1. An aircraft engine inlet must supply 47 *kg/s* of air at $M_2 = 0.43$ to the compressor when the aircraft is cruising at $M_a = 0.88$ at an altitude where ambient conditions are 26.5 *kPa* and 230 *K*. The diffuser adiabatic efficiency for the internal flow is 0.85 and 45% of the static pressure rise is to occur externally. Determine preliminary design values of the required flow areas A_1 and A_2 at the front and back faces respectively of the inlet.

2. Air at an initial temperature and pressure of 500 *K* and 200 *kPa* is compressed to a final pressure of 1 *MPa* in a compressor with a polytropic efficiency $\eta_{pc} = 0.92$.

(i) Calculate the function $T(s)$ for this process and plot it on a T–s diagram.

(ii) Calculate the final temperature, T_2.

(iii) Calculate the adiabatic efficiency of the compressor, η_c and check that it is less than η_{pc}.

3. Air at an initial temperature and pressure of 1500 *K* and 800 *kPa* is expanded in a turbine to a final pressure of 300 *kPa* with a polytropic efficiency $\eta_{pe} = 0.93$.

(i) Calculate the function $T(s)$ for this process and plot it on a T–s diagram.

(ii) Calculate the final temperature, T_2.

(iii) Calculate the adiabatic efficiency of the turbine, η_t and check that it is greater than η_{pe}.