5. Please **select a material** for a **forging die**! The forging die is used to forge the main shaft of an internal combustion engine, with dimensions of 800 × 500 × 300 mm. The die is subject to high dynamic mechanical and thermal stresses and is produced in small series. 5.1 What is the **function of a forging die**? (2 points) 5.2 What are the **main loads**? (2 points) 5.3 Which **material group** do you select and why? (2 points) 5.4 Which **specific material grade(s)** do you recommend? (2 points) 5.5 Please sketch the **temperature (T) - time (t) diagram** of the proposed heat treatment. (5 points) 5.6 Please outline the **manufacturing process** of the part. (2 points) **Choice of materials:** C45U, C70U, C80U, C90U, C105U, C120U, 105V, 50WCrV8, 60WCrV8, 102Cr6, 21MnCr5, 70MnMoCr8, 90MnCrV8, 95MnWCr5, X100CrMoV5, X153CrMoV12, X210CM2, X210CrW12, 35CrMo7, 40CrMnNiMo8-6-4, 45NiCrMo16, X40Cr14, X38CrMo16-9; 55NiCrMoV7, 32CrMoV12-28, X37CrMoV5-1, X38CrMoV5-3, X40CrMoV5-1, 50CrMoV13-15, X30WCrV9-3, X35CWMoV5, 38CrCoWV18-17-17;HS10-4-1, HS18-0-1, HS3-3-2, HS6-5-3-8, HS10-4-3-10.		**Name:**	**Neptun code:**
		1. General questions. Answer the following questions in a couple of sentences each.	
		1.1 Please write down the reaction equation for the **indirect reaction** in a blast furnace. (4 points)	
		1.2 What are the **conditions** for quenching? (4 points)	
		1.3 Please interpret the material designation **S 235 JR W**. (4 points)	
		1.4 Please list **four groups of alloyed structural steels**. (4 points)	
		1.5 Please describe the types of **heat-treatable structural steels** (main alloys, expected properties, applications) (4 points)	
		1.6 Please describe **ferritic stainless steels** (main alloys, expected properties, applications) (4 points)	
		1.7 Please interpret the **EN GJL 250** material designation! (4 points)	
		1.8 Please interpret the material designation **Al1050**! (4 points)	
		1.9 Please briefly describe the **sprue's task in sand casting**! (4 points)	
		1. 10 Please list the main steps of **powder metallurgy**! (4 points)	
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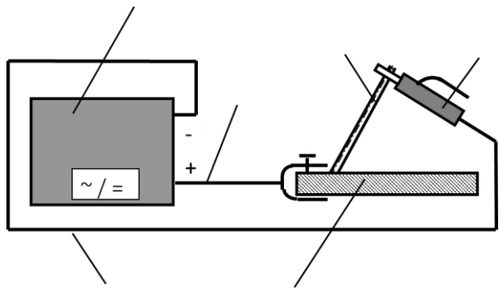
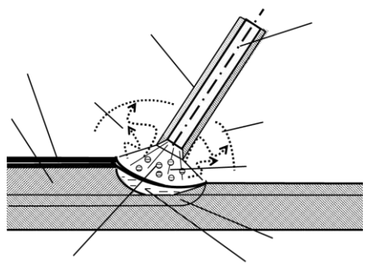
2. Technology. Describe the technology of **shearing/punching** with a sketch, naming the elements of the process.
2.1 **Sketch**, elements of the procedure (9 points)

2.2 On the sketch above, also mark the **clearance**! Please explain in detail why it is a problem if the clearance size differs from the optimum! (3 points)

2.3 What is the difference between **punching and blanking**? (3 points)

3. Welding. Manual metal arc welding.
3.1 In the sketch below, name the **elements of the manual metal arc welding process and the parts of the weld**.





3.2 Please list the **types of coatings** you know and their main properties.

4. Please **select a material** for a **cylindrical, straight-tooth gear**! The gear has an outer diameter of 80 mm, a width of 80 mm, and an inner bore diameter of 40 mm. The gear is subject to medium dynamic stresses, and the surface hardness is min. 50 HRc, produced in large series.
4.1 What are **gears**? (2 points)

4.2 What are the **main loads**? (2 points)

4.3 Which **material group** do you select and why? (2 points)

4.4 Which **specific material grade(s)** do you recommend? (2 points)

4.5 Please sketch the **temperature (T) - time (t) diagram** of the proposed heat treatment. (5 points)

4.6. Please outline the **manufacturing process** of the part. (2 points)

Choice of materials: C25, C35, C60, 28Mn6, 38Cr2, 41Cr4, 41CrMo4, 50CrMo4, 34CrNiMo6, 36NiCrMo16, 51CrV4; 24CrMo13-4, 31CrMo12, 41CrAlMo7-10, 40CrMoV13-9; C10E, C15E, 17Cr3, 10NiCr5-4, 20MnCr5, 17NiCrMo6-4; X10CrNi18-8, X2CrNi19-11, X5CrNi18-10, X8CrNiS18-9; X2CrNi12, X6Cr13, X6Cr17, X2CrTi17; X30Cr13, X29CrS13, X39Cr13, X46Cr13; C120U, 105V, 50WCrV8, 60WCrV8, 102Cr6; 55NiCrMoV7, 32CrMoV12-28, X37CrMoV5-1; HS10-4-1, HS18-0-1, HS3-3-2; EN-GJL-200, EN-GJL-250, EN-GJL-300; EN-GJS-450-10U, EN-GJS-500-7U, EN-GJS-600-3U; EN-GJMW-450-7U, EN-GJMB-350-10U, EN-GJMP-450-6U.

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