Q & A (Questions and Answers)

Q: Hello Dr. Howard, I am working on the Met Thermo Chapter 2 problems and have a question. On problem #8, I had no problem finding the work of the cycle, but have really no idea how to find the max and min temperatures. Can you give me a hint or two on how to go about finding those? Your help is much appreciated!

A: A plot of P vs V (assuming equal scales) will be a mirror image along the 45 degree line into the first quadrant. A line of constant T is also symmetrical about this 45 degree line. Since the position of a constant T line moves away from the origin as T increases, the last point on the 45 for the circular path will be the maximum T and the first contact point on the 45 will be the minimum temperature. A more mathematical proof could be written, but it would be no more true or rigorous.

Q: I am questioning the equation given in the table in your book for V2 of an adiabatic process. For adiabatic, we know that PV^(cp/cv) is a constant.

Thus p1v1^(cp/cv) = p2v2^(cp/cv)
Then p1/p2 = [v2/v1]^(cp/cv)
or [p1/p2]^(cv/cp) = v2/v1
Therefore v2 = v1 [p1/p2]^(cv/cp)
In your table you have v2 = v1[p2/p1]^(cv/cp) so it appears that the subscripts on the p's are reversed.

A: Your work is correct. As you may recall, we addressed the error in the text and it has been corrected. Try updating the link to the file using the "F5" key and download again.

Q: Are the text’s answers for Problem 3.4 correct? I am having trouble getting the same answers as given in the back of the text for Problem 3.4.

A: I confirm the text’s answers. Attached is my work using MathCad, which is a nice computational tool: pdf MathCad. When such errors occur, I suggest you check each term with someone else. If you scroll down on the above files, you will see that I have provided the values for each of the four integrated terms for both the enthalpy and entropy computation. The first file is a pdf in case you do not have MathCad installed on your computer. MathCad is available for free download from the SDSM&T server and in-network use, including vpn connection.

Q: I was wondering if the Excel and MathCad material you covered in class today will be on tomorrow's quiz?

A: They could be. You should know how to use at least one of the computational tool: Excel Macro or MathCad. Alternatively, you may also use your user-defined calculator functions, but if that is your choice you need to be ready to describe how to create them.

Q: I'm working on chapter 5 homework and having difficulties with the first several problems that involve **derivations. For example, Problem 5.1, the book answer in the back uses the total differential H(T,P)** to solve the problem. However, in my notes and the book I only see that H(S,P) and not sure how they arrived then at dH=(dh/dT)dT+(dH/dP)dP? If you could provide me some guidance or insight on this, it would be greatly appreciated.

A: Just because we said during the derivation of the "Other" Thermo relationships that H(S,P) does not preclude our writing H as a function of any two other intensive variables. You may recall from Chapter 1 that fixing any two intensive variables fixes all intensive variables in a 'simple' (one component, i.e. pure) system. We selected S and P so as to obtain the "Other" thermo relationships, but in Problem 5.1 it is useful to choose two other independent variables; viz. T and P. In that case dH=(dH/dT)pdT+(dH/dP)TdP is simply the total differential when H= f(T,P).

Q: Would you explain again what I am supposed to do on the graphical integration of (z-1)/Pr dPr to get the fugacity coefficient?

Are we to extend the plot to Pr = 5?

Do you want us to continue in 0.5 increments or just whole integers between 2 and 5?

Are we reading the z-values directly off of the chart given in class?

Are the values of the vertical axis on the hand-out our z-values?

Looking at the table we made in lecture, z~0.82 at Pr=0.5, which corresponds well to the handout, however z~0.2 at Pr=1. Was that a glaring error made in class or is z~0.2 correct and how was that value determined?

A: You are to use Figure 8.4 to obtain values of z so that you can construct a plot of (z-1)/Pr versus Pr. The area from 0 to any Pr is the ln(fi/Pi), which is also called the fugacity coefficient. You are to compare the results you get from graphical integration of your plot (use the trapezoid rule to get areas) with the values on the handout provided in class of f/p versus Pr (plotted on log-log scales).

Extend it to the maximum Pr on Table 8.4: 7.

After Pr=2, you may proceed in increments of 1.

No. The z values come from Figure 8.4, not the class handout.

No. They are the fugacity coefficients that you are to compute via graphical integration. The result of the integration are fugacity coefficients to be plotted on the class handout to confirm the quality of your graphical integration.

You need to read z values from Figure 8.4 in the textbook (Gaskell). The chart handed out in class are not z values. The results of your integration should be plotted on the figure of (f/p) versus Pr handed out in class.

Q: What time and day will the MET 320 Final Exam be?

A: Thursday Dec 12, 2013, 11:00 am -12:50 pm (the first day of finals) - Dec 11, Wednesday, is a dead day set aside for student preparation. See http://www.sdsmt.edu/academics/registrar/docs/final-examination-schedule-for-fall-2013/

Q: How does one find the Keq for problem #4 on posted old exam HQ3-2011?

4. Solve for the equilibrium moles of CO at 900 K for a system at a total pressure of 2 atm initially containing 3 moles of CO_2, 1 mole of O_2, and 16 moles of CO.

$$CO_{(g)} + 0.5\ O_{2\,(g)} = CO_{2\,(g)} \qquad \Delta G^{\circ} = \text{(see data)}$$

A:

To get K_{EQ} , find $\Delta G_3°$ for the reaction using the data in Table A1 in Gaskell. You will need to combine the two reactions below to obtain the desired reaction.

$C + O_2 = CO_2 \qquad \Delta G_1° = -394{,}100 - 0.84T$

$-\{C + ½\, O_2 = CO \qquad \Delta G_2° = -111{,}700 - 87.65T\}$

$CO + ½\, O_2 = CO_2 \qquad \Delta G_3° = -394{,}100 - 0.84T – (-111{,}700 - 87.65T) = -282{,}400 + 86.81T$

$\Delta G_3° = -RT\ln K_{EQ} \qquad K_{EQ} = 1.375\text{x}10^{-12}$ (Note: this agrees with ThermoCalc, $1.396\text{x}10^{-12}$.)

****

As it turns out, this is not a very good reaction extent problem since the reaction scarcely proceeds. A good reaction problem needs a K around unity. I was thinking of the following reaction and intended to use it instead.

$C + O_2 = CO_2 \qquad \Delta G_1° = -394{,}100 - 0.84T$

$-2\{C + ½\, O_2 = CO \qquad \Delta G_2° = -111{,}700 - 87.65T\}$

$2CO = C + CO_2 \quad \Delta G_3° = -394{,}100 - 0.84T –2\,(-111{,}700 - 87.65T) = -170{,}700 + 174.46T$

$\Delta G_3° = -RT\ln K_{EQ} \qquad K_{EQ} = 6.228$ (Note: this agrees with ThermoCalc, 5.6.)