

CADET _____ SECTION _____ TIME OF DEPARTURE _____

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

CH365 2022-2023
Carnot Cycle Bonus
14 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 21 October 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	15	
B	25	
TOTAL BONUS	40	

Problem: Weight:
A 15

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 m³, 1.00 bar, and 601.4 K to a final state of 2.00 m³, 2.50 bar, and 601.4 K.

(b) Adiabatic compression from an initial state of 5.00 m³, 1.00 bar and 601.4 K to a final state of 2.00 m³ 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.

Problem: Weight:
B 25

A piston contains 0.1 kmol of nitrogen gas initially at 1.00 bar, 5.00 m³, 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 m³ and 4.00 bar.

(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:

$$R=8.314 \text{ J/(mol}\cdot\text{K)},$$

$$C_P=7R/2, \text{ and}$$

$$C_V=5R/2.$$