中國文化大學 100 學年度轉學招生考試

系組：化學工程與材料工程學系三年級　　日期節次：7 月 27 日第 2 節 11:00-12:20

科目：**質能均衡**　　(39-166)

1. (15 pts) Explain the following terms:

(a) The method of least squares

(b) Gauge pressure

(c) Semibatch process

(d) Scale factor

(e) Steam table

2. (10 pts) A mixture of gases has the following compositions by mass:

Component *i*	O_2	CO	CO_2	N_2
Mass fraction x_i (g *i*/g total)	0.16	0.04	0.17	0.63

What are the molar compositions of each component?

3. (15 pts) A mass flow rate Φ is measured as a function of temperature *T*.

T (℃)	10	20	40	80
Φ (g/s)	14.76	20.14	27.73	38.47

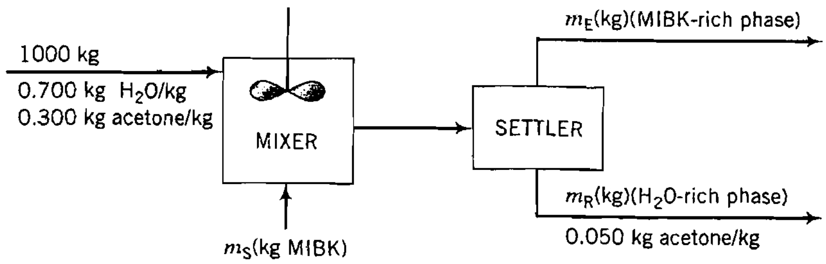
There is reason to believe that Φ varies linearly with the square root of *T*:

$$\Phi = aT^{1/2} + b$$

Use a straight-line plot to verify this formula and then determine the parameters *a* and *b*.

4. (20 pts) Five hundred kilograms per hour of steam drive a turbine. The steam enters the turbine at 44 atm and 450°C at a linear velocity of 60 m/s and leaves at a point 5 m below the turbine inlet at atmospheric pressure and a velocity of 360 m/s. The turbine delivers shaft work at a rate of 70 kW, and the heat loss from the turbine is estimated to be 104 kcal/h. Please calculate the specific enthalpy change associated with the process.

5. (20 pts) One thousand kilograms of a 30.0 wt% solution of acetone in water and a second stream of pure methyl isobutyl ketone (MIBK) is fed to a mixer. The mixture is then fed to a settler where two phases form and are withdrawn separately at 25°C. Assuming that the fluids remain in the settler long enough for achieving equilibrium, how much MIBK must be fed to the process to reduce the acetone concentration in the water-rich phase to 5 wt%? (The behavior of partially miscible H_2O-MIBK-acetone system is shown in Fig. 1)



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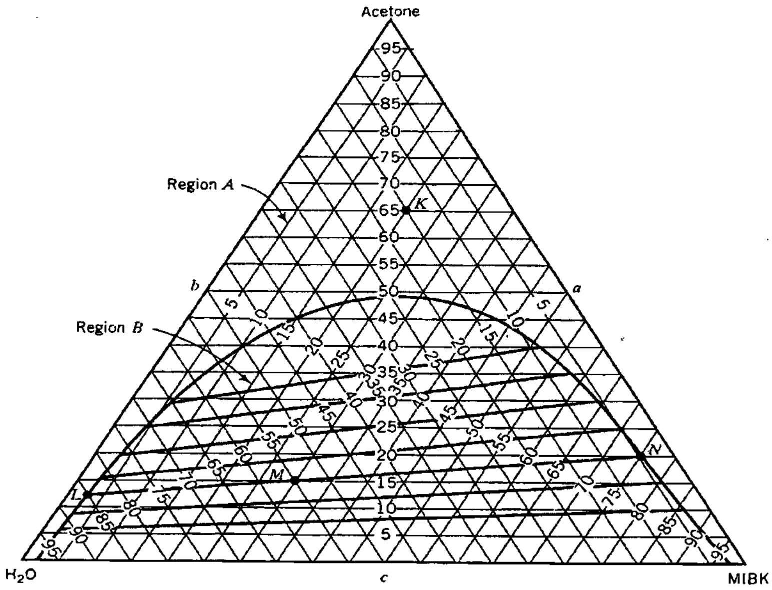
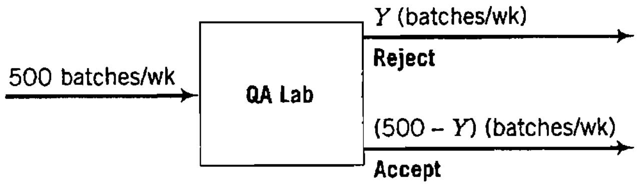


Fig. 1 The phase diagram of H_2O-MIBK-acetone system at 25°C

6. (20 pts) Five hundred batches of a pigment are produced each week. In the plant's quality assurance (QA) program, each batch is subjected color analysis test. If a batch does not pass the test, it is rejected and sent back for reformulation.



Let Y be the number of bad batches produced per week, and suppose that QA test result for a 12-week base period are as follows:

Week	1	2	3	4	5	6	7	8	9	10	11	12
Y	17	27	18	18	23	19	18	21	20	19	21	18

The company policy is to regard the process operation as normal as long as the number of bad batches produced in a week is no more than three standard deviations above the mean value for the base period (i.e., as long as $Y \le \bar{Y} + 3S_Y$). If Y exceeds this value, the process is shut down for remedial maintenance (a long and costly procedure). Such large deviations from the mean might occur as part of the normal scatter of the process, but so infrequently that if it happened the existence of an abnormal problem in the process is considered the more likely explanation.

(a) How many bad batches in a week would it take to shut down the process?

(b) What would be the limiting value of Y if two standard deviations instead of three were used as the cutoff criterion? What would be the advantage and disadvantage of using this stricter criterion?

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