Mastercourse

Metallurgical Engineering

(Ferrous Process Metallurgy)

2008-03-17

Last name, first name: **Matrikel-Nr.:**

Signature:

Task	Points (max.)	Points	Signature	Approvaldate	Finalpoints (total)
1	5				
2	5				
3	5				
4	5				
5	5				
6	5				
7	5				
8	5				
9	5				
10	5				
Total:			**Total after approval:**		

Mastercourse

Metallurgical Engineering

Univ. Prof. Dr.-Ing. Dieter Senk **2008-03-17**

1. Task: Pelletizing und Sintering **5 points**

a) Please name

1. three targets
2. three methods and
3. two processes

of iron ore preparation.

4,0 points

b) Where do the respective processes of iron ore preparation from a) generally take place:

1. at the place of iron ore mining?
2. at the place of iron ore use?

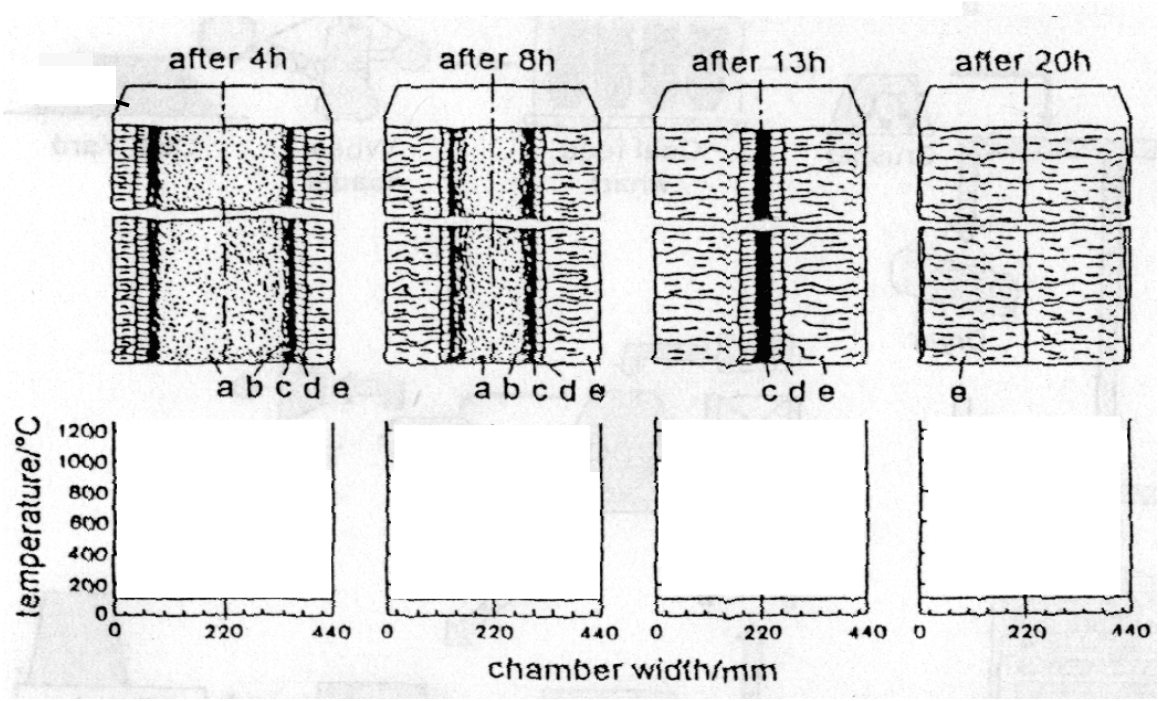
1,0 points

2. Task: Metallurgical Coke 5 points

a) The following picture shows a cross sectional view of a coke oven at different times during the coking process.

Explain the reactions in the zones a, b, c, d, e and sketch the temperature profiles for the different times into the lower picture.

4,5 points



b) Which element beside carbon is mainly by coke charged into the blast furnace?

0,5 points

3. Task: Blast Furnace 5 points

a) Give the reduction reactions of hematite to metallic iron in the blast furnace.

3,0 points

b) Where is the “cohesive zone” in the blast furnace and what happens in the “cohesive zone”?

1,0 Points

c) What are the so-called coke-windows in the blast furnace, which task do they fulfil?

1,0 points

4. Task: Thermodynamics 5 points

a) Calculate the equilibrium constant at 750°C for the reaction:

$$(NiO) + \{H_2\} = [Ni] + \{H_2O\}$$

Given:

1. $[Ni] + ½\{O_2\} = (NiO)$ $\Delta G^o = -244555 + 98{,}53*T$ [J/mole]
2. $\{H_2\} + ½ \{O_2\} = \{H_2O\}$ $\Delta G^o = -246438 + 54{,}81*T$ [J/mole]

R = 8,3143 kJ/kmole*K

5,0 points

5. Task: Converter 5 points

a) Due to several reasons addition of lime during the BOF process is necessary. Name two of these reasons!

1,0 points

b) Hot metal of the following composition

Element	C	Si	Mn	P	O_2
Mass.-% in HM	4,45	0,50	0,50	0,04	---
Mole mass [g/mole]	12	28	55	31	32

is refined.

1. How much SiO_2 [kg] is generated per ton of hot metal, if 0,49 mass-% [Si] are oxidised? (2,5 points)

2. How much lime [kg] is needed per ton of hot metal, if a slag basicity of B=3,8 is required? (1,0 points)

3. Why is a high content of (FeO) in the slag necessary for effective dephosphorisation? (0,5 points)

4,0 points

6. Task: Direct and Smelting Reduction 5 points

a) Explain the direct reduction process concerning:

5,0 points

1. the input materials (at least 2 answers)

2. the reduction of the input materials

3. the reducing agents (at least 2 answers)

4. the generation of the reducing gases

5. the temperature region

6. the products (at least 2 answers)

7. the production volumes

7. Task: Electric Steelmaking 5 points

a) Sketch a flow chart of the input and output materials of the electric arc furnace process!

3,5 points

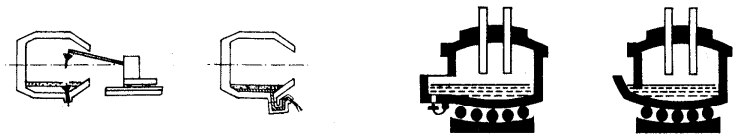
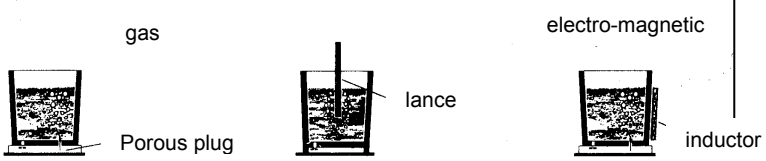
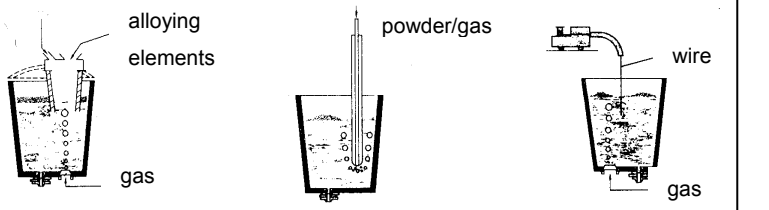
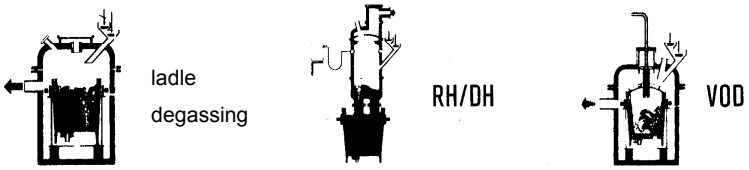
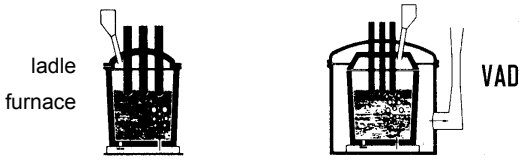
b) 100 tons of scrap are melted in an electric arc furnace with 120 MW electric power. The energetic efficiency of the melting process amounts 70 %. How much time is needed to melt 100 tons of scrap, assuming an energy consumption of 375 kWh per ton of scrap.

1,5 points

8. Task: Secondary Metallurgy: 5 points

a) Write the illustrated basic operations of secondary metallurgy in the tabular below.

2,5 points

b) Sketch the RH-process schematically and name the different parts in your sketch

2,5 points

9. Task: Continuous Casting 5 points

a) Explain the term “solidification” and the solidification events nucleation, heat transfer, volume contraction and micro segregation.

5,0 points

10. Task: Protection of Environment, Recycling 5 points

a) Name 3 different sorts of scrap and give a short definition for each of them.

3,0 points

b) Name 4 potentials for the reduction of the specific energy consumption in steel making.

2,0 points