Aircraft Performance – Assignment 3

A 45,000 lb aircraft climbs from SL to FL 390 (i.e. 39000 ft) in ISA+10 conditions. Assume that aircraft weight is constant during climb and Aircraft wing area is 520 ft^2. The following climb speed profile is used:

- Climb at 250 kts CAS (calibrated airspeed) from SL to FL 100 (i.e. 10000 ft)
- Accelerate in level flight from 250 kts to 290 kts CAS at FL 100
- Climb at 290 kts CAS from FL 100 to the transition altitude
- Climb at M 0.74 from the transition altitude to FL 390

Note :
For simplicity, assume instantaneous acceleration from 250 KCAS to 290 KCAS at FL100.

The transition altitude is the altitude at which the pilot transitions from climb at constant CAS to climb at constant Mach

As the aircraft climbs at constant CAS, the Mach number increases. At the transition altitude, the constant CAS value (i.e. 290) used for climb results in a Mach number equal to the planned climb Mach number (i.e. 0.74). From the transition altitude, the aircraft climbs at constant Mach (CAS will decrease as altitude increases).

1. Calculate and plot, as a function of pressure altitude, the following parameters (do not forget the discontinuities that may happen at the transition altitude or at the tropopause):
   V (true airspeed)
   Vc (Calibrated Airspeed)
   M
   C_L (Lift coefficient)

2. Derive an equation that allows the calculation of the transition altitude ($h_{p\,tran}$) knowing the values of Vc and M used for a climb speed profile. Note that two equations are required, one for the case where the transition altitude is below the tropopause and the other for the case where it is above.