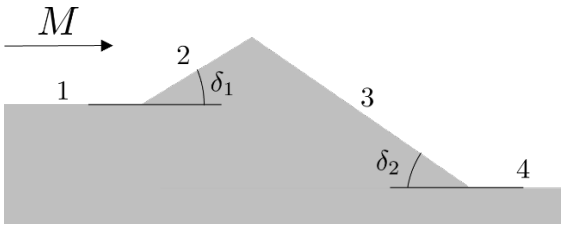
Compressible Flows
Intermediate Test – 20/12/2021

1) [6 pts] Evaluate the Mach number and the pressure coefficient with respect to the undisturbed pressure p_∞ for each of the numbered surfaces. The upstream Mach number is equal to 3, and the angles in the figure below are $\delta_1 = 7°$ and $\delta_2 = 10°$.

   a. M2 = 2.65 - Cp2 = 0.1088
   b. M3 = 3.56 - Cp3 = -0.0885
   c. M4 = 2.87/2.91 - Cp4 = 0.0066/-5.90*10^(-4)

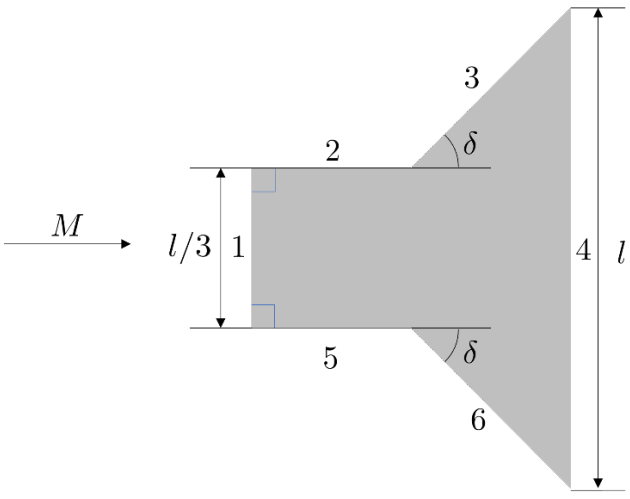


2) [6 pts] Consider the blunt body shown in the figure below, where $\delta = 45°$ and the upstream Mach number is $M = 5.0$.
   Evaluate using the Newtonian **and** the modified Newtonian theory:

   a) the pressure coefficients on each section (Newt.): 2 – 0 – 1 – 0 – 0 – 1
      (modif. Newt): 1.808 – 0 – 0.904 – 0 – 0 – 0.904

   b) the drag coefficient based on the length of the rear section: 1.333 (Newt.)/ 1.205 (Modif.)

   Evaluate the maximum pressure coefficient according to the modified Newtonian theory: 1.808



3) [18 pts] Consider a supersonic profile with a semi-opening angle δ of 2.0°, at an angle of attack α of 6° and a Mach number $M_\infty = 3.00$. Evaluate:

a) C_L and C_D with the exact theory: 0.1507 – 0.0177
b) C_L and C_D with small perturbation theory: 0.1481 – 0.0172
c) Mach number on profile surface #2: 3.22
d) Pressure coefficient (C_p) on profile surface #2: -0.0408
e) Mach number on profile surface #3: 3.46
f) Pressure coefficient (C_p) on profile surface #3: -0.0766
g) Mach number on profile surface #4: 2.60
h) Pressure coefficient (C_p) on profile surface #4: 0.1278
i) Mach number on profile surface #5: 2.78
j) Pressure coefficient (C_p) on profile surface #5: 0.0582