Examination TA 3330 on 16.01.03.

- 1. Bales of aluminium sheet will be transported by truck to a refiner plant. The bulk density of the baled sheets is 1800 kg/m³. The trucks used can carry 13 m³/trip. The transportation cost is 55 €/truck*hour. The average speed of the truck is 70 km/h. Due to profitability analysis the total payment for transportation shall under no circumstances exceed 50 €/t of baled sheet. What is the maximum distance from where the refiner plant can purchase such material?
- 2. A new foundry plant was built to manufacture gearboxes. The output should be 650 000 pieces/year. The total investment for this new foundry sums up to 72 mio. €. The proportional cost of this plant is 65 €/gearbox. The fixed production cost (excluding depreciation) is 7 mio. €/year. Depreciation is assumed linear over 12 years. What is the break-even sales price of a gearbox to cover all given cost?
- 3. The above mentioned foundry plant is producing gearboxes from an aluminium alloy with a density of 2750 kg/m³. The average wall thickness is 9 mm. Several holes have to be drilled into the gearboxes generating swarf. The average length of this swarf is 18 cm, its thickness is in average 1.2 mm. The swarf is oxidised on its surface and covered by an oxide layer of 95 μm. The density of that oxide layer is 2800 kg/m³. What is the average metal content of the oxidised swarf?
 - The swarf is now melted in a crucible of an induction furnace (no dust development) together with 20 % of dry salt. During melting 0.75 % of the metal content is burned off and form oxide. All oxide together with the salt is skimmed and entraps 30 % of liquid metal. What is the metal recovery of this melt?
- 4. In an aluminium refiner plant an alloying furnace of rectangular box-type-shape holds 10 m³ of a liquid aluminium alloy with a density of 2480 kg/m³. The bath depth of the liquid metal is 95 cm. The retention time of metal is in average 8 ½ hours. Dross generation during the 8 ½ hours is 3.2 wt. % of metal. The formed dross contains oxide and by capillarity forces 71 % metal. The density of oxide is 2.95 t/m³ What is the thickness of the dross layer neglect porosity on top of the metal bath after 8 ½ hours? What is the oxidation rate in (g oxidised metal/m²*min.) and in (mg oxide/m²*sec.)?
- 5. In the USA 460 aluminium beverage cans are used per inhabitant and year. If this specific consumption would be applicable to the 371 mio. inhabitants of the EU what number of beverage cans would have to be manufactured/year? An aluminium beverage can has a mass of 14.7 g. The thickness of the sheet is 95 μm and has a density of 2.65 t/m². Per can 100 g of TiO₂ is used as pigment. What is the surface of a beverage can in (cm²)? How many m² of sheet have to be produced per year, if the production losses are 3 %? If the sheet is produced as a 3-m wide band, how many km of such sheet have to be manufactured per day (333 working days/year)? The mass of a recycled and delaquered used beverage can (UBC) is 14 868 mg, of which 124 mg is

oxide and 100 mg the said TiO₂ pigment. Melt this UBC in an induction furnace without salt. The generated dross (assume a burn off rate of 0.3 % of the metal content) is skimmed off with 70 % metal. What is the metal recovery of this melt?

- 6. An engineer pays for the next 20 years on 1. January of each year 485 €/year into a kind of a pension fund. The guaranteed interest rate is 3.5 %/year. What is the amount of money he has accumulated at the beginning of the 21. year? What is its present value?
- 7. The consumption of a metal increases by 3.5 %/year in average. After how many years is the consumption twice as high as today? Deduct a general rule for estimating the period of time necessary to double any present figure at a given growth rate!

8. Three different lead smelters published the following data:

	Production (t/y)	Proportional Cost (€/t)	Total annual production cost (€/y)	Annual cash income . (€/y)
Α	25 000% ২৫ ৩০	90	8.1 mio.	2.9 mio.
В	37 000 333 00	80	17.72 mio.	3.4 mio.
С	48 000 ዛቴ ኣውቁ	65	17.22 mio.	3.9 mio.

Due to a world-wide over-supply all 3 smelters have to reduce their production by 10 %. What is the annual cash income of the 3 smelters?

$$\frac{1}{2} + 1 - 8^{\gamma}$$

$$\frac{1}{2} = (1 - 8^{\gamma})^{n} \cdot (1 - 8^{\gamma})^{n} \quad | n|^{2} = (1 - 8^{\gamma})^{n}$$

$$\frac{1}{2} - (1 - 8^{\gamma})^{n} = 0$$

$$\frac{1}{2} + 1 + 8^{\gamma} = 2$$

$$\frac{1}{2} + 1 + 8^{$$