AE 234/711 Aircraft Propulsion
Tutorial 5 - Thermodynamics

1. Show that $c_p - c_v = \mathcal{R}_g$.
2. Derive the expressions that relate $T - s$ and $p - v$ for `isobaric`, `isochoric`, `isothermal` and `isentropic` processes. Use these expressions to represent them on $T - s$ and $p - v$ axes.
3. Consider the compression of a system from a volume of $\mathcal{V}_i$ to a smaller volume $\mathcal{V}_f$. Compare the change in internal energy, pressure gain, work and heat interactions with surroundings `isobaric`, `isothermal` and `isentropic` processes. Which of these is the most efficient way to compress a gas?
4. Derive the expression for the ideal efficiency of an Otto Cycle. Plot the dependence of this efficiency as a function of the compression ratio.
5. Derive the expressions for the efficiencies of Carnot and Diesel cycles.
6. The temperature at the beginning of the compression process of an air-standard Otto cycle with a compression ratio of 8 is 300 K, the pressure is 1 bar, and the cylinder volume is 560 cm^3. The maximum temperature during the cycle is 2000 K. Determine (a) the temperature and pressure at the end of each process of the cycle, and (b) the thermal efficiency.
   How would these change if there was a energy loss of 1% during compression and expansion? Assume that the compression ratio and maximum temperature are maintained as before.