A key measure of a supersonic engine inlet is the total pressure of the air that it delivers to the engine, typically measured as the “inlet efficiency” $p_{\text{inlet}}/p_{\infty}$. The higher this inlet efficiency, the greater the engine thrust and fuel economy.

In this problem we will compare the efficiency of a simple bow-shock engine inlet with a more sophisticated oblique-shock inlet such as the ones found on the F15 and the Concorde. We will assume a flight Mach number of $M_{\infty} = 2.0$ for both cases, typical of a Concorde in cruise. Since only pressure ratios will be considered, we can conveniently define $p_{\infty} = 1$.

a) For the simple bow shock inlet, determine the total pressure $p_{\text{inlet}}$ of the air going into the engine.

b) The oblique-shock inlet shown below must have the front oblique shock angled at 40° so that it intersects the tip of the top nacelle wall. Determine the necessary wedge angle $\theta$, and also $M_A$ and $p_{oA}$ behind the front shock.

c) The second oblique shock is also the result of a simple wedge flow, but which is “upside down” and tilted by the wedge angle $\theta$ found in b). Determine the angle $\beta$ of the second shock. Also determine $M_B$ and $p_{oB}$.

d) The third shock is a simple normal shock. Determine $M_C$ and $p_{oC}$ ($= p_{\text{inlet}}$).

e) Compare the efficiencies of the bow-shock and oblique-shock inlets.