

Master Examination

„Materials Science of Steel“

Part 2

“Steel Design”

3rd April 2014

Name:

Matrikelnummer:

Signature:

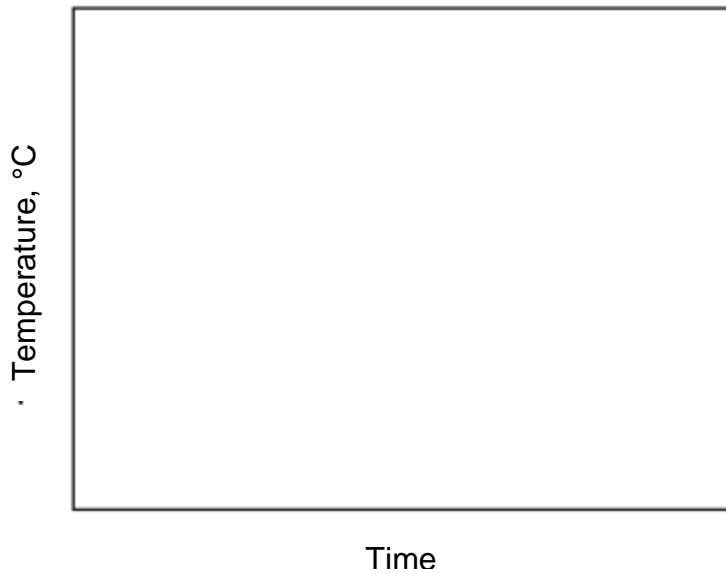
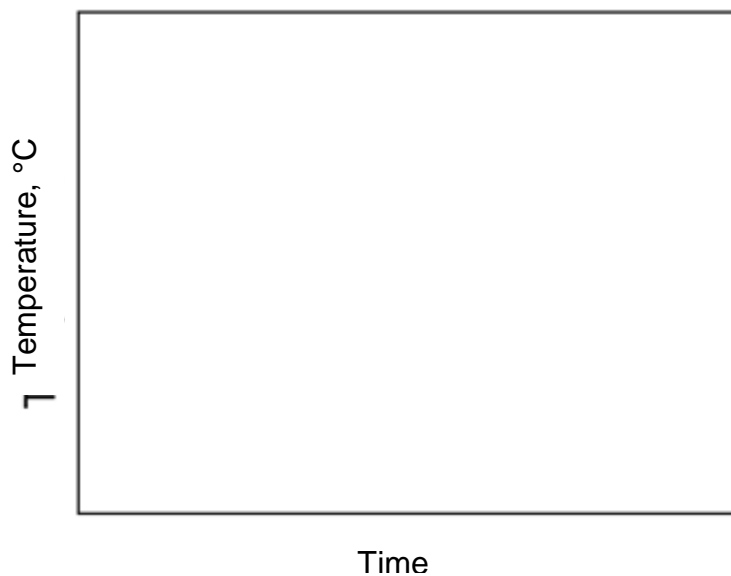
Question	Maximum available Points:	Points:	Review: (additional points)
1-19	70		
20	1.5		
21	4.0		
22	1.0		
23	2,5		
24	6.0		
25	1.5		
26	1.5		
27	1.5		
28	3.0		
29	3.0		
30	0.5		
31	2.0		
32	2.0		
Sum	100		

Task 20**AHSS - 1****1.5 Points**

Dual Phase steels show low ratio ($R_{p0.2}/R_m$) ratio and high initial strain hardening rate when strained in a tensile test. Explain this material behavior on the base of crystal lattice defects. (1,5P)

Task 21**AHSS - 2****4.0 Points**

Sketch schematically the hot rolled strip and the cold rolled strip production of a DP-steel using a TTT-diagram. What is the microstructure before cooling? (4P)

Hot rolled strip**cold rolled strip**

Task 22**AHSS - 3****1.0 Point**

In Dual Phase steels, there is usually 5 to 30 vol.-% martensite present in the microstructure. Explain the lower and the upper limit of the martensite content on the based on the mechanical properties. (1P)

Task 23**AHSS - 4****2.5 Point**

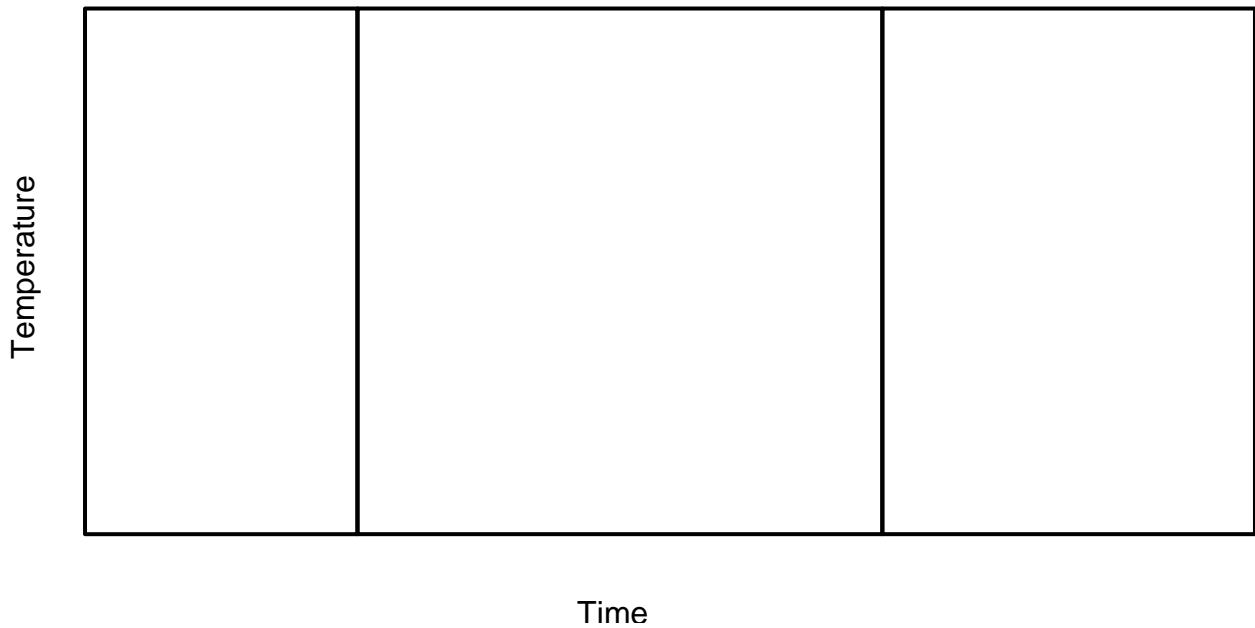
What is the difference between Advanced High Strength Steels and conventional high strength steels (1P)?

Draw schematically the strain hardening rate vs. the strain for a deep-drawing steel, a TRIP-steel and a TWIP-steel. (1,5P)

Task 24**tool steels****6.0 Point**

Sketch the typical time temperature cycle for air hardening steels and name the important regions. Indicate the approximate maximum temperature for these important regions.

What happens during the tempering of air hardening steels? (6.0 P)?



Task 25**HSS - 1****1.5 Point**

What is the characteristic feature of thermomechanical rolling of heavy plates? What is the main goal of thermomechanical rolling? Which alloying element is necessary here? (1,5P)

Task 26**OCTG****1.5 Point**

What is the most important aspect in improving the corrosion resistance to sour gas in high strength quenched and tempered steels for oil pipes from materials science point of view? (1,5P)

Task 27**boiler tubes****1.5 Points**

Which chemical element is mainly responsible for oxidation resistance of ferritic/martensitic steels for power plants? What is the average alloying content of this element in this kind of steels? How does this element provide a good oxidation protection? (1.5P)

Task 28**HSS****3.0 Points**

Why are high-strength water-quenched steels with martensitic microstructure and large sheet thickness alloyed with Chromium and Molybdenum and especially with Boron? What is the effect of these alloying elements on the transformation behavior? (2 P)

What is the approximate B content that is alloyed (3%, 0,3%, 0.03%, 0,003%)? (1P)

Task 29**EDDS****3.0 Point**

In cold rolled batch annealed steels the preferred “pancake” microstructure is obtained.

What is a pancake-microstructure? (1P)

Which process parameters lead to the formation of such microstructure? (2P)

Task 30

stainless steel

0.5 Point

What is the heat treatment condition of delivered duplex steels? (0.5P)

Task 31**rails steels -1****2.0 Point**

Talking about rails, there are two factors that determine the life time, according to the field of application. Name these two factors, explain what leads to their occurrence and give an example for the fields of application they are used. (2P)

Task 32

rail steels - 2

2.0 Point

What are the demands on rails? Name at least 4! (2P)