MEMS 0051
Summer 2018
Midterm #1
6/18/2018

Name (Print): _____

This exam contains 2 pages (including this cover page) and 4 problems. Check to see if any pages are missing. Enter all requested information on the top of this page, and put your initials on the top of every page, in case the pages become separated.

You may *not* use your books or notes. Calculators are permitted on this exam.

The following rules apply:

- All work must be done in the blue testing book. Any work done on the exam question sheet will not be graded.
- All work must be substantiated. A result with no methodology and mathematics will not be graded.

Do not write in the table to the right.

Problem	Points	Score
1	10	
2	20	
3	30	
4	40	
Total:	100	

BONUS (5 pts):

This date, June 18$^{\text{th}}$, 1940, marks the speech *whom* gave to the House of Commons stating that although the Battle of France may be over in the eyes of the Germans, "the Battle of Britain is about to begin." This speech is commonly referred to as "This was their finest hour."

Written Problem #1

1. (10 points) Determine the specific volume for water existing at 1,823 [kPa] and 462 °C.

Written Problem #2

2. (20 points) 1 [kg] of water initially at 20 °C and 100 [kPa] is contained within a mass-less piston-cylinder device. Heat is added until the temperature reaches 110 °C. Determine:

    1. The quantity of heat required for the process.
    2. The work produced.

Written Problem #3

3. (30 points) A piston-cylinder contains air at Standard Temperature Standard Pressure (25 °C and 100 [kPa]) and has an initial volume of 0.855 [m^3]. The air is compressed to where the final temperature is 200 °C and a pressure of 750 [kPa]. Determine:

    1. The work required to compress the piston-cylinder.
    2. The heat removed from the piston-cylinder.
    3. Whether, given P_c=3.78 [MPa] and T_c=132.63 [K], if the Ideal Gas law is valid for this analysis.

Written Problem #4

4. (40 points) A system contains 1 [kg] of water and undergoes a power cycle, which is comprised of the following processes:

    - *Process 1 → 2* - Constant pressure heating at 1,000 [kPa] from saturated vapor.
    - *Process 2 → 3* - Constant volume cooling to P_3 = 500 [kPa], T_3= 160 °C
    - *Process 3 → 4* - Isothermal compression with $Q_{3\to4}$ = -815.8 [kJ].
    - *Process 4 → 1* - Constant volume heating

    Determine the following:

    1. This process schematically on P-ν and T-ν diagrams.
    2. Determine the heat supplied to the system in *Process 1 → 2*.
    3. Determine the work done by the system in *Process 1 → 2*.
    4. Determine the heat rejected in *Process 2 → 3*.
    5. Determine the work done onto the system in *Process 3 → 4*.
    6. Determine the heat supplied in *Process 4 → 1*.