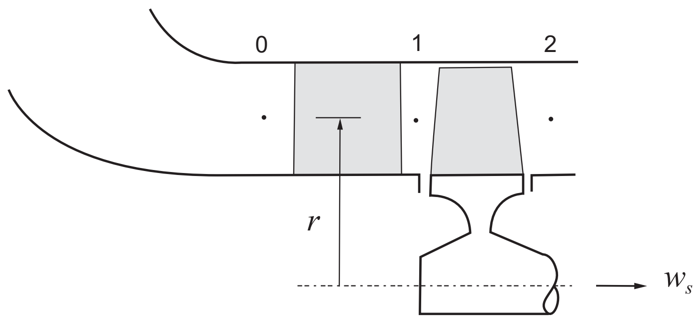
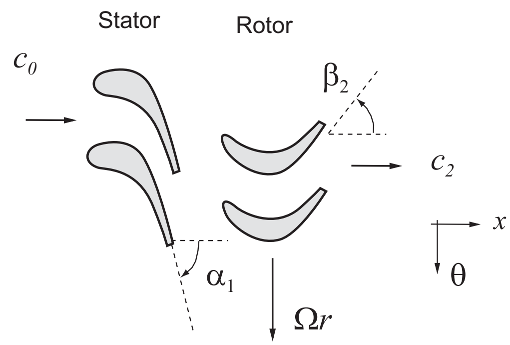
Unified Engineering **Name:**
Thermo Quiz 2 **Spring 2009**

Consider the adiabatic axial turbine stage shown below. The turbine is supplied with air at T_{t0} = 300 K and p_{t0} = 2 bar. Due to viscous dissipation, the entropy change across the stator is $\Delta s_{stator}/R$ = 0.1. The rotor is ideal and provides w_s = 50,000J/kg of specific shaft work. The axial velocity is constant throughout such that $c_{x0} = c_{x1} = c_{x2}$ = 50 m/s. The flow into the stator is axial, $c_0 = c_{x0}$, and leaves the rotor with no absolute swirl, $c_2 = c_{x2}$. The mean radius, r = 0.3m, is constant through the stage. The rotor trailing edge blade metal angle is known to be β_2 = 60 degrees and air can be modeled as an ideal gas with constant specific heats γ = 1.4 and R = 287 J/kg-K.





a) What is the stagnation temperature at rotor inlet, T_{t1}?

b) What is the stagnation pressure at rotor inlet, p_{t1}?

c) Based on the above drawing, sketch the velocity triangles, for station 1 and 2.

d) What is the rotor angular velocity, Ω, in rad/s?

e) Determine the stator trailing edge angle α_1 and stator exit velocity c_1.

f) Sketch an *h*-*s* diagram for the processes from station 0 all the way to station 2 and indicate static and stagnation states.

g) What is the rotor exit stagnation pressure, p_{t2}?

h) Determine the adiabatic efficiency of the turbine stage, η_T.