## Problem 334A

A pitot tube which senses the stagnation pressure, $p_S$, at its mouth is often used to measure the speed of an airplane. Such a device is incorporated into the nose of a supersonic airplane for the purpose of measuring the Mach number, $M$, at which the airplane is travelling ($M > 1$):
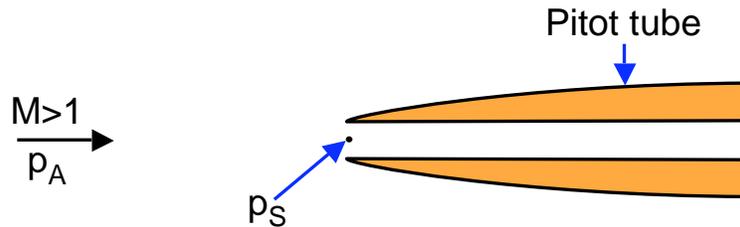


Assume that the ambient pressure of the air, $p_A$, through which the airplane is travelling is known. If a bow shock (like a normal shock wave) forms upstream of the pitot tube, find the relation between the measured quantity, $p_S/p_A$, and the required quantity, $M$. The relation also involves the ratio of specific heats, $\gamma$.

[Note:    The answer cannot be written explicitly as $M = $ function($p_S/p_A$) but can be written as $p_S/p_A = $ function($M$).]