CADET _____ SECTION _____TIME OF DEPARTURE _____

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

CH365 2023-2024
Carnot Cycle Bonus
13 October 2023

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

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

INSTRUCTIONS

1. This is a BONUS exercise and is due **1630 20 October 2023**.
2. There are 2 problems on 1 page in this exercise (not including the cover page).
3. Submit all electronic work in Canvas.

(TOTAL WEIGHT: 30 POINTS - BONUS)

DO NOT WRITE IN THIS SPACE

PROBLEM	VALUE	CUT
A	10	
B	20	
TOTAL BONUS	30	

Cadet:_____

Problem:	Weight:
A	10

A closed system (piston) containing 0.100 kmol of nitrogen gas undergoes the following two processes:

(a) Isothermal compression from an initial state of 5.00 m^3, 1.00 bar, and 601.4 K to a final state of 2.00 m^3, 2.50 bar, and 601.4 K.

(b) Adiabatic compression from an initial state of 5.00 m^3, 1.00 bar and 601.4 K to a final state of 2.00 m^3 and 3.61 bar

Use Microsoft Excel to construct a plot of pressure versus volume for each of these processes. Your plot should be fully formatted and professional in appearance. Submit your Excel file and a cover page on Canvas for credit.

Problem:	Weight:
B	20

A piston contains 0.1 kmol of nitrogen gas initially at 1.00 bar, 5.00 m^3, and 601.4 K.

(a) Use Microsoft Excel to construct a graph of a Carnot cycle operating between 601.4 K and 721.7 K and to a minimum volume of 1.50 m^3 and 4.00 bar. Submit your Excel file and a cover page on Canvas for credit.

(b) Calculate the efficiency of the Carnot cycle, the heat absorbed from the hot reservoir, the heat ejected to the cold reservoir, and the work produced in units of kJ.

Additional information for Problems A and B:

$R=8.314$ J/(mol·K),

$C_P=7R/2$, and

$C_V=5R/2$.