AE 234/711 Aircraft Propulsion
Quiz 1

The Airbus A380 has four turbofan engines, developing a nominal thrust of 1,061,800 N at sea level, for a take-off mass of 540,000 kg. The aircraft speed is 110 m/s for an air density of 1.16 kg/m^3. The wing area is 858 m^2, and the airplane drag polar is given by

$$C_D = 0.02 + 0.042\, C_L^2$$

A380 uses Trent 900 engine, with a fan diameter of 2.95m. Assume the fuel-air ratio at take-off to be 0.01 and that the core and bypass exhaust jets have the same speed.

1. What is the drag being experienced by the airplane?
   $C_L = 0.88, C_D = 0.053$, L/D = 16.8, Drag = $316.2\, kN$

2. Calculate the following: exhaust jet speed, propulsive, thermal, and overall efficiencies.
   Temperature = 288.15 K, assuming $Q_R = 42.0\, MJ/kg$

   (a) $\dot{m}_a = 3,488.5\, kg/s, \mathcal{T}/\dot{m}_a = 304\, m/s \implies V_e = 414\, m/s$
   (b) Efficiencies: $\eta_p = 0.42, \eta_{th} = 0.19, \eta_{ov} = 0.08$

3. Repeat the above calculations (drag, exhaust speed, and efficiencies) for a sea-level temperature of 40°C.
   Temperature = 40^oC =313.15 K. $\rho = 1.067\, kg/m^3$, assuming $Q_R = 42.0\, MJ/kg$

   (a) $C_L = 0.96, C_D = 0.058$, L/D = 16.4, Drag = $323.5\, kN$
   (b) $\dot{m}_a = 3,210\, kg/s, \mathcal{T}/\dot{m}_a = 331\, m/s \implies V_e = 441\, m/s$
   (c) Efficiencies: $\eta_p = 0.4, \eta_{th} = 0.22, \eta_{ov} = 0.087$