Date: February 26, 2008
To: CHEN 2AA0 Students
From: Professor Ronald D. Neuman
Subject: Important Update on CHEN2AA0 Progress Assessment Examination

The Department of Chemical Engineering (via the Department Chair and Curriculum and Accreditation Planning and Action Committee) has implemented a change to the structure and grading of the Progress Assessment Examination. Beginning with the second exam of this term (10 March 2008) the exam will consist of fifteen (15) "multiple choice" problems (as in the previous exam) and five (5) "show work" problems which will not be "multiple choice". The five "show work" problems will be clearly indicated on the exam sheet and are selected from among the original twenty problems on the exam. No new problems types or other new material is being tested on.

This new exam structure has several advantages for both the student and the department. There is an incentive for students to apply and the department to evaluate problem-solving (methodology and strategy) skills to both scientific and engineering bases problems.

"Show work" problems will be graded on a "pass or fail" basis depending on the solution methodology demonstrated by the student's work sheet. As has always been required, each problem should be worked on a separate page of paper and clearly identified. A "pass grade" will be awarded when the student has demonstrated a correct approach to solving the problem and identified all the key elements (information, equations, etc) necessary to solve the problem. In this approach, a "correct answer" is not necessary as simple math mistakes or other minor errors will not be considered as "failure". As long as the student provides a solution methodology appropriate for correctly solving the problem along with identifying the required information, a "pass" will be awarded.

Please note: It should be stressed that a final answer is required. Students will not be awarded a "pass" for just citing some of the relevant equations or providing a "word description" of how to proceed. A complete solution will need to be provided.

The grading of the exam will not change (that is, you will still need to have a correct answer or "pass" on at least 60% of the problems).

As an example of what is expected, please see the solution to Problem 9a and 18a of the CHEN 2AA0 Progress Assessment I Sample Exam below.

19.518.5.60a

9a. 5.0 kg of steam are placed in a tank at 1000 kPa (abs) and 250 °C. The tank is then cooled until the pressure is 200 kPa (abs) during which some of the steam condenses. What mass of steam (kg) condensed?

(a) 0.2771 kg (b) 1.8223 kg (c) 3.6955 kg (d) 4.7229 kg (e) none of these

Basis 5 kg steam @ 1000 kPa and 250 °C

Initial Conditions: $\Delta H_v = 2942.6$ kJ/kg

$\hat{V} = 0.2327$ m³/kg.

Final Conditions: P = 200 kPa (chart sat'd @ 198.53 kPa is close enough)

$T_{sat} = 120°C$ $\hat{V}_v = 0.8919$ m³/kg $\hat{V}_L = 0.00106$ m³/kg

$\Delta H_v = 2706.3$
$h_L = 503.71$
$\Delta h_{vL} = 2202.6$
} kJ/kg

$V_{tank} = m \cdot \hat{V}_v = 5\ kg\left(0.2327 \frac{m^3}{kg}\right) = 1.1635\ m^3$

$M_{vapor\ final} = \frac{V_{tank}}{\hat{V}_{vf}} = \frac{1.1635\ m^3}{0.8919\ m^3/kg} = 1.3045$ kg.

∴ mass steam condensed

$5 - 1.3045 = 3.695$ kg.

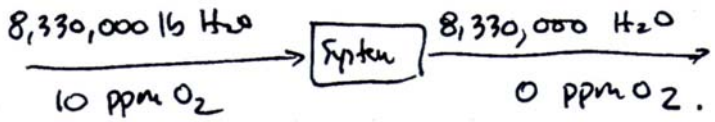
19.180.3.11

18a. Corrosion of pipes in boilers by oxygen can be alleviated through the use of sodium sulfite. Sodium sulfite removes oxygen from boiler feedwater by the following reaction:

$$2\ Na_2SO_3 + O_2 \rightarrow 2\ Na_2SO_4$$

How many pounds of sodium sulfite are required (for complete reaction) to remove the oxygen from 1.0 million gallons of water containing 10.0 parts per million of dissolved oxygen and at the same time maintain a 35% excess of sodium sulfite?

(a) 332 lb (b) 886 lb (c) 3057 lbs (d) 2126 lb (e) none of these



Basis 10^6 gal = 8,330,000 lb H_2O

$$O_2 \text{ entering} = \frac{8{,}330{,}000 \text{ lb } H_2O}{(1{,}000{,}000 - 10 \text{ lb } O_2) \text{ lb } H_2O} = 83.3 \text{ lb } O_2$$

$$\frac{83.3 \text{ lb } O_2}{} \left| \frac{1 \text{ lb mol } O_2}{32 \text{ lb } O_2} \right| \frac{2 \text{ lb mol } Na_2SO_3}{1 \text{ lb mol } O_2} \left| \frac{126 \text{ lb } Na_2SO_3}{1 \text{ lb mol } Na_2SO_3} \right| 1.35$$

$$= 886 \text{ lb } Na_2SO_3$$