CADET _____ SECTION _____TIME OF DEPARTURE _____

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

CH365 2022-2023
Carnot Cycle Bonus Redux
31 October 2022

TEXT: Smith, Van Ness, Abbott & Swihart
SCOPE: Lessons 22-23
TIME: 60 minutes

References Permitted: Open notes, book, internet, CHEMCAD, Mathematica, Excel.

INSTRUCTIONS

1. This is a BONUS exercise and is due **1630 14 November 2022**.
2. There are 2 problems on 1 page in this exercise (not including the cover page).
3. Save all electronic work to your SharePoint Directory.
4. Write down the file name and file location.

(TOTAL WEIGHT: 40 POINTS)

DO NOT WRITE IN THIS SPACE

PROBLEM	VALUE	CUT
A	25	
B	15	
TOTAL BONUS	40	

Cadet:_____

Problem:	Weight:
A	25

A piston contains 0.1 kmol of nitrogen gas initially at 1.00 bar, 5.00 m^3, and 601.4 K. The gas undergoes a cyclic Carnot-type PV process between 601.4 K and 721.7 K, with minimum volume of 1.50 m^3 at pressure 4.00 bar. In other words, referring to Figure 5.2 on page 185, point d in the figure corresponds to 5.00 m^3 and 1.00 bar, and point b is 1.50 m^3 and 4.00 bar. Use Mathematica to solve for the intermediate points (points a and c in Figure 5.2) and construct a graph of the given Carnot cycle in Mathematica. Your plot should be fully formatted and professional in appearance. A sample is provided below.

Problem:	Weight:
B	15

Use your results from part (a) to calculate the heat absorbed from the hot reservoir, the heat ejected to the cold reservoir, and the work produced, all in units of kJ. Calculate the efficiency of the Carnot cycle by both equations 5.6 and 5.7

Additional information for Problems A and B:

R=8.314 J/(mol·K),

C_P=7R/2, and

C_V=5R/2.

Sample plot created in Mathematica:

Out[826]=