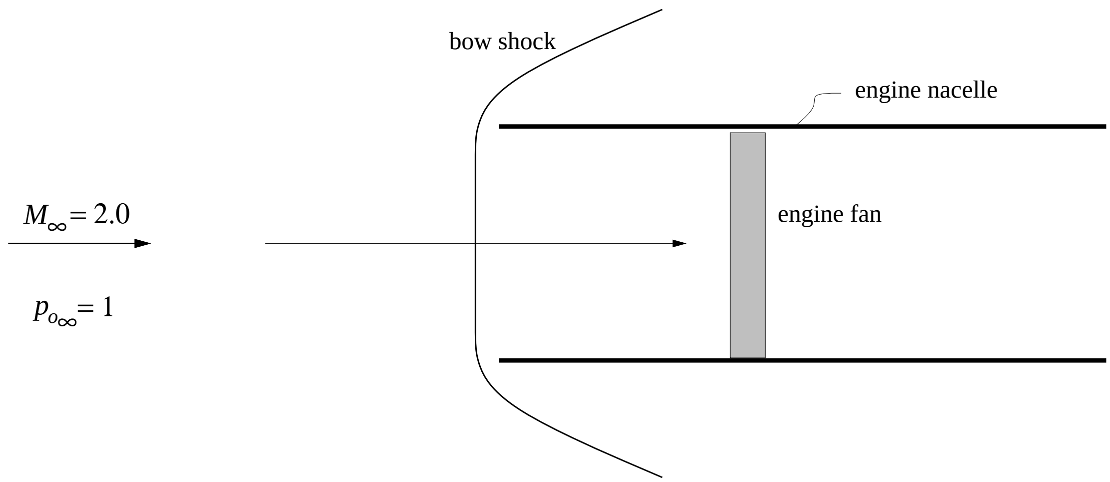
Unified Engineering Spring 2008
Fluids Problem F16+17 (worth 2 Psets Q's)

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" $p_{o_{\text{inlet}}}/p_{o_\infty}$. 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 $p_{o_\infty} = 1$.

a) For the simple bow shock inlet, determine the total pressure $p_{o_{\text{inlet}}}$ 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 θ, and also M_{A} and $p_{o_{\text{A}}}$ 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 θ found in b). Determine the angle β of the second shock. Also determine M_{B} and $p_{o_{\text{B}}}$.

d) The third shock is a simple normal shock. Determine M_{C} and p_{o_C} $(= p_{o_{\text{inlet}}})$.

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