RETAKE MID-TERM BMEGEÁTNW19 Vehicle Aerodyn. (15th of Dec. 2021, WED 14:00, online 90 min)

NAME:…… NEPTUN code:……..

It is not allowed to use any non-authorised means!

PLEASE READ CAREFULLY THE QUESTIONS! TAKE CARE OF YOUR HANDWRITING! GIVE YOUR ANSWER IN A SHORT & CLEAR FORMAT! USE SKETCHES IF NEEDED!

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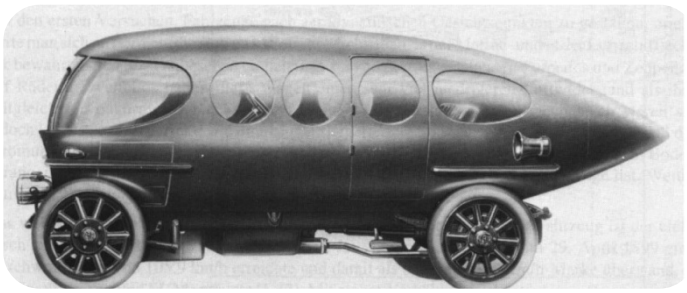
1)QUESTION (10p)

The first documented attempt at streamlining a passenger car is the Alfa Romeo from 1914. The „ALFA 40-60 HP Castagna Aerodinamica" was also known as „Siluro Ricotti" (=Ricotti's Torpedo). It was built by the coach builder Carlo (Marco?) Castagna (Carrozzeria Castagna, Milan, Italy) for the Italian Count Ricotti.



List and explain the disadvantages of the Zeppelin shape used for ground vehicles!

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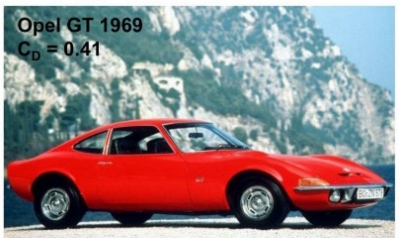
2)QUESTION (10p)

Contrary to the different body shapes, these two vehicles from 1969 and 1974 have the same c_D=0,41 drag coefficient.

Explain how is it possible!

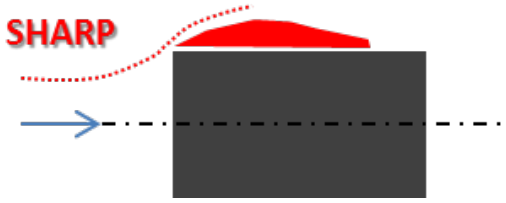


3)QUESTION (10p)

What do you know about the λ_{opt} “optimum slenderness”?

4)QUESTION (10p)

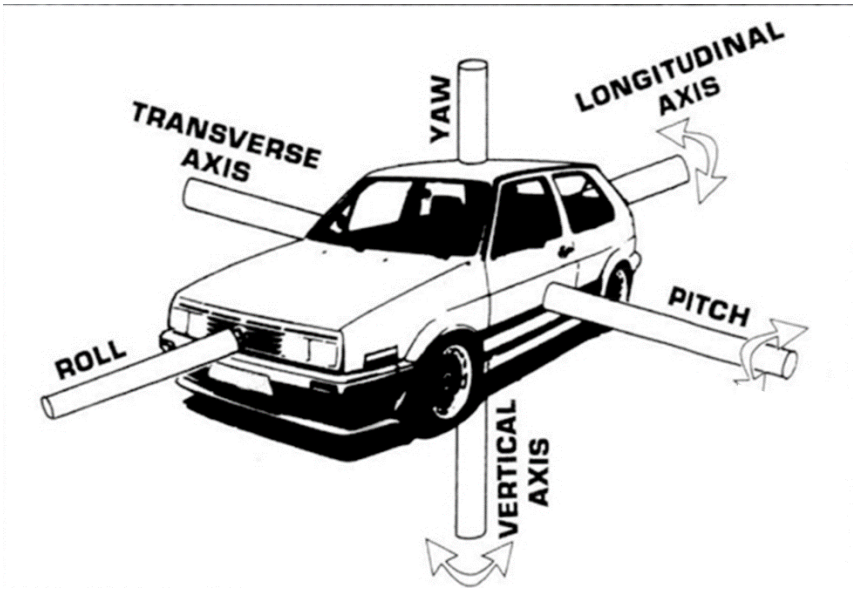
List the different solutions for the drag reduction of a sharp front edge of the prismatic bluff body!



5)QUESTION (10p)

Define in the figure:

- the v_∞ incident flow velocity vector (at no wind condition)
- the coordinate system: denote the three axes,
- the aerodynamic force components,



Define by its formula in the table below: the drag, the lift and the side force coefficients!

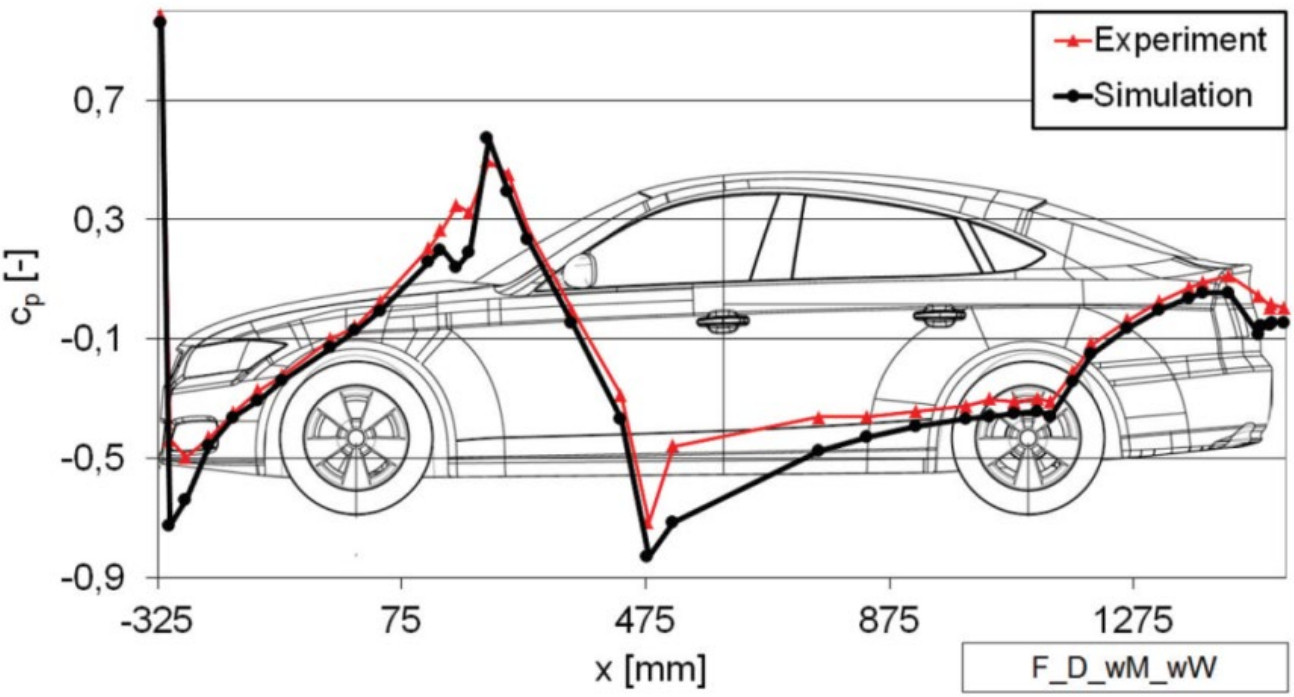
drag coefficient	
side (yaw) force coefficient	
lift coefficient	

Define the pressure coefficient and the wall (skin) friction coefficient with their formula and indicate their range, magnitude, min/max limits, if any!

pressure coefficient	
wall (skin) friction coefficient	

6)QUESTION (10p)

The figure below shows the measured and simulated c_p distribution curves along the centre-line of the upper body contour.



Which part of the vehicle's upper body surface is characterised by the highest positive lift force? Give a detailed explanation in your answer!

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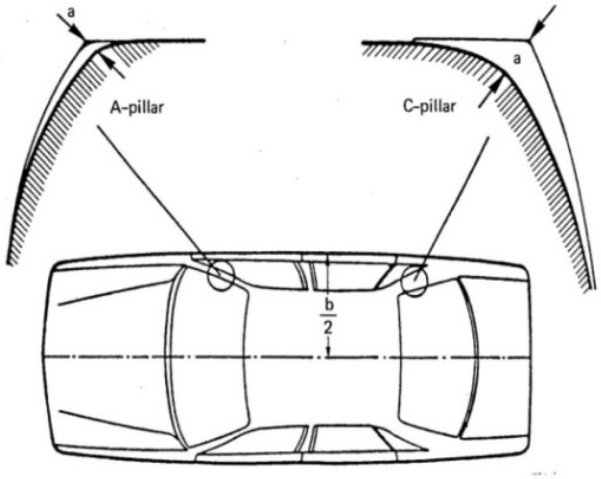
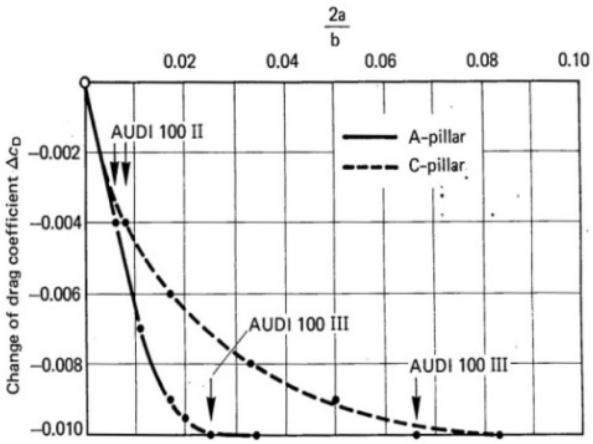
7)QUESTION (10p)

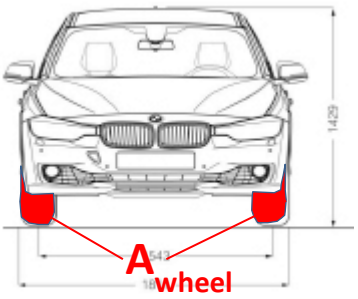
The diagram shows the Δc_D vs $2a/b$ (relative radius) applied on the A-pillar and the C-pillar. Explain the significant differences between the drag reduction values of the same rounding-up radius applied on the A-pillar and on the C-pillar!

What is the reason for such a significant difference?





8)QUESTION (10p)



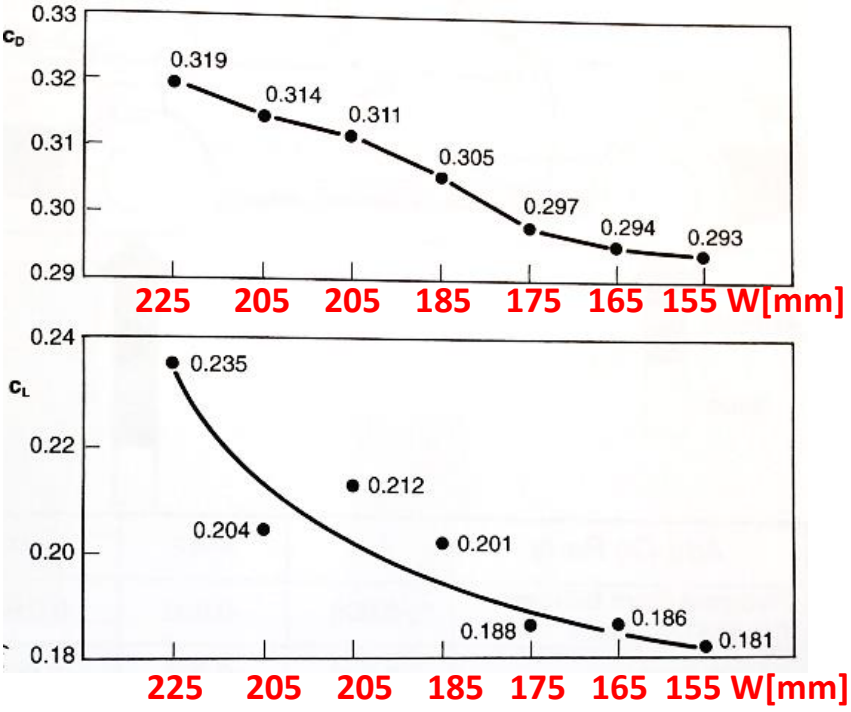
Wind tunnel tests confirmed that the **wheel width (W)** plays a significant role in the aerodynamic parameters of a vehicle.

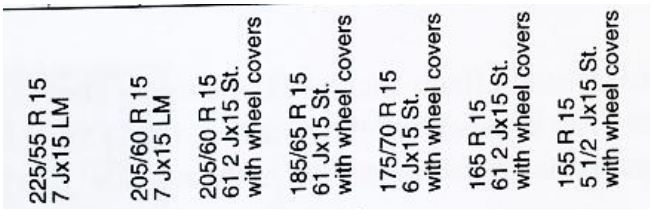
The measured data (c_D and c_L vs the wheel width (W)) are shown in the diagrams.

Let's consider a vehicle that has an A_{proj}**=2m²** projected frontal area without the two front wheels' projected frontal area.

The two front wheels' additional total projected area is listed in the table below.

W [mm]	A_{wheel} [cm²]
155	620
165	660
175	700
185	740
205	820
225	900





The vehicle speed is v_{max}**=180km/h.**

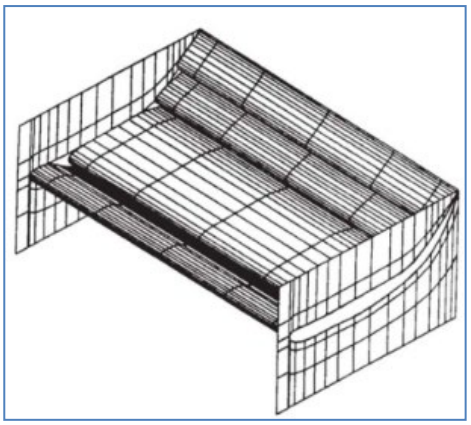
The vehicle is moving forward on a straight motorway in no wind condition.

The air density is ρ_{air}**=1,2kg/m³**.

Calculate the <u>difference</u> in the drag force, the lift force and the aerodynamic power loss of the vehicle between the cases: when it is fitted with the widest (W_{max}=225mm) and with the thinnest (W_{min}=155mm) wheels!

9)QUESTION (10p)

Explain why is the rear wing's performance better if side fins (endplates) are used?



10) QUESTION (10p)

Explain the role of the small additional parts (air deflector flaps) that is placed in front of the front wheels!