C A R L E T O N U N I V E R S I T Y

MIDTERM EXAMINATION
October 15, 2003

DURATION: 45 MINUTES No. of Students: 99+77

Department Name & Course Number: **Mechanical & Aerospace Engineering MAAE 2400 Thermodynamics and Heat Transfer - Sections A and B**
Instructors: **Profs. T. Kaya and J. Gu**

AUTHORIZED MEMORANDA
Open book, Open Notes

Students **MUST** count the number of pages in this examination question paper **before** beginning to write, and report any discrepancy immediately to a proctor. This question paper has **1** page.
This examination question paper **MAY** be taken from the examination room.

DATA FOR THE QUESTION 1 AND 2:
c_v=718 J/kgK and c_p=1005 J/kgK
R = 287 J/(kg·K).

QUESTION 1) Air at 100 kPa and 280 K is compressed to 600 kPa in a compressor during a steady-state process. The mass flow rate of the air is 0.04 kg/s, and a heat loss of 16 kJ/kg occurs during this process. The volume flow rate of air at the exit is 7.65×10^{-3} m^3/s. Assuming the change in the velocity of the air across the compressor is negligible, determine the necessary power input to the compressor. Air can be treated as ideal gas with constant specific heats. (ANS. -5.456 kW)

QUESTION 2) Consider the piston-cylinder system shown in Figure 1. Initially, the piston is resting on a set of stops and the cylinder contains 1 kg of air at 150 kPa and 15^0C. 200 kPa pressure is required to raise the piston against the atmospheric pressure and piston weight. Heat is now transferred to the air until its volume doubles. While the piston starts rising, a paddle wheel transfers energy to the air by work in the amount of 50 kJ.

(i) Determine the work done by the air. (ANS. -110.21 kJ)
(ii) Determine the amount of heat transferred to the air. (ANS. 404.85 kJ)
(iii) Plot the process on a P-v (Pressure - specific volume) diagram.

NOTE: Assume that air behaves as an ideal gas with constant specific heats

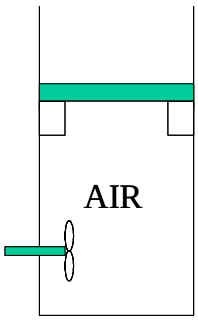

Figure 1