CHE 205 --- Chemical Process Principles **Fall 2005**

TEST #1. Open textbook/closed notes and workbook. Put your name, section (1–Bullard, 2–Felder), and "Test #1" on the outside of your blue book. *Begin each numbered problem on a new page, show all your work, and box your answers.* (Note: The numbers in parentheses next to each part of each problem are point values for that part.) Note that the exam has a front and back side.

1. (10 pts) A steadily flowing stream of liquid acetone is funneled into a flask for 2.00 minutes, during which time 100.0 ft^3 is collected. Calculate the volumetric flow rate $\dot{V}$, the mass flow rate $\dot{m}$, and the molar flow rate of the stream $\dot{n}$, all in American engineering units. Use correct significant figures.

2. (20 pts) The pressure (P) and volume (V) of the air in a cylinder of an air compressor are measured at two conditions. The two variables are theoretically supposed to be related by the equation

$$PV^k = C$$

where k and C are constants. The two data points are (P_1, V_1) and (P_2, V_2).

(a) (15) Write the equations that you would use to determine k and C as a function of the given data points. Your final answer should solve explicitly for k =... and C =...

(b) (3) Suppose P_3 is measured for volume V_3, and the measured value is significantly different from the one you calculated using the equation in Part (a). Assuming that you didn't make any mistakes in your measurements or calculations, what is a probable cause of the discrepancy?

(c) (2) Pressure is defined as force/area. What does the statement "15.5 lb_f/in^2 = 800 mm Hg" mean?

3. (20 pts) A rectangular tank 3.0 m long by 1.0 m wide is filled with liquid methyl ethyl ketone (MEK, S.G. = 0.805) to a depth of 5.0 m on a day when atmospheric pressure is 772 mm Hg.

(a) (17) Write equations that would enable you to calculate the force F(N) acting on the bottom of the tank. Do *not* do the numerical calculations.

(b) (3) What is the gauge pressure at the bottom of the tank, P_g, in units of meters of MEK? (This should not take much time.)

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4. (40 pts) A liquid stream flows into a distillation column. It contains 60.0 mole% of A (MW = 20.0, SG = 1.00) and the rest is Species B (MW = 50.0, SG = 2.00). The production rate of the bottom product is 100.0 mol/s and the mole fraction of B in the bottom product stream is 0.90. Of the A fed to the column, 15% emerges in the bottom product.

(a) (13) Draw and *completely* label a flow chart of the process and carry out the degree-of-freedom analysis.

(b) (27) Write the complete set of equations you would solve for all flowrates and compositions, as well as the fraction of B in the feed stream that emerges in the overhead product, and the *volumetric* flow rate of the feed stream (cm^3/s). State all assumptions you make. *Just write the equations: don't do any algebra or arithmetic.*

5. (10 pts) Felder and Rousseau, Problem 4.9, p. 158, Parts (a) and (b) only.

HONOR PLEDGE: "I have neither given nor received unauthorized aid on this test."

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Student Signature

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