Unified Engineering **MIT ID# (last four digits):**
Thermo Quiz 2 **Spring 2008**

Consider the Junkers Jumo 004B (1939 development – an original is on display at the Gas Turbine Laboratory on the lab ground floor) turbojet engine shown in the figure below. Assume that the engine is on the ground and that the ambient temperature and pressure are 300K and 1bar respectively. The compressor pressure ratio is 3, the mass flow through the engine is 20 kg/s and the temperature at the turbine inlet is 1050 K. Kinetic and potential energy effects in the compressor and in the turbine can be neglected. Assume air and the combustion gas to be perfect gases with the same $\gamma = 1.4$, and $R = 287$ J/kg-K. The engine can be assumed ideal and the effect of the fuel can be neglected.

a) What are the stagnation pressure and stagnation temperature at the compressor exit?

b) What is the specific shaft work of the single stage turbine, required to drive the compressor?

c) The axial velocity and the wheel velocity are constant through the single stage turbine ($c_{0x} = c_{1x} = c_{2x}$ and $u_1 = u_2$) and the flow leaves the rotor with no swirl in the absolute frame. Considering the blade geometry shown below, draw the velocity triangles.

d) What is absolute velocity c_1 at the stator exit (station 1)?

e) What is the absolute velocity c_2 at the rotor exit (station 2)?