



PRODUCTION PROCESSES & MACHINERY Q1 SOLUTION

Lebanese American University
School of Engineering and Architecture



Name: _____
Date: Tuesday 1st of April 2008;
Time: 12:30 → 13:45
Location: ENG ATTIC
Instructor: Dr. Ramy HARIK
Notes: Closed Book

EXERCICE 1 (18 POINTS)

Round the option that is the most correct, each correct answer values 3 pts & each wrong one values -1 pt.

- Magnesium production uses _____ as the 'ore'.
 - Coke & Limestone
 - Seawater
 - Under-ground mines
- Non Ferrous materials have better corrosion resistance, better strength then Ferrous Materials but are more expensive.
 - True
 - False
 - None of the above
- Tensile strength is a material property that:
 - Expresses the highest compressional stress the element can endure.
 - Expresses the ductility of a material.
 - None of the above
- Sand molds are used to make _____ product (s).
 - 1
 - 10452
 - None of the above
- A pattern is:
 - Made of wood.
 - Made of ferrous material.
 - All of the above.
- Lost Wax Casting requires heating the mold so it looses the wax-made pattern.
 - True
 - False
 - Not necessarily

EXERCICE 2 (12 POINTS)

Explain the process of obtaining steel out of iron ores: Name the main phases & explain them briefly.
Do not surpass this page. Drawings are encouraged.

Iron Ores → Process 1: BLAST FURNANCE → Pig Iron [3 pts]
[3 pts]: Explanations

Pig Iron → Process 2: BASIC OXYGEN FURNACE → Steel [3 pts]
[3 pts]: Explanations

EXERCICE 3 (70 POINTS)

This exercise requires engineering logic and application of concepts mentioned in class. Do not try to explain things more than it requires; keep your answer simple and clear.

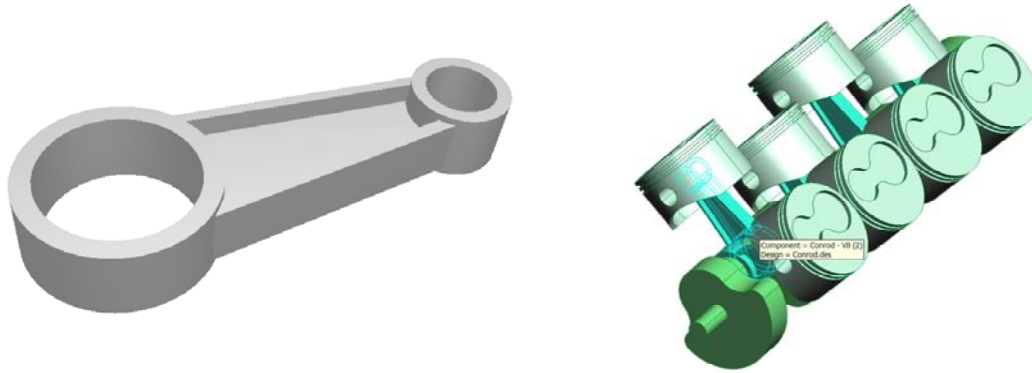
DRAWINGS: Should be colorful & clear.

Case Study: Casting of a Connecting Rod

The production of a connecting rod can be made in Casting, Material Removal and recently Chrysler & ford made connecting rods using Powder Metallurgy.

In our exercise we are trying to **sand-cast** a connecting rod with a **removable pattern**.

The 3D drawing of the Connecting Rod is given on the left; the position of a connecting rod within the engine is given on the right.



This is the side view (with internal lines):



You do not need to reproduce the internal lines on your drawings, it is for your understanding of the part (for pattern construction).

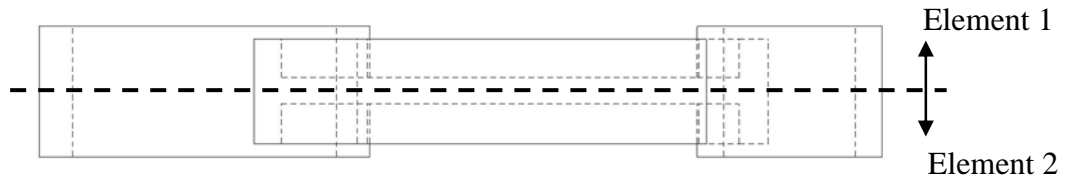
1. Propose a removable Pattern. Identify its material, loose pieces, parts. Draw & Explain. (10 points)

Pattern optimal material: Aluminum

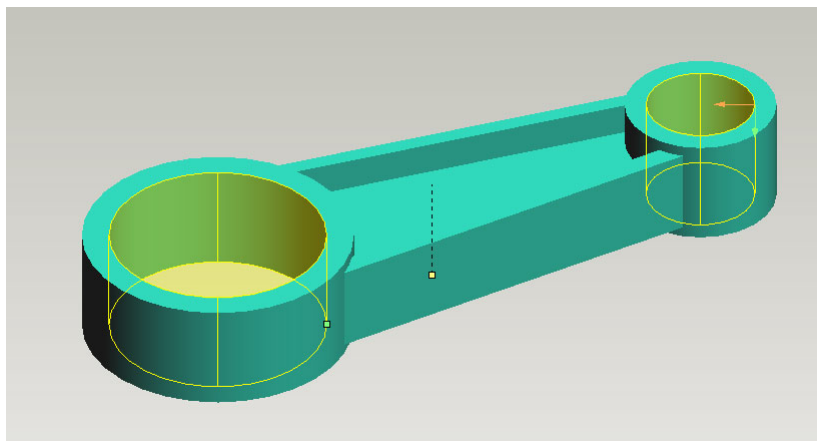
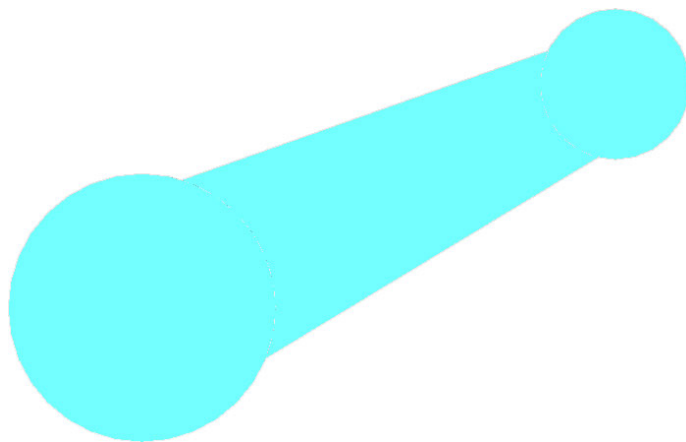
[A Connecting Rod is mass produced; a wooden pattern would not withstand the mass production]

Pattern Loose pieces: No Loose pieces are required for the selected pattern.

Pattern optimal material:

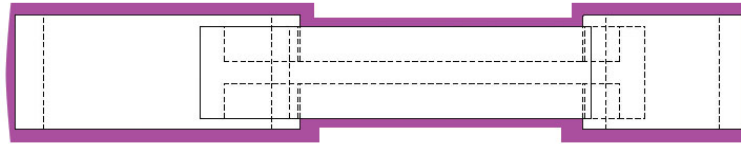


TOP VIEW



We have filled the empty areas with material (to be replaced by cores later)

2. Enhance your pattern by including allowances. Draw & Discuss. (10 points)



Shrinkage, draft, finishing

3. Enhance your pattern by including a core. Draw & Explain. (10 points)
Check figure in yellow section 1

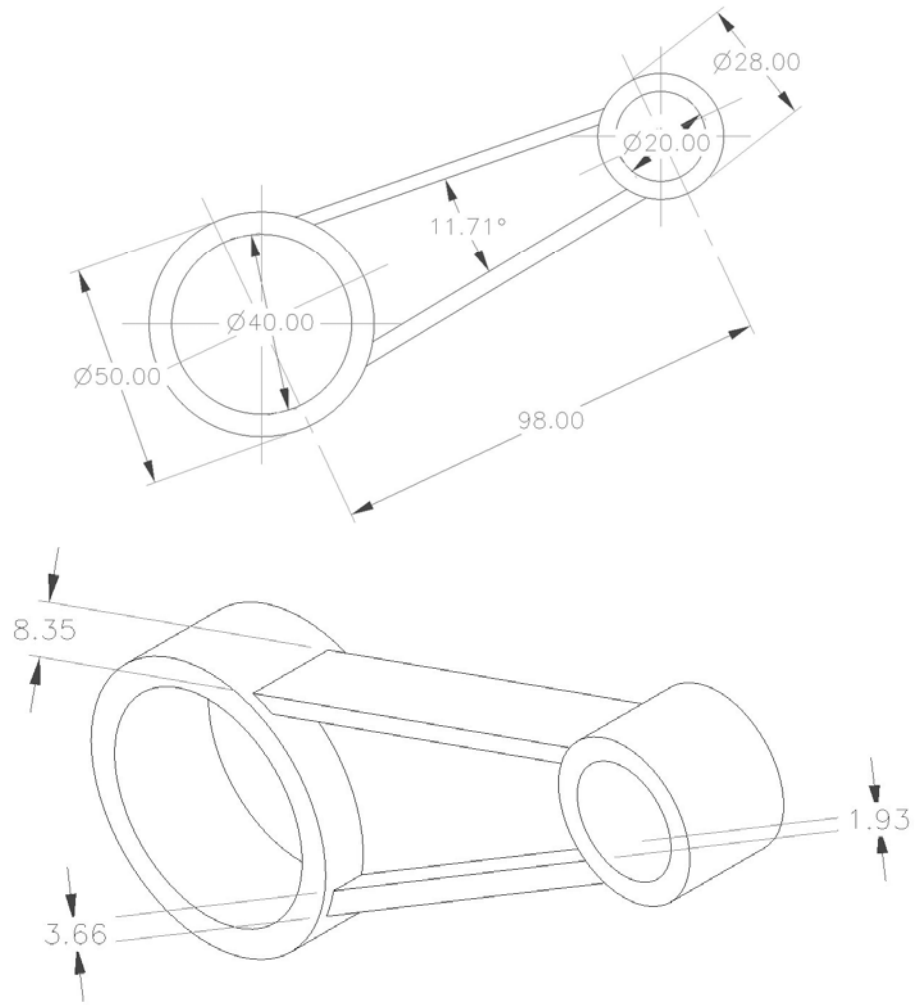
4. Explain the molding procedure to obtain the product and design your mold (with all of the details).
(20 points)

COPE / DRAG / GATES / RISERS / SPRUE / POURIN BASIN / VENTS

5. Calculate the solidification time using Chvorinov's rule (15 points)

Use $n = 2.0$, $B = 1 \text{ s/mm}^2$

$$t = B \cdot \left(\frac{V}{A}\right)^n = 1 \cdot \left(\frac{33213}{17787}\right)^2 = 3.48 \text{ s}$$



6. Show areas in your mold where gas bubbles might be present by hand drawing. (5 points)



Good Luck!
Dr. HARIK