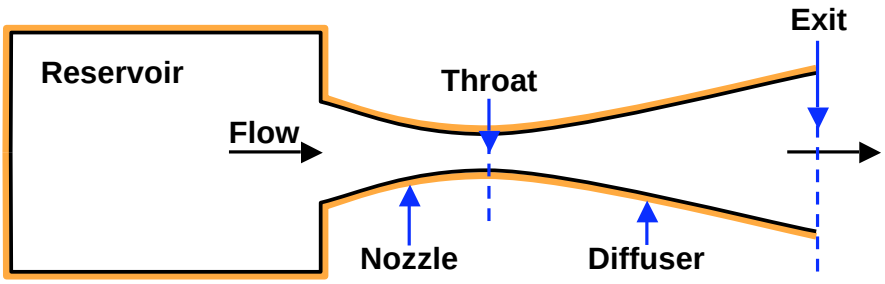
Problem 320A

A rocket engine can be modelled by a reservoir of gas at high temperature ($3000°K$) feeding gas to a convergent/divergent nozzle:



Assume the gas behaves like air ($R = 280\ m^2/s^2\ K°$, $\gamma = 1.4$). The flow reaches critical conditions at the throat, is subsonic upstream of the throat and supersonic in the divergent section between the throat and the exit. The pressure at exit is atmospheric ($10^5\ kg/m\ s^2$) and the supersonic flow at the exit is travelling at $M = 2.5$. Find:

(a) The temperature of the flow at the exit.

(b) The pressure in the reservoir.

(c) The area of the exit divided by the area of the throat.

(d) The mass flow rate per unit area of the exit cross-section.

(e) The thrust produced by the engine per unit area of the exit cross-section.

Assume the gas behaves isentropically throughout.