SIS Quiz Solution

1. In what two ways does a thermodynamic analysis augment chemical reactor design?

    Thermodynamics tells us if (1) the design conversion is feasible and (2) the heat duty of the reactor. //ANS

2. In what way does a thermodynamic analysis enable distillation design?

    K-values are calculated from thermodynamic methods. //ANS

3. Define entropy.

    (1) Unavailability of a system's thermal energy for conversion into mechanical work, and (2) the degree of disorder or randomness in the system. //ANS

4. True or False: Joan's resume for the writing assignment requires a cover sheet.

    True. //ANS

5. True or False: I must purchase a textbook for this course.

    True. //ANS

6. Mitch needs AI but the only time he has is Tuesday at 0930. Are there any constraints on instructor availability that time?

    Yes, AI is possible, but not during class time. //ANS

7. How can personal laptops be used on the WPRs?

    As a reference only. //ANS

8. A problem set with ten problems is due on a Friday at 1630. Cadet Jones submits five out of ten of the problems on time and five problems were submitted separately at 0705 on Saturday morning. Of the five on-time problems, one was perfect and four had minor errors. Of the five late problems, one had minor errors, three were perfect, and one showed an answer with no work. Use the rubric and grading policy to compute the score before resubmission.

    10 + 4*4 + (4-2) + 3*(10-2) + (0)=52/100. //ANS

9. Cadet Jones' grade was posted on Sunday, so she resubmitted the entire problem set Monday at 1600. All problems were perfect, errors were identified, and corrections explained. Use the rubric and the resubmission policy to compute the new score.

    10 + 4*9 + (4-2) + 3*(10-2) + (0)=72/100. //ANS

10. Cadet Jones' grade was posted on Sunday, so she resubmitted the entire problem set Monday. She used the approved solution to produce a perfect solution, but she failed to identify her mistakes and how she repaired them. Use the rubric and the resubmission policy to compute the score.

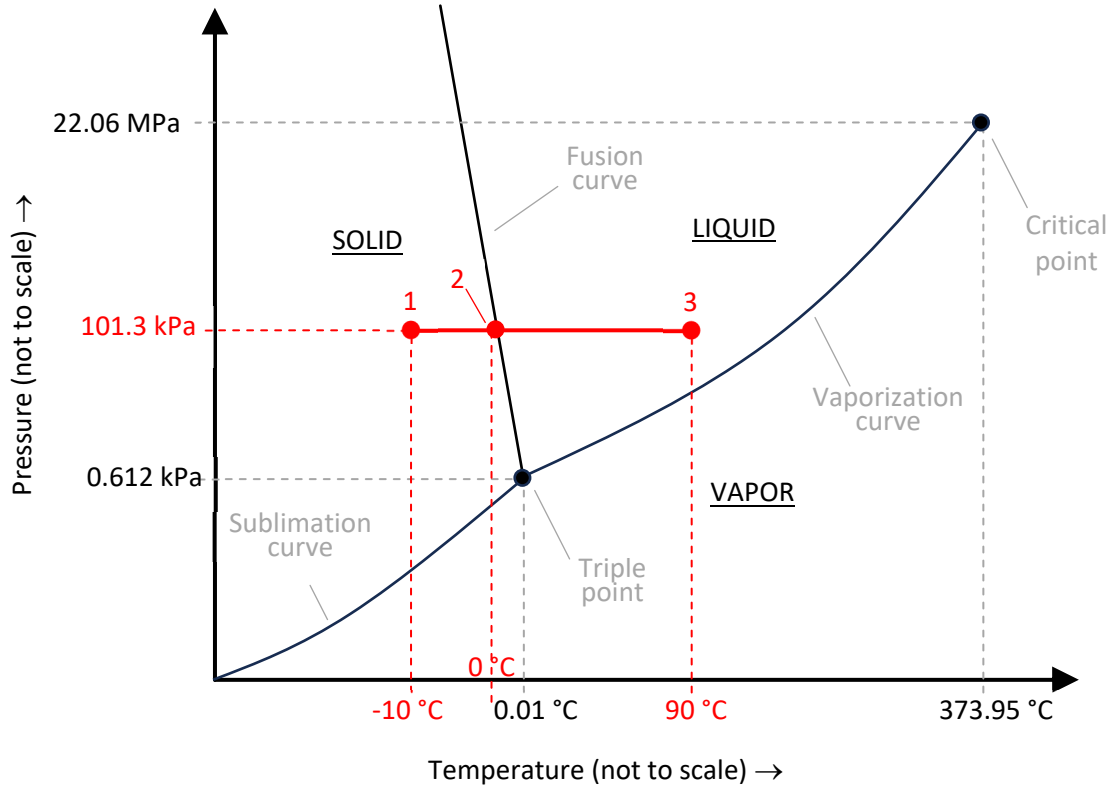
    52/100 (NO CHANGE). //ANS

11. Cadet Halsey submitted all ten problems on Friday at 1635, answers were all perfect, and detailed work was provided. Use the rubric to compute his score.

10*(10-2)=80/100 //ANS

12. Calculate the total heat (in J) required to raise the temperature of 125 g of water from -10°C to 90°C at constant pressure of 1 atm (101.3 kPa). Use $q = n\Delta H^{o}_{fus}$ (where n is the number of moles) to calculate the heat of fusion of water, and use $q = mC_S\Delta T$ to calculate the heat associated with temperature changes of liquid and solid water. Add these heats to determine the total change in enthalpy. The specific heat capacity (C_S) of solid water is 2.09 J/g·K and ΔH^{o}_{fus} of water is 6.09 kJ/mol.

Solution: (from CH101 Lesson 34):
G: mass of water and temperature range
F: enthalpy change of water over the given temperature range
P: process goes from 1 to 2(s) to 2(l) to 3 in the diagram below.



ice at -10°C (1) $\xrightarrow[mC_S\Delta T]{\Delta H^{12}}$ ice at 0°C (2) $\xrightarrow[n\Delta H^{o}_{fus}]{\Delta H^{22}}$ liq water at 0°C (2) $\xrightarrow[mC_S\Delta T]{\Delta H^{23}}$ liq water at 90°C (3)

$$\Delta H^{total} = \Delta H^{12} + \Delta H^{22} + \Delta H^{23}$$

S:

$$\Delta H^{12} = 125\,g \cdot \frac{2.09\,J}{g \cdot K} \cdot (273.15\,K - 263.15\,K) = 2612.5\,J$$

$$\Delta H^{22} = 125\,g \cdot \frac{1\,mol}{18.016\,g} \cdot \frac{6.09\,kJ}{mol} \cdot \frac{1000\,J}{1\,kJ} = 42254.1\,J$$

$$\Delta H^{23} = 125\,g \cdot \frac{4.184\,J}{g \cdot K} \cdot (363.15\,K - 273.15\,K) = 47\underline{0}40\,J$$

$$\Delta H^{total} = 26\underline{1}2.5\,J + 42\underline{2}54.1\,J + 47\underline{0}70\,J = 91\underline{9}36.6\,J = 91\underline{9}00\,J = 9.19 \times 10^4\,J$$

R: ΔH from 1 to 2 and 2 to 3 are "sensible heats" and ΔH of the phase change is "latent heat."

Comment 1: Cadets should visualize the process. Sketch the process in a phase diagram before doing the calculation.	Comment 2: Specify pressure (above triple point) and specify pressure is constant. Liquid and solid enthalpies do not depend on pressure, but this is not covered.