CADET ____________________ SECTION ______TIME OF DEPARTURE ________

DEPARTMENT OF CHEMISTRY & LIFE SCIENCE

CH365 2024-2025
WRITTEN PARTIAL REVIEW III
20 November 2024, Practice

TEXT: Smith, Van Ness, & Abbott
SCOPE: Lessons 22-32
TIME: 55 Minutes

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

INSTRUCTIONS

1. Do not mark this exam or open it until "begin work" is given.
2. You have 55 minutes to complete the exam.
3. There are 4 problems on 4 pages in this exam (not including the cover page). Write your name on the top of each sheet.
4. Solve the problems in the space provided and in Mathematica or CHEMCAD as required. Show all work to receive full credit.
5. Laptops are authorized for referencing only. Desktop PCs must be used for all calculations.
6. Save Mathematica and CHEMCAD files on your desktop and re-save frequently.
7. When finished, upload all electronic work files to Canvas.

(TOTAL WEIGHT: 200 POINTS)

DO NOT WRITE IN THIS SPACE

PROBLEM	VALUE	CUT
A	50	
B	50	
C	50	
D	50	
TOTAL CUT		
TOTAL GRADE	200	

Cadet:________________________

<u>Problem:</u> <u>Weight:</u>
A 50

Calculate ΔH^{ig} and ΔS^{ig} for the following *ideal* gas-phase molecules compressed and heated from 298.15 K and 1 bar to 750.0 K and 25.00 bar. Report your answers for ΔH^{ig} and ΔS^{ig} in J/mol and J/(mol·K), respectively.

(a) N-Octane
(b) Ethylene
(c) Benzene
(d) Chlorine
(e) Hydrogen

<u>Problem:</u> <u>Weight:</u>
B 50

Use the PR equation of state to calculate the compressibility, residual enthalpy, and residual entropy (Z, H^R, and S^R) for the following molecules at 750.0 K and 25.00 bar. Report your answers for H^R and S^R in J/mol and J/(mol·K), respectively.

(a) N-Octane
(b) Ethylene
(c) Benzene
(d) Chlorine
(e) Hydrogen

Cadet:________________________

Problem: C   Weight: 50

(a) Determine $\Delta H^\circ_{f,298}$, $\Delta G^\circ_{f,298}$, and $\Delta S^\circ_{f,298}$ for the following molecules and complete the following table. Report your answers for enthalpy and Gibbs energy in J/mol and entropy in J/(mol·K).

	$\Delta H^\circ_{f,298}$, J/mol	$\Delta G^\circ_{f,298}$, J/mol	$\Delta S^\circ_{f,298}$, J/(mol·K)
(1) n-Octane			
(2) Ethylene			
(3) Benzene			
(4) Chlorine			
(5) Hydrogen			

(b) Use your results from problems A, B, and C(a) to calculate H and S for the following molecules at 750.0 K and 25.00 bar and complete the table.

	H, J/mol	S, J/(mol·K)
(1) n-Octane		
(2) Ethylene		
(3) Benzene		
(4) Chlorine		
(5) Hydrogen		

(c) Use CHEMCAD and the PR equation of state to calculate H and S for the following molecules at 750.0 K and 25.00 bar and complete the table.

	H, J/mol	S, J/(mol·K)
(1) n-Octane		
(2) Ethylene		
(3) Benzene		
(4) Chlorine		
(5) Hydrogen		

Problem: Weight:
D 50

In class we derived the Gibbs energy generating function (lesson 27 slides 21 and 22, Lesson 28 slide 3, and pages 224-225 in the textbook). The importance of the Gibbs energy generating function is that it is used to derive the residual Gibbs energy, residual entropy, and residual enthalpy (Lesson 28, slides 4 to 6 and pages 225-227 in the textbook).

(a) Use the dimensionless Gibbs energy function G/RT along with the fundamental property relationship for dG and the definition of G (equations 6.11 and 6.4) to show that V/RT and H/Rt are functions of G/RT.

(c) Recall that the Helmholtz energy is based on internal energy and entropy and is defined as (eq. 6.3). Also recall that the fundamental property relation for Helmholtz energy is (eq. 6.10). Instead of Gibbs energy, use Helmholtz energy to derive a generating function for the molar volume and enthalpy. That is, prove that V/RT and H/RT are functions of A/RT.

(b) Explain what is meant by the phrase “residual property.”