# Week 2

Example questions

# Example 1:

An aircraft that weighs $11000\ \mathrm{kg}$ has two rectangular wings with NACA 4412 profiles. Each wing has $15\ \mathrm{m}$ span and $2\mathrm{m}$ chord. Two jet engines producing a total of $14\ \mathrm{kN}$ of net thrust force are mounted on the aircraft, resulting. The lift coefficient at take-off in standard conditions is 0.46 for this aircraft. The aircraft is taking off from O. R. Tambo International Airport in Johannesburg, renowned as one of the highest altitude international airports. Its elevation is $1694\ \mathrm{m}$, where the air density is about $0.99\ \mathrm{kg/m^3}$.

What is the take-off speed for the aircraft?

**Given information:**

$M = 11000\ kg$

wing area $= 2 \times 15 \times 2 = 60\ m^2$

$T = 14\ kN$

$\rho = 0.99\ {}^{kg}/_{m^3}$

runway length $= 3405$ m

$C_L = 0.46$

**Find:**

$U_{take-off}$

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runway length $= 3405$ m

$C_L = 0.46$

**Find:**

$U_{take-off}$

$$C_L = \frac{L}{1/2\ \rho U^2 S}$$

$$U = \sqrt{\frac{2Mg}{\rho C_L S}}$$

$$\boxed{U_{take-off} = 88.87\ m/s}$$

# Example 2:

You have just started working in an aerodynamics lab. Your first task is to identify the types of airfoils present in the lab. You know that all the wings have NACA 4-digit profiles.

**How would you approach this task?**

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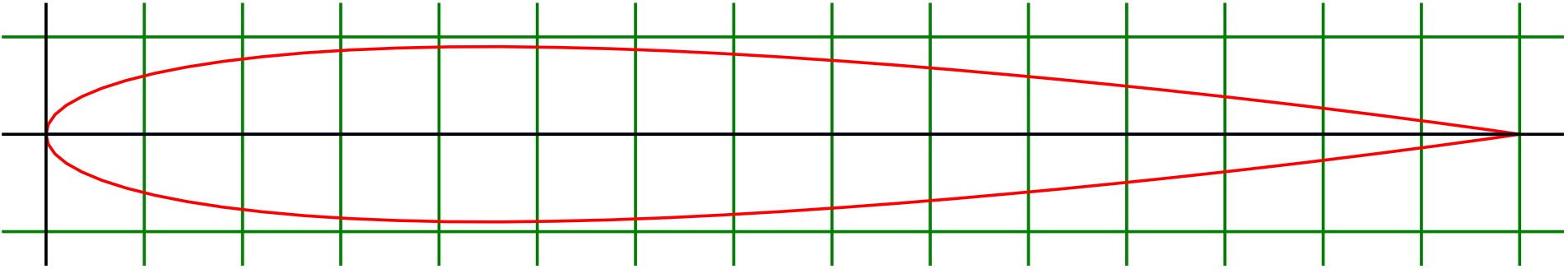
**How would you approach this task?**

**Step 1:** Obtain the shape of the airfoils by tracing their outlines
**Step 2:** Measure the chord length of the airfoil. This will be the reference in the NACA 4-digit code.
**Step 3:** Measure the maximum thickness at 30 % of the chord.
**Step 4:** Identify the point of maximum camber (the inflation point of the curve) and measure the distance between this point and the leading edge of the airfoil (p/c) and the vertical distance between the max camber and chord (m/c).

# Example 2:



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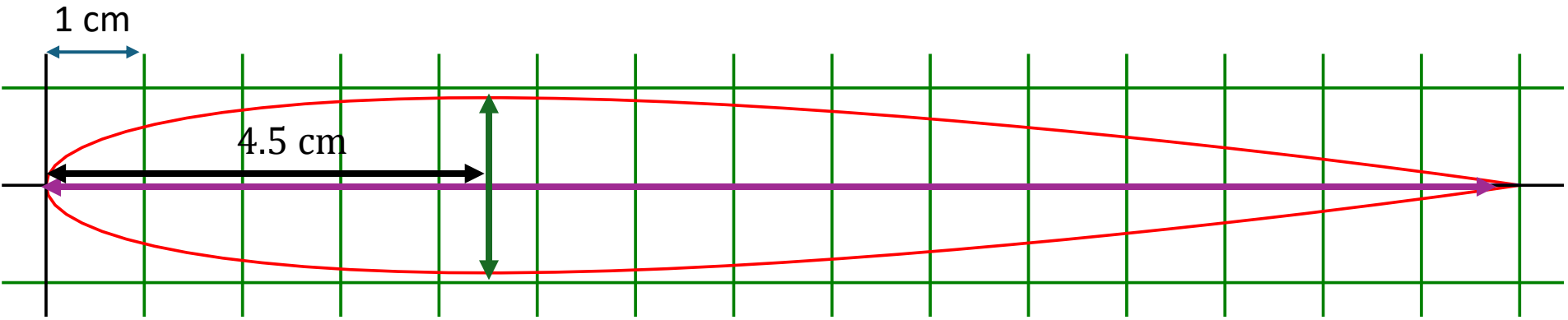


$\text{chord} = 15\ \text{cm}$

max thickness at 30% of chord (at 4.5 cm from LE) is $1.8\ \text{cm}$

$t/c = 1.8/15 = 0.12$

The airfoil is symmetric, so m/c and p/c =0

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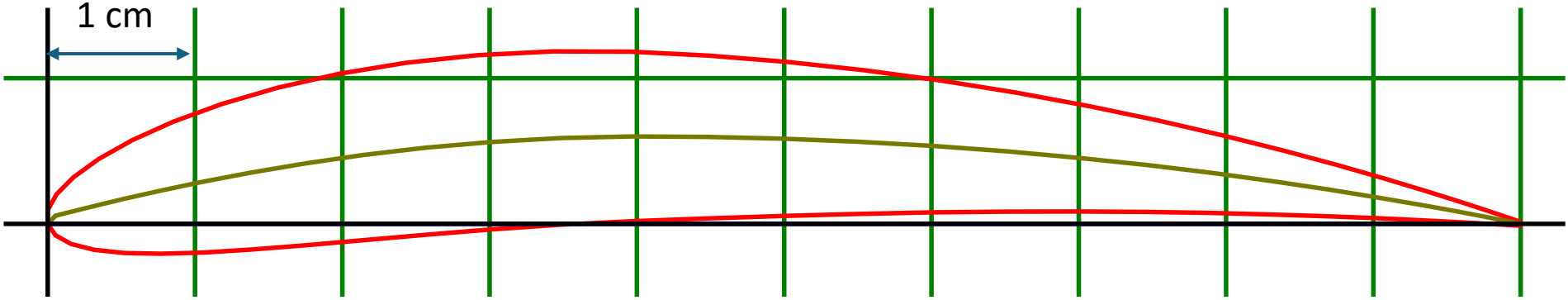

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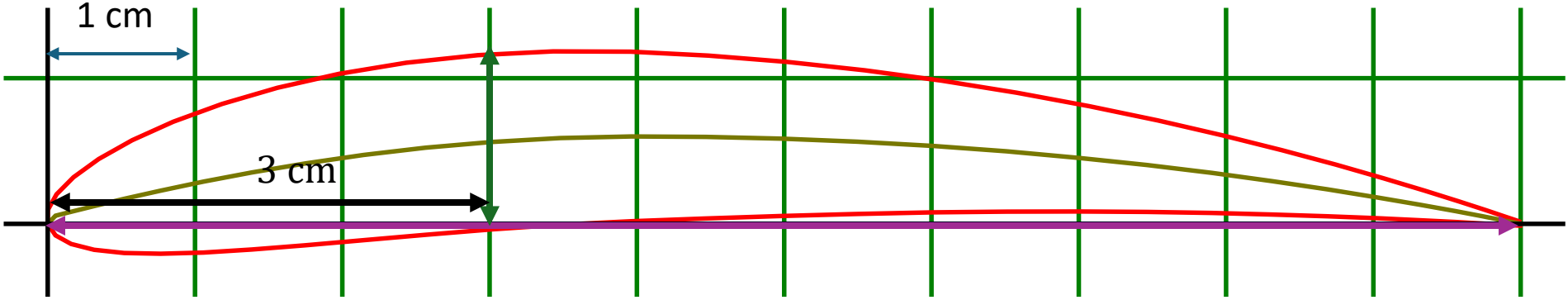


Chord = 10 cm

Max thickness at 30% of chord = 1.2 cm

$t/c = 0.12$

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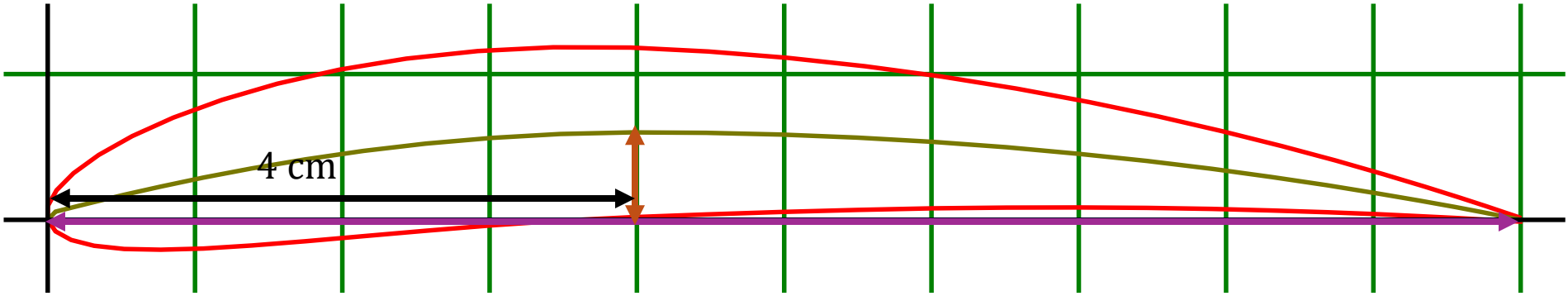


Chord = 10 cm

Max thickness at 30% of chord = 1.2 cm

$t/c = 0.12$

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Max camber = 0.6 cm
m/c = 0.06

Max camber position from LE = 4 cm
p/c = 0.4