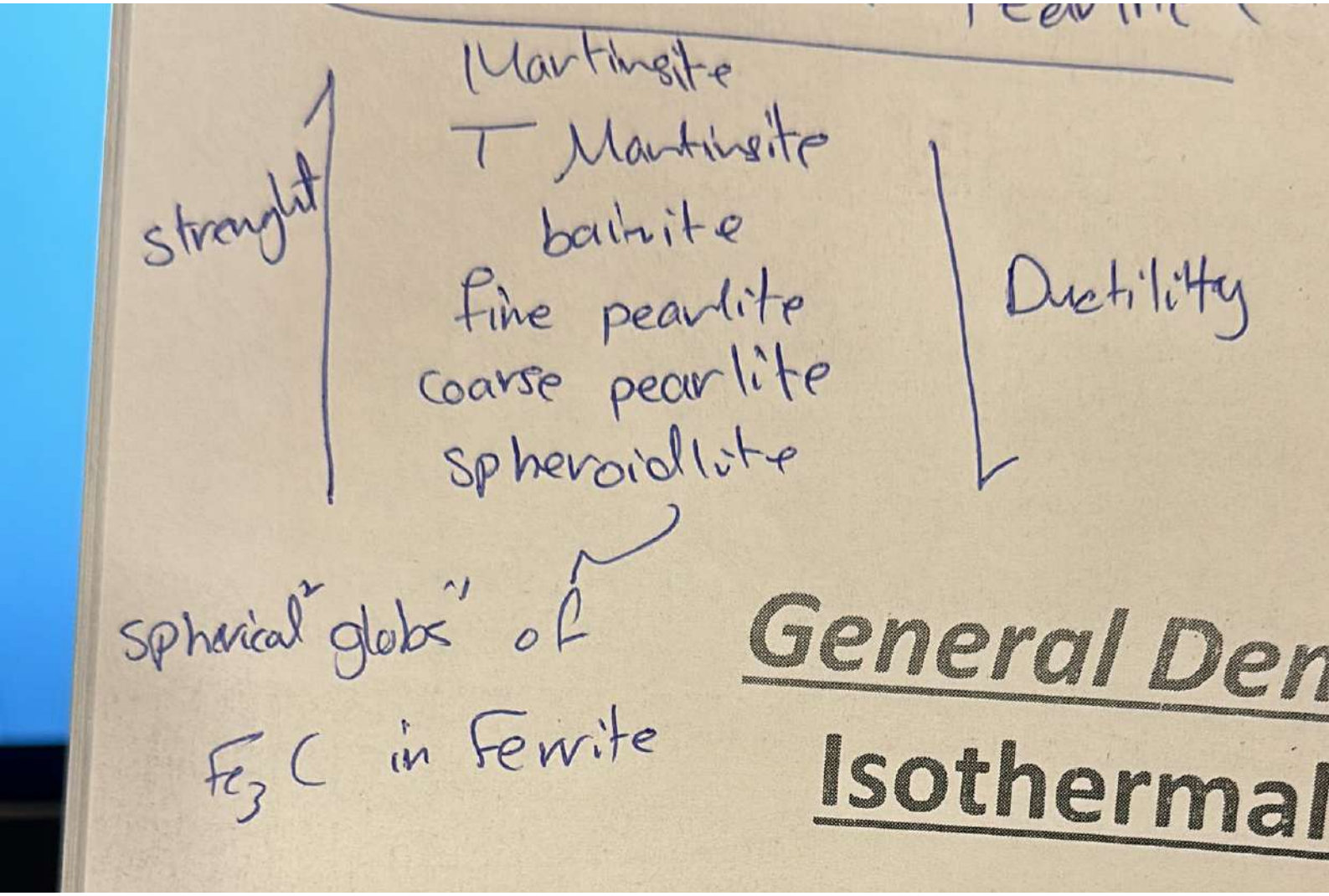
rtb

Q3: Sort the following microstructures from Highest to lowest ductility:
Martensite, Bainite, Tempered martensite, spherodite, fine pearlite, Coarse pearlite.

6 4 5 1 3 2


Martinsite
T Martinsite
bainite
fine pearlite
coarse pearlite
spheroidlite
straight
Ductility
spherical globs of
Fe3C in Ferrite
General Den
Isothermal

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Read aloud

2 of 27

6 4 5 1 3 2

Q4: Can Plain low carbon steel be hardened and Why?

Q5: For each line of the 4 lines on the T-T-T plot (Figure 2 below), What are the micro-structures that form and their percentages?

curve 1: 100% perlite

curve 2: 100% martensite

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Read aloud

1 of 27

6. Secondary bonds have a directional properties **(T)**

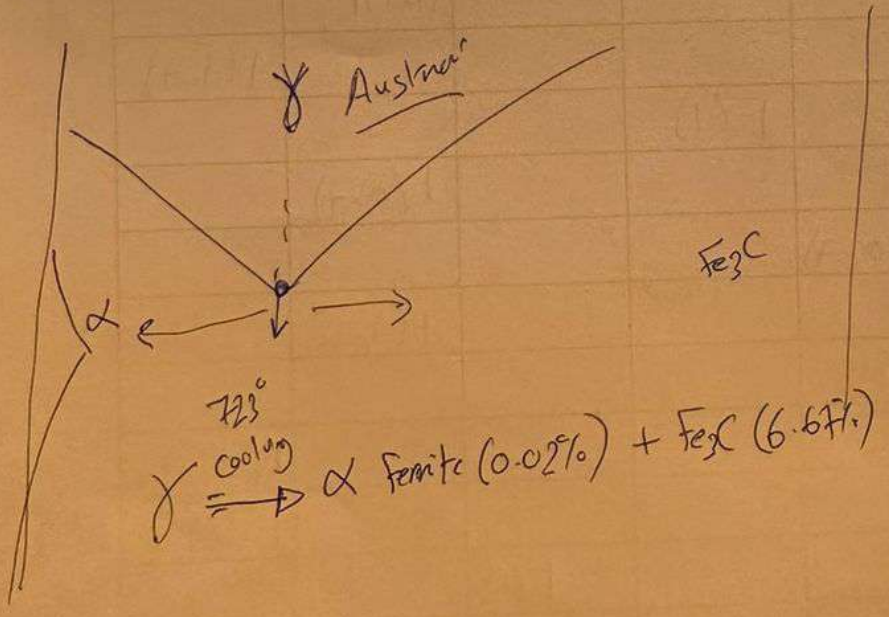
7. Maximum solubility of carbon in austenite 0.2% at Temperature 1128. **(F)**

Q2: Explain the mechanism of the formation of pearlite from austenite for the eutectoid alloy. Illustrate with a sketch.

m3adltha

rasmeh

2



1

Q6: Referring to figure below, fill in the following blanks:

The microstructure of 1 consist of:

100 martensite

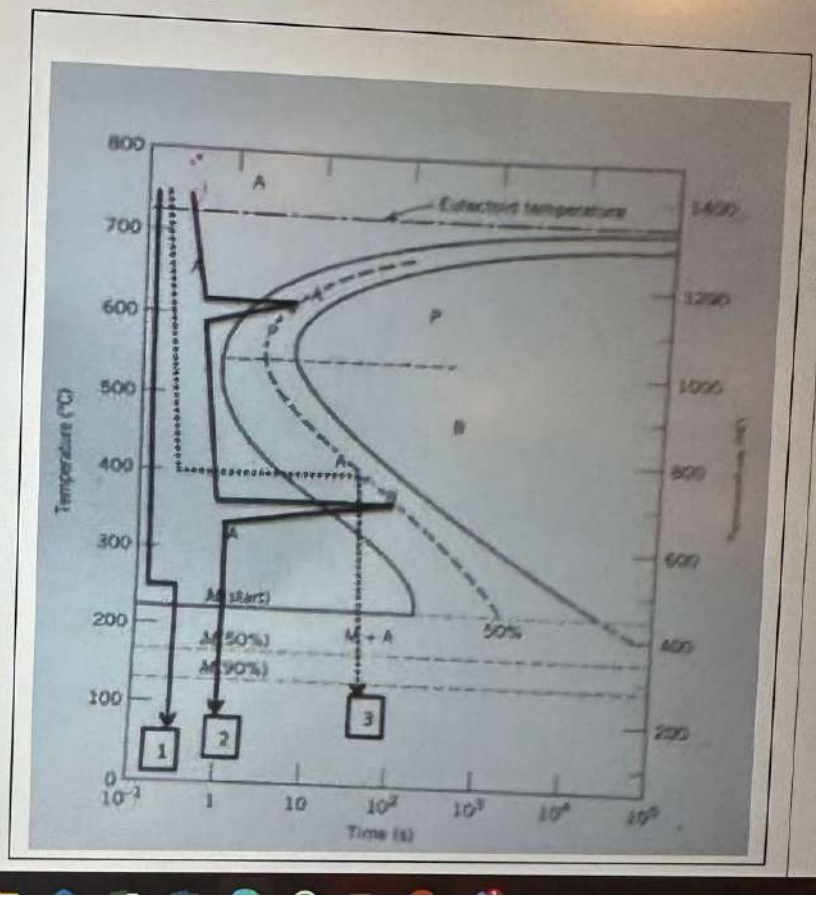
The microstructure of 2 consist of:

50 martensite 25 perlite 25 bainite

The microstructure of 3 consist of:

50 bainite 50 martensite

The microstructure of 4 consist of:



Q1: State whether the following statements are true or false: (6 marks)

1. *Ionic bending energy is variable but non directional* (F)
2. *Covalent bending energy is the smallest but directional* (T)
3. *Atomic packing factor for BCC and HCP crystal structures are the same* (T)
4. *Magnetic and none-magnetic iron have the same crystal structure* (T)
5. *Delta ferrite has a negligible solubility limit* (Fake)
6. *The addition of Mn lowers the eutectoid temperature of plain carbon alloy* (F)

Q2. Fill in the blanks in the following table: (12 marks)

Heat treatment Process or sub process	Purpose
1. Full Annealing	
2. Tempering	
3. Hardening	
4. Process annealing	
5. Normalizing	
6. I-T diagrams	

Low carbon steel typically has less than 0.25 percent carbon content1. Due to its low carbon content, it cannot be hardened by heat treatment (to form Martensitic) 12. However, it can be hardened by case hardening 2. Is there anything else you would like to know?

8:02 PM

Isothermal Transformation (I-T) Diagrams:

It is the heat treatment process that uses the Temperature – Time - Transformation (TTT) curves. (*I-T diagrams are also called the Bain S-Curve or T-T-T (time-temperature-transformation) diagrams*)

TTT Curve: ***It is a graphical representation of the cooling of the specimen that relates the microstructure to temperature and time.***

Purpose: ***this process assumes that the temperature of the piece is held constant for a period of time before cooling.***

Q3: The figure2 below shows a continuous cooling (CCT) curve of X- steel alloy. The microstructure of this alloy after cooling by following: *(18 marks)*

a) Curve No.1 will be.....100% martensite.....

b) Curve No.2 will be.....bainite + martensite.....

c) Curve No.3 will be.....bainite.....

d) Curve No.4 will be.....pearlite + b + m.....

e) Curve No.5 will be.....pearlite + bainite.....

f) Curve No.6 will be.....spherodite.....

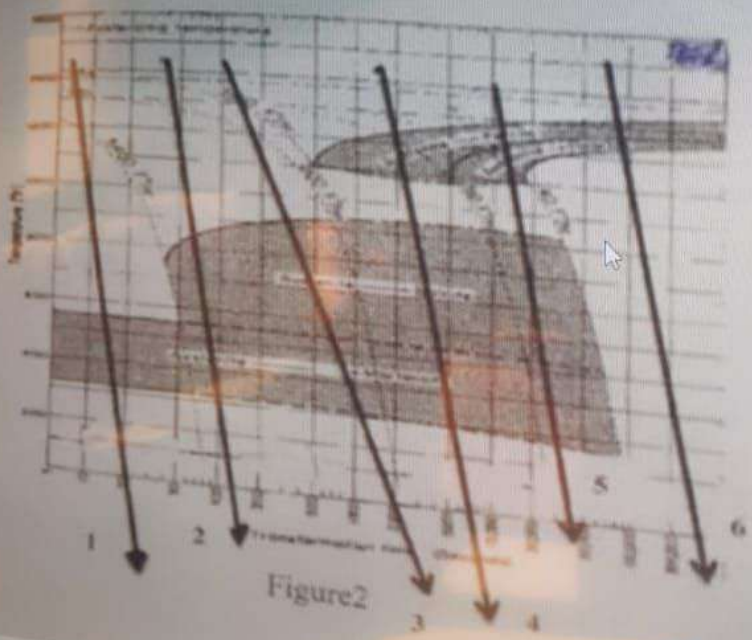


Figure2

1. What are the benifits of having classification standards of materials?

1) necessery to ease communication between companies and dealers
2) necessary to ease communication among scientist and researchers.
3) necessary to grap the materials and alloys that have same behaviour.
4) nesessory for material selection for ceration applications
5) necessary not to repeat the reductive of experiment everytime to explore the properities

what are the main phases in iron-iron carbon diagram?

① alpha Ferrite ② gamma austenite ③ cementite Fe_3C ④ delta Ferrite

Nickel is never added to high carbon steel. why?

because it will slow the transformation to other phases and allow more martensite to form

explain why Ferritic and austenitic steels are not heat treatable:

austenite to martensite transformation is not possible since austenite doesnot form upon heating and it's phase field extend to low temp.

low carbon concentration → Ferrite: annaling
austenite: cold working

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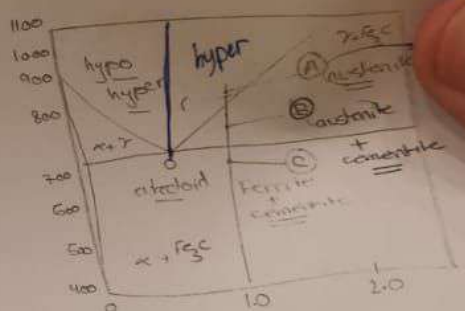
steel having more than 0.8% (wt%c) of carbon is cooled from higher temperature to below 725°C
hyper eutectoid is formed.
alloy
it is the phase mixture of BCC and cementite
for the formation of hyper eutectoid wt%c remains in the range of 0.8% to 2.1%

strength: C > B > A

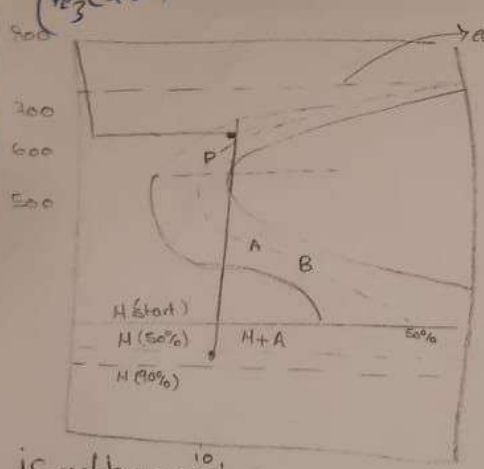
hardness: A > B > C



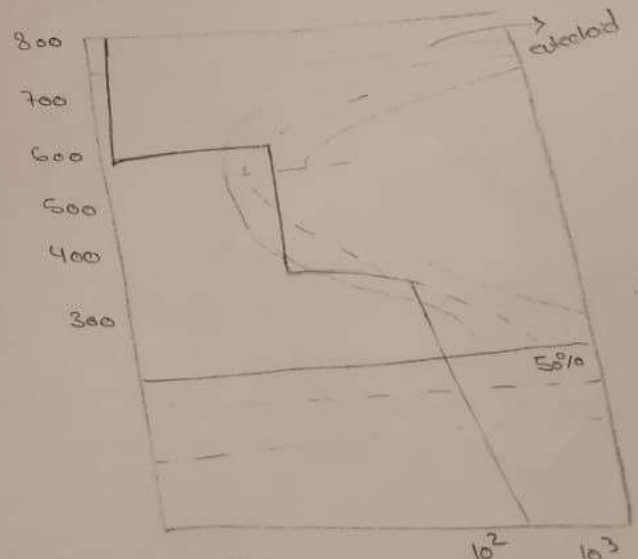
(B) austinite + cementite at B: $\frac{6.67-C_1}{6.67-0.8}$, $\frac{C_1-0.8}{6.67-0.8}$

(C) Pearlite + cementite at C: $\frac{6.67-C_1}{6.67-0.02}$, $\frac{C_1-0.02}{6.67-0.02}$

($Fe_3C+\alpha$)

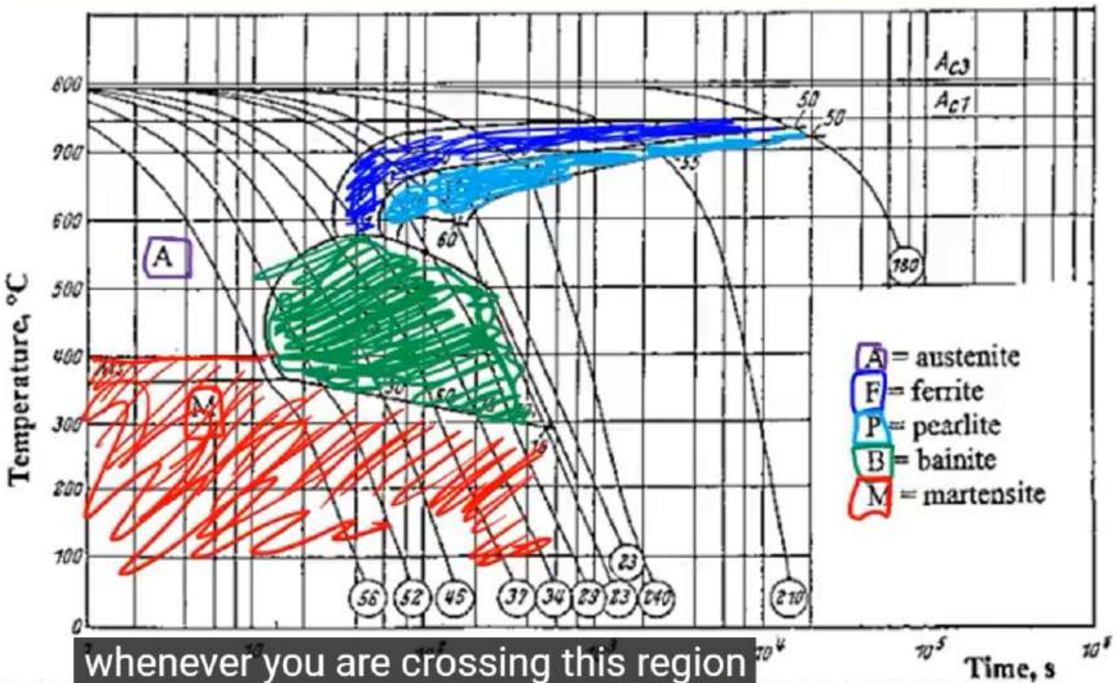


isothermal curve
50% pearlite 50% martensite



Pearlite, Bainite and martensite

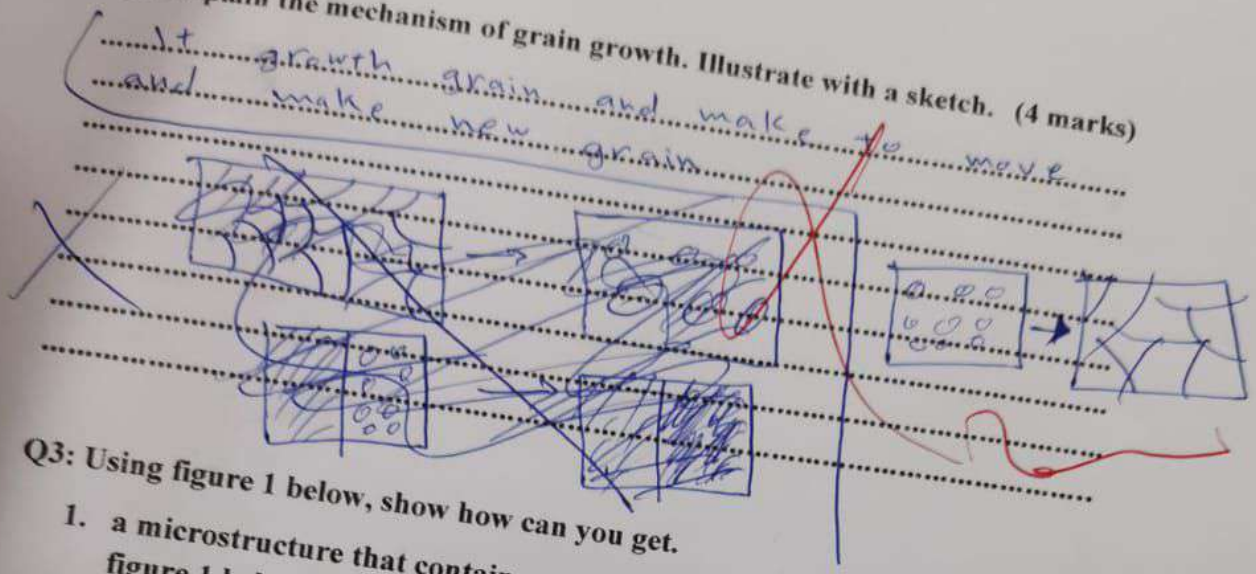
Continuous cooling transformation (CCT) diagram determined by measurements for the DIN 34 Cr 4 steel, austenitized at 850°C for 8 min.



whenever you are crossing this region
you will have martensite okay

Computer simulation of steel quenching process using a multi-phase transformation model (PDF Download Available). Available from: https://www. ... _steel_quenching_process_using_a_multi-phase_transformation_model [accessed Mar 5, 2017]

Q2: Explain the mechanism of grain growth. Illustrate with a sketch. (4 marks)



Q3: Using figure 1 below, show how can you get.

1. **a microstructure that contains martensite, pearlite, and Bainite using figure 1 below?**
2. **Spherodite microstructure**
3. **Pearlite and bainite**

(6 marks)

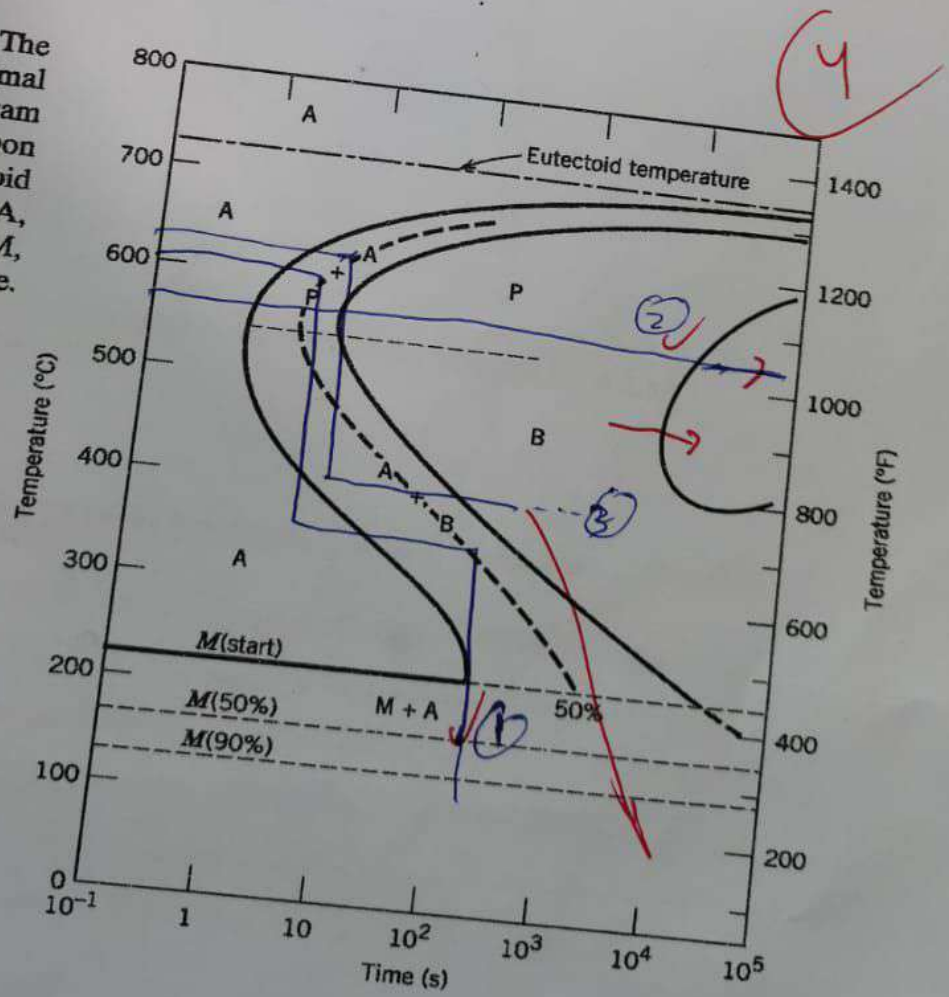


Figure 1 The complete isothermal transformation diagram for an iron–carbon alloy of eutectoid composition: A, austenite; B, bainite; M, martensite; P, pearlite.

Q1: Choose the right answer for the following: **(10 marks)**

1. **The addition of Nickel, Chromium and Molybdenum will:**

a- allow more martensite to form.

b- b-not allow more martensite to form

c-not affect the formation of martensite

d-increase the transformation to other phases

2. **Bainite is formed as a result of:**

a-rapid cooling b-slow cooling

c-moderate cooling d-processing parameters

3. **If the carbon content in plain carbon steel:**

a- Increases, the Ms temperature decreases

b- Increases, the Ms temperature increases

c-Increases, the Ms temperature remains the same

d- Increases, the Ms temperature sometimes decreases and sometimes increases

10

4. **Low carbon steel:**

a- can be hardened by choosing the right quenching medium

b-can be hardened but it takes more time in the quenching medium

c- can't be hardened at all

d-can't be machined if it is hardened

5. **We can get tempered martensite:**

a- if we rapid quench martensite b- if we reheat martensite by tempering

c-after slow cooling of martensite d-if we rapid quench bainite

Q4: The figure2 below shows the continuous cooliling transformation diagram. Label continuous cooloing curves to yield the following microstructures. P- pearlite, A-austinite, F- ferrite, M- martensite

(8 marks)

1. **Fine pearlite and proeutectoid ferrite**
2. **Martensite**
3. **Martensite, Fine pearlite and proeutectoid ferrite**
4. **Martensite and proeutectoid ferrite**

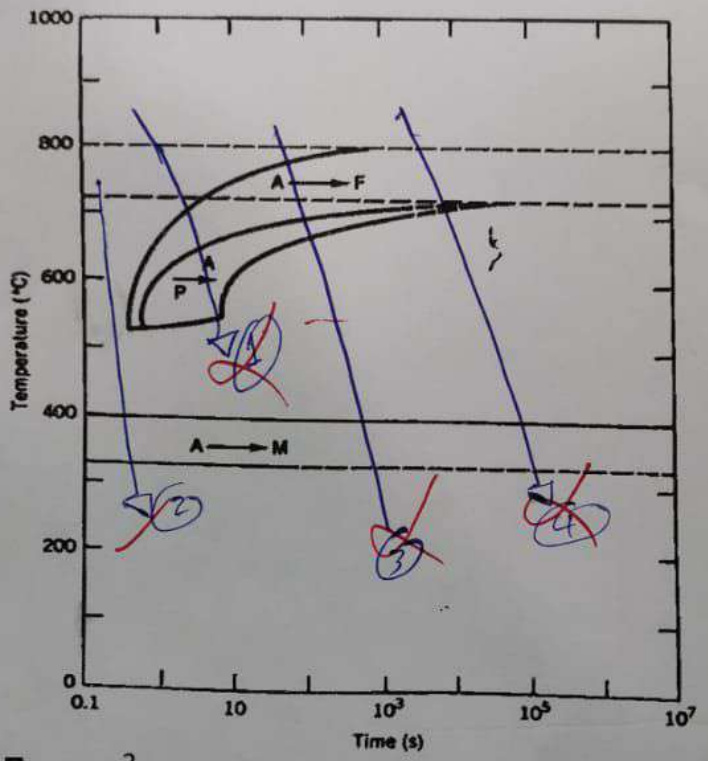


Figure 2 Continuous cooling transformation diagram for a 0.35 wt% C iron–carbon alloy.

Q5: Are there any drawbacks to the hardening process? Name one (2 marks)

dis advan

it decreas ductipulity and increase strenghth of ~~metimal~~ material and increase in ~~wh~~ wlight and ~~toughg~~ ~~magnetic~~

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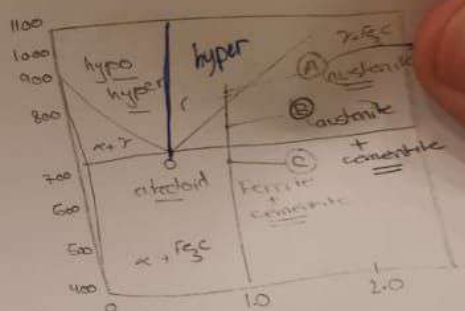

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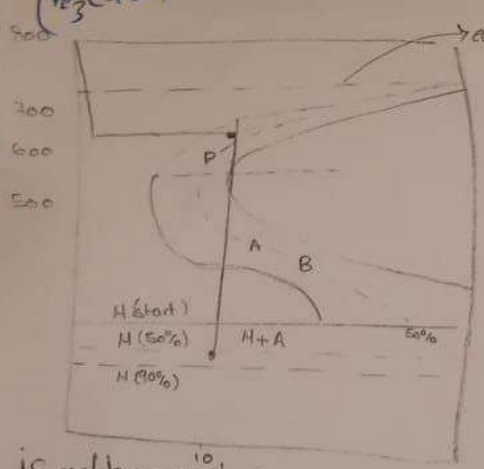

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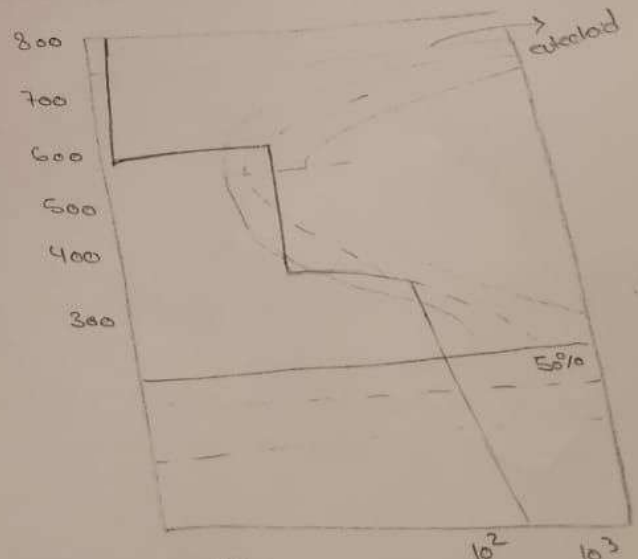

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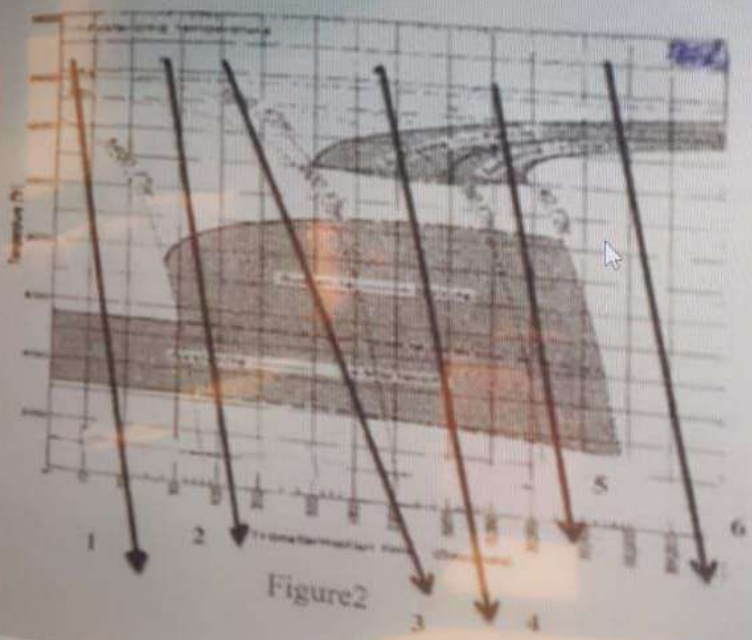

Figure2