CADET _____ SECTION _____TIME OF DEPARTURE _____

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

CH365 2023-2024
Advanced Plotting in Mathematica
31 October 2023

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 20 November 2023**.
2. This bonus exercise will teach you how to make publication-quality plots in Mathematica.
3. There are 2 problems on 1 page in this exercise (not including the cover page).
4. Save all electronic work in Canvas.

(TOTAL WEIGHT: 30 POINTS)

DO NOT WRITE IN THIS SPACE

PROBLEM	VALUE	CUT
A	20	
B	10	
TOTAL BONUS	30	

Cadet:_____

Problem:	Weight:
A	20

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. This is illustrated in Figure 1, where point d is plotted at 5.00 m^3 and 1.00 bar, and point b is at 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 reproduce the graph of the given Carnot cycle in Mathematica. To receive maximum credit, your plot must have each of the features shown in Figure 1.

Problem:	Weight:
B	10

Use your results from Problem A to calculate the heat absorbed by the system from the hot reservoir, the heat ejected from the system 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:
Direction of cycle: a-b-c-d-a
C_P=7R/2 and C_V=5R/2
R=8.314 J/(mol·K)

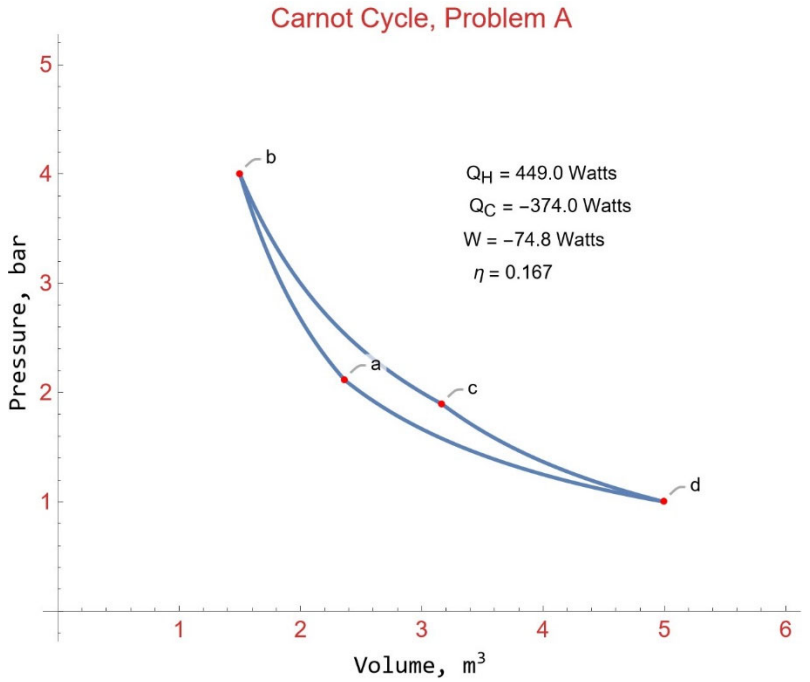

Figure 1. Plot of PV cycle from Problem A, copied from Mathematica.