (b) Define the terms, "Accuracy" and "Precision" used in metrology.

   (c) Explain with the aid of neat sketches the following numerical assessment methods of measuring surface texture.

   (i) Center Line Average (CLA)

   (ii) Ten point height of irregularities

6. (a) Distinguish between hot working and cold working metal forming processes giving at least 3 examples for each process.

(b) What is strain hardening? Explain the importance of strain hardening in manufacturing. How are the effects of stain hardening eliminated?

(c) Crushing and spring-back are two undesirable effects encountered during bending process. Explain these two effects and indicate how these could be minimized.

7. (a) Discuss taking suitable examples, the classification of metal cutting processes. Also, state the basis on which the above classification is made.

(b) What are the important angles of a single pointed cutting tool in the context of metal cutting operations? Describe the effect of above angles on the metal cutting process.

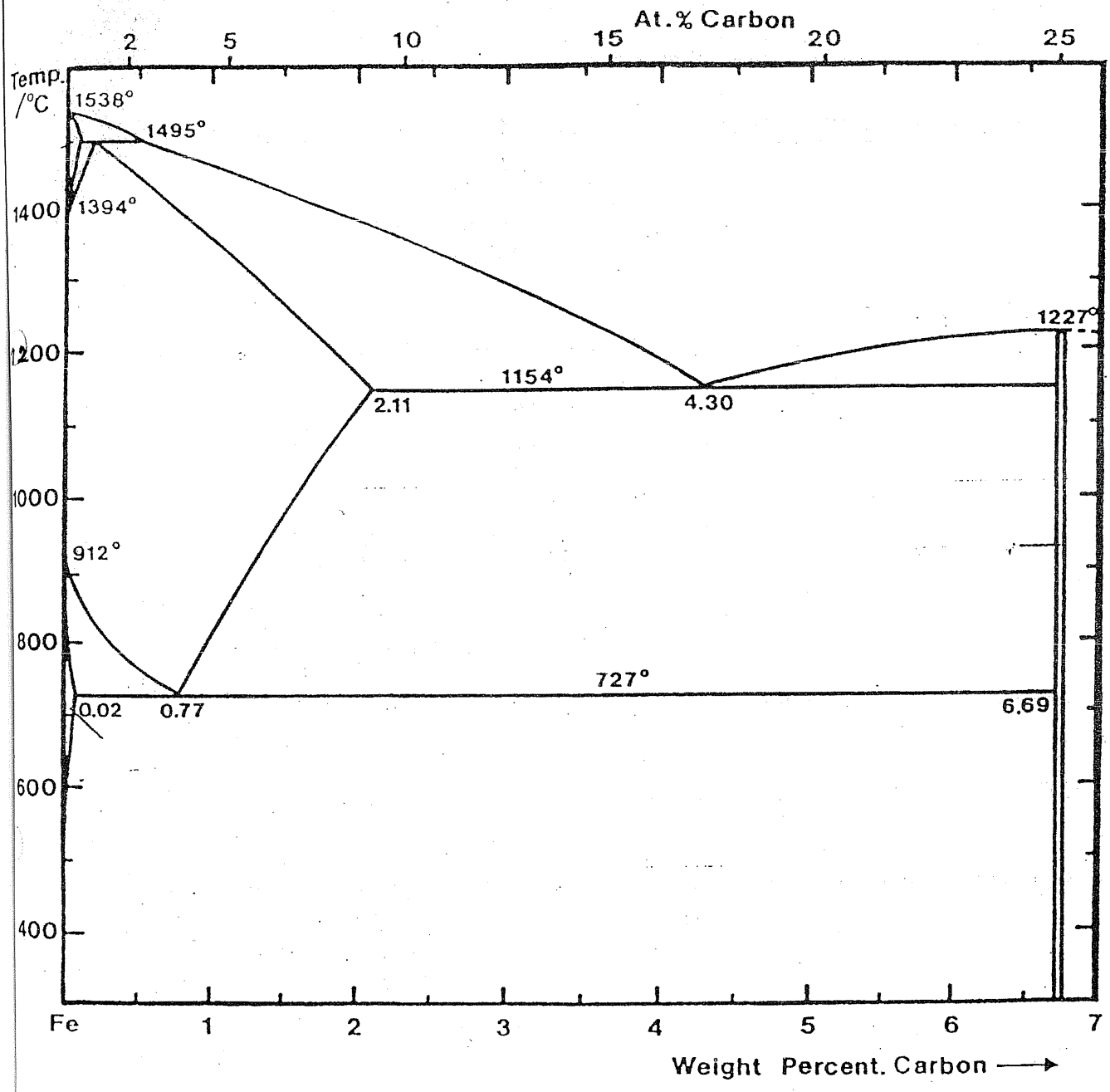
(c) Various types of chips are formed during metal cutting processes. What are the types of chips formed? Explain why knowledge of chip formation is important in tool design.

8. (a) List out the basic steps in a casting process.

(b) Define shrinkage and porosity. How do you distinguish cavities in a casting are due to porosity or to shrinkage?

(c) List out the common defects in metal casting. What are the effects of these defects on the finished product?

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Iron Carbon Phase diagram