Wing sizing is an important initial step of the design of an aircraft. The objective of this design problem is to expose you to such a task.

You are asked to design the wing of a transport aircraft with a target mass of 205,000 Kg at take-off. You are reminded that preliminary design studies are usually based on historical data, and employ curve fitting wherever appropriate.

1. Using the data of the DC 8-50 and the DC 10-30 aircraft reported in your textbook, chose a wing loading for this wing and size it in m$^2$.

2. Knowing that the airfoil section chosen for this aircraft has the best $C_l/C_d$ for $C_l = 0.425$, determine in the standard atmosphere the optimum flight altitude for a cruising speed corresponding to $M = 0.85$.

3. Between take-off and landing, the weight of the aircraft varies between 205,000 kg and 170,000 kg. Determine the optimum flight altitude as a function of weight.

4. Using some high-lift devices (flaps and slats), it is assumed that a $C_{l_{max}} = 2.7$ can be reached. Compute the true airspeed at which the airplane will stall at sea level for the maximum landing mass of 185,000kg. How does this speed vary with altitude? (Plot values from sea level to 6000 ft in the standard atmosphere).

5. If a speed indicator is based on the calibrated airspeed given in formula 6.12 of your textbook, how would the INDICATED stall airspeed vary with altitude? Give in knots the calibrated stall speed as a function of altitude.

6. For take-off, the flaps setting is lower than the maximum flap deflection. Therefore, it is estimated that a $C_{l_{max}} = 2.30$ will be achieved. Furthermore, it is assumed that the aircraft is required to take-off at a speed that is 20% higher than the stall speed at the take-off configuration. Analyze the take-off speed at sea level when the pressure is the standard sea level pressure, but with a varying air temperature between $T = -5^0$C and $T = 35^0$C.