

EngrD 2190 – Lecture 20

Concept: Process Analysis - Graphical Modeling

Context: Liquid+Vapor Phase Maps and
Tie Lines with the Lever Rule

Defining Question: What is the first step when using a phase map?

Read Chapter 4, pp. 262-267.

Graphical methods for combined mass & energy balances.

Lecture 22 will cover same concepts, but in a different context.

Bring a Straightedge or Ruler to Lecture 21.

2025 Distinguished Raymond G. Thorpe Lecture

**Marlene Quijano**

(Retired) Vice President

Kraft Foods R&D

My Personal Journey- How Cornell's Chemical Engineering became my Life's "Secret Ingredient"

In the 2025 Raymond G. Thorpe Lecture, Marlene M. Quijano, a retired Vice President of R&D at Kraft Foods, shares her personal journey and experiences as a Cornell Chemical Engineering graduate. She reflects on how her education at Cornell shaped her career and life, emphasizing the importance of character, self-discipline, determination, and service. Marlene discusses her passion for chemistry and innovation, inspired by her mother's cooking, and how it led her to a successful career in R&D. She highlights the transformative impact of Cornell's financial aid and mentorship, particularly from Professor Thorpe, on her academic and professional development. Marlene also provides insights into her diverse career path, professional achievements, and the lessons learned from overcoming challenges. She concludes with advice on embracing opportunities, building networks, and giving back to the community.

Marlene Quijano is a retired Vice President of Kraft Foods R&D with 30 years of experience in leadership roles across innovation; product and process development; quality; product and process cost management; packaging and engineering. Marlene also held cross-functional assignments in supply chain and human resources. Marlene holds a bachelor's degree in chemical engineering from Cornell. She served as the Kraft Key School recruiter for over 15 years as well as serving on The Cornell Food Science Advisory Board and the Chemical Engineering Advisory Council. She is a member of Cornell's President's Council of Cornell Women where she is currently Vice Chair of Mentoring. She is passionate about giving back and established the Marlene Quijano Class of 1985 Engineering Scholarship in the College of Engineering to make a transformative difference in the lives of students. Marlene lives in Harrington Park, NJ, and is the mother of twins who she is raising bilingual and bicultural. Marlene is Cuban-American and is fluent in Spanish and English.

October 20, 2025**4:00 PM****155 Olin Hall**

Pre-seminar reception at 3:30 p.m. in 128 Olin (Rhodes Lounge)

LinkedIn Page Excellence



Maame Boatemaa Amanpene-Sekyere · 3rd

Chemical Engineering Student at Cornell University

Bedford, New Hampshire, United States · [Contact info](#)

186 connections

[Connect](#)



Cornell University



Cornell University

About

I'm a Chemical Engineering student passionate about process design, separations, and water treatment, with growing interests in the pharmaceutical and food & drug industries. Recently, I've also developed a curiosity for nanotechnology and its potential to transform healthcare and sustainable systems. I enjoy bridging theory and practice—whether translating PFDs into real systems, exploring membrane technologies, or applying ChemE principles to create reliable, people-centered solutions. Active in NSBE, AIChE, and SWE, I value collaboration, mentorship, and hands-on learning.

Activity

188 followers

Maame Boatemaa hasn't posted yet

Recent posts Maame Boatemaa shares will be displayed here.

Experience



Undergraduate Research Assistant, Lavagnino Lab

Cornell University

Sep 2025 - Present · 2 mos

Ithaca, New York, United States



Petroleum Operations Intern

Ghana National Petroleum Corporation

May 2024 - Jul 2024 · 3 mos

Immersed in GNPC's upstream environment, observing how multidisciplinary teams manage the project lifecycle and HSE standards. Joined daily ops briefings, reviewed documentation workflows, and saw... [more](#)



Biomedical Laboratory Intern

Korle-Bu Teaching Hospital · Part-time

Mar 2023 - Jun 2023 · 4 mos

Supported physiology, anatomy, and biochemistry labs alongside faculty, prepared and analyzed microscopy slides, and streamlined instruction by organizing lab records and teaching materials.

Education



Cornell University

Bachelor's degree, Chemical Engineering

Aug 2024 - Apr 2028

Organizations

American Institute of Chemical Engineers (AIChE)

Aug 2025 - Present



Associated with Cornell University

LinkedIn Page Excellence



Lila CHAMI She/Her · 3rd

Chemical Engineering Student | Cornell University

United States · [Contact info](#)

117 connections



Connect



Message



Food Science Product
Development Club at Cornell



Cornell University

About

Hi! I'm Lila, a sophomore Chemical Engineering major at Cornell University, and passionate about creating a more sustainable future and innovate the food industry. To me, innovating means pushing the boundaries of what is possible, while anticipating and responding to tomorrow's needs. The world will always need to be fed, and I believe it can be done in a way that is more delicious, nutritious and sustainable.

My interest includes Research & Development, particularly in areas such as food quality, texture and microstructure.

Activity

119 followers

Posts

Comments

+ Follow

Experience



Membership Committe

Food Science Product Development Club at Cornell

Oct 2025 - Present · 1 mo



Internal Operations Committe Member

Cornell International Students Union - ISU

Sep 2025 - Present · 2 mos



Summer Intern

AGRIN MAROC · Internship

Jul 2025 - Aug 2025 · 2 mos

Fès-Meknès, Morocco · On-site

High-Performance Liquid Chromatography (HPLC), Gas Chromatography and +4 skills



Student Intern

Natixis Partners · Internship

Mar 2022 - Apr 2022 · 2 mos

Paris, Île-de-France, France · On-site

Familiar with

- Private Equity... more

Investment Strategies, Public-private Partnerships and +1 skill



Introductory Internship

AGRIN MAROC · Internship

Jun 2021 - Jul 2021 · 2 mos

Fez, Fès-Meknès, Morocco · On-site

Intro to supply chain

Negotiation of export sales... more

Market Research, Analytical Skills and +3 skills

LinkedIn Page Excellence



Eleanor Fredine ✓ · 3rd

Chemical Engineering @ Cornell | Undergraduate Researcher, Daniel Lab

Ithaca, New York, United States · [Contact info](#)

126 connections



Cornell University

[Connect](#)

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About

I am a Chemical Engineering student at Cornell University graduating in May 2028. I have a strong interest in process development and applications of chemical engineering to the pharmaceutical industry.

Activity

126 followers

[Posts](#)

[Comments](#)

[+ Follow](#)

Experience



Quality Engineering Intern

Monteris Medical · Internship

May 2025 - Present · 6 mos

Minnetonka, Minnesota, United States · On-site

-Proposed and developed a fully automated supplier scorecard creation tool, streamlining performance tracking of 350+ suppliers, decreasing scorecard creation time per supplier from 20 minutes to 30... [more](#)

♥ **Python (Programming Language), QA Engineering and +3 skills**



Undergraduate Researcher

Daniel Lab

Jan 2025 - Present · 10 mos

Ithaca, NY · On-site

Developing a nose-on-chip diagnostic platform for aspiration pneumonia. Responsible for the cell-free expression and characterization of an olfactory binding proteins and the conducting of market... [more](#)

♥ **Laboratory Skills and Experimental Design**



AEW Facilitator/ELI Tutor

Cornell Engineering Learning Initiatives · Part-time

Aug 2024 - Dec 2024 · 5 mos

Ithaca, New York, United States · On-site

Organized, planned, and facilitated a one-credit academic excellence workshop for MATH 1920 (Multivariable calculus)... [more](#)



Summer Camp Supervisor

STEM Builders Learning Center · Full-time

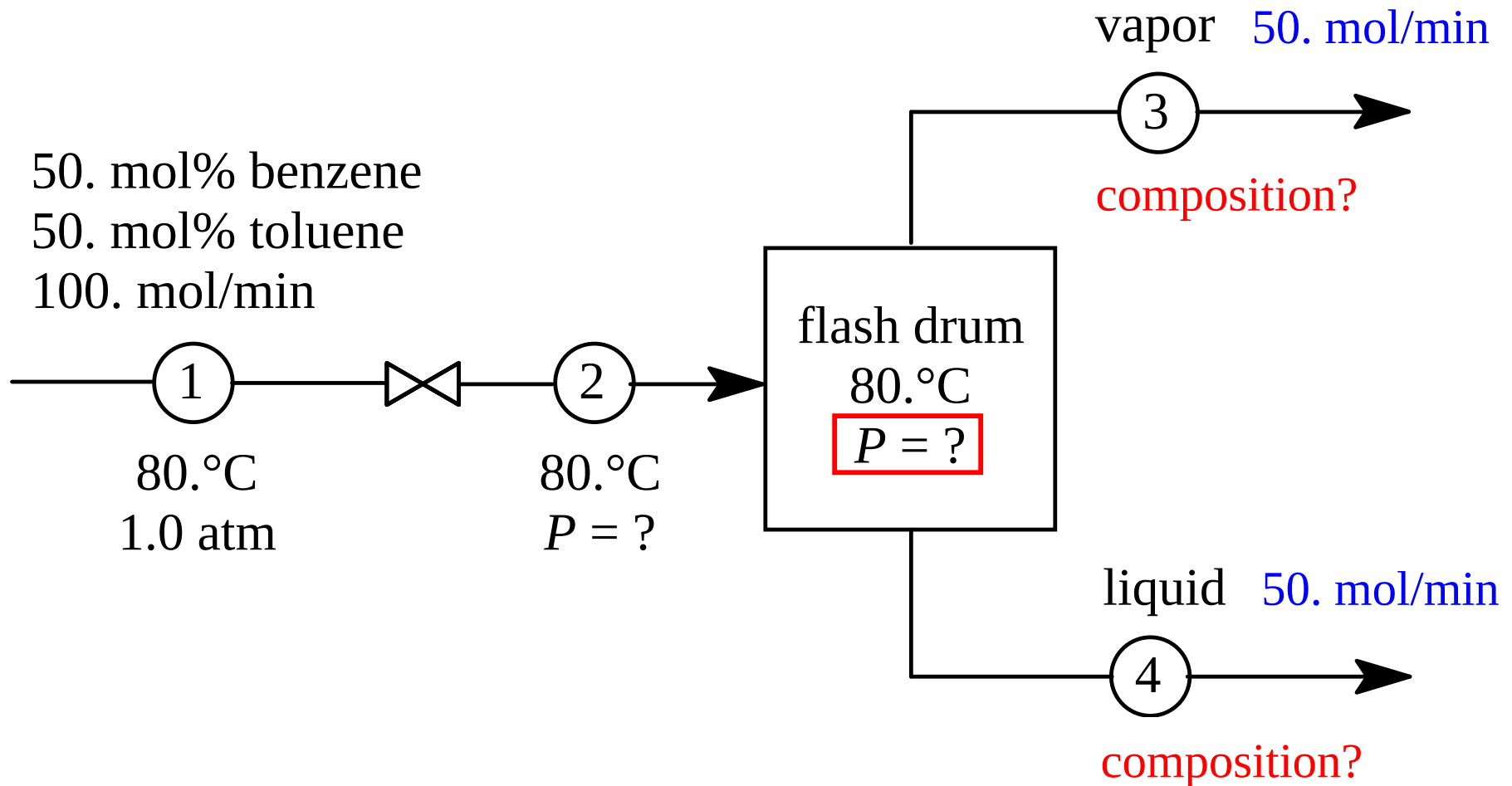
Jun 2024 - Aug 2024 · 3 mos

Blaine, Minnesota, United States · On-site

Supervised a team of instructors leading concurrent, week-long STEM summer camps for students ages 6-12. Also planned, organized, and executed STEM-enrichment activities for the students.

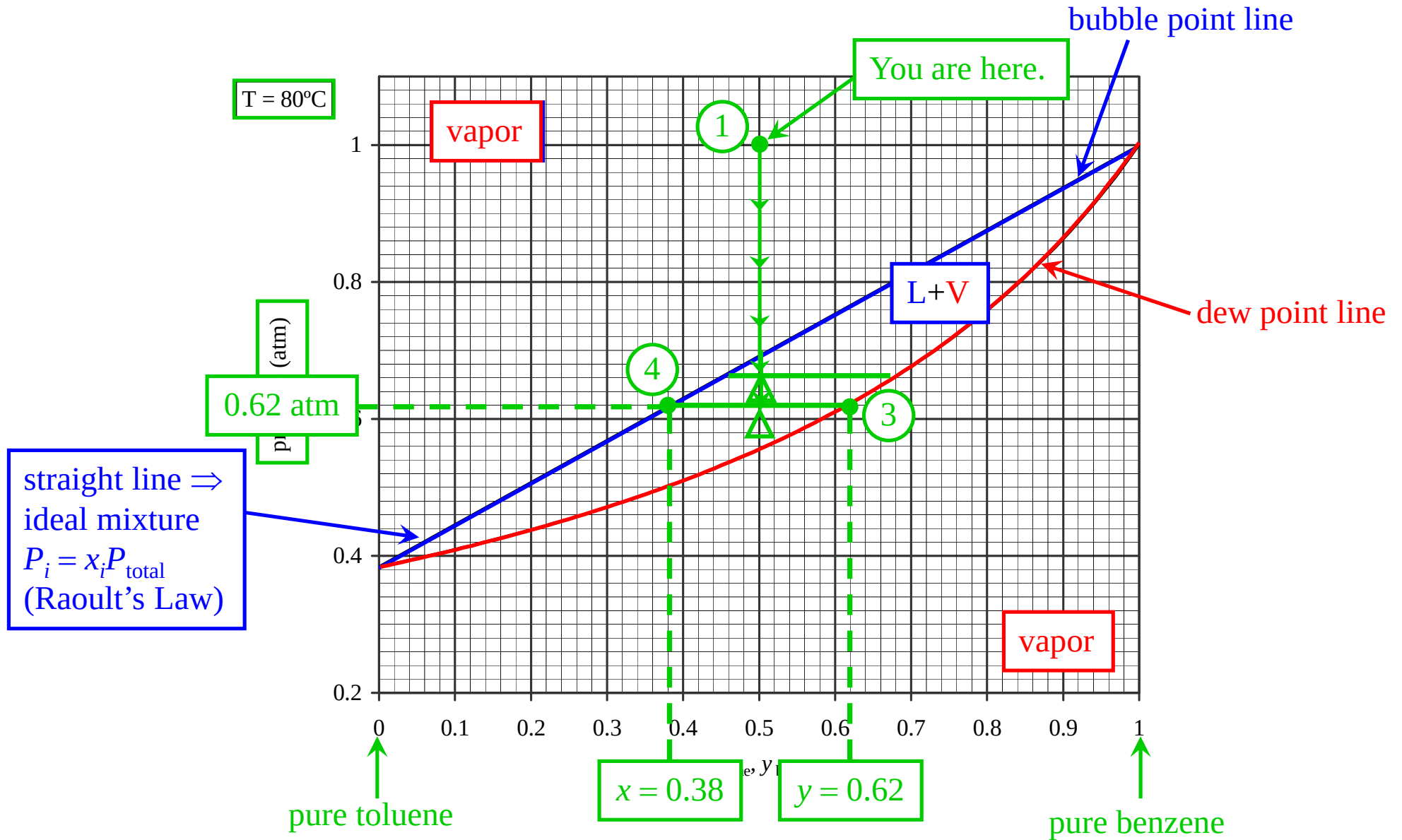
♥ **Working with Children**

Flash Drums: Example 2

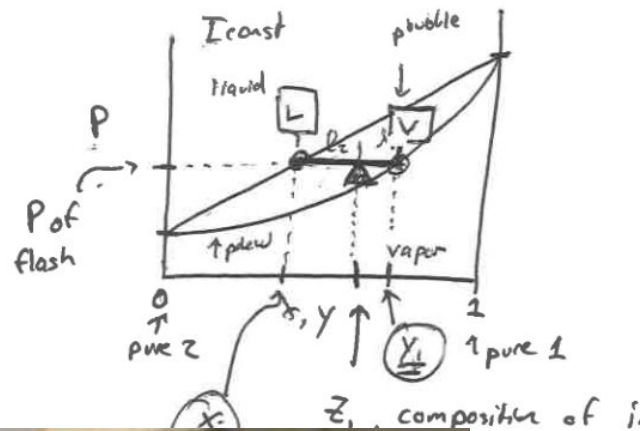


Example 2.

Benzene+Toluene Mixtures at Equilibrium



- Graphical solution to flash calculations.



use

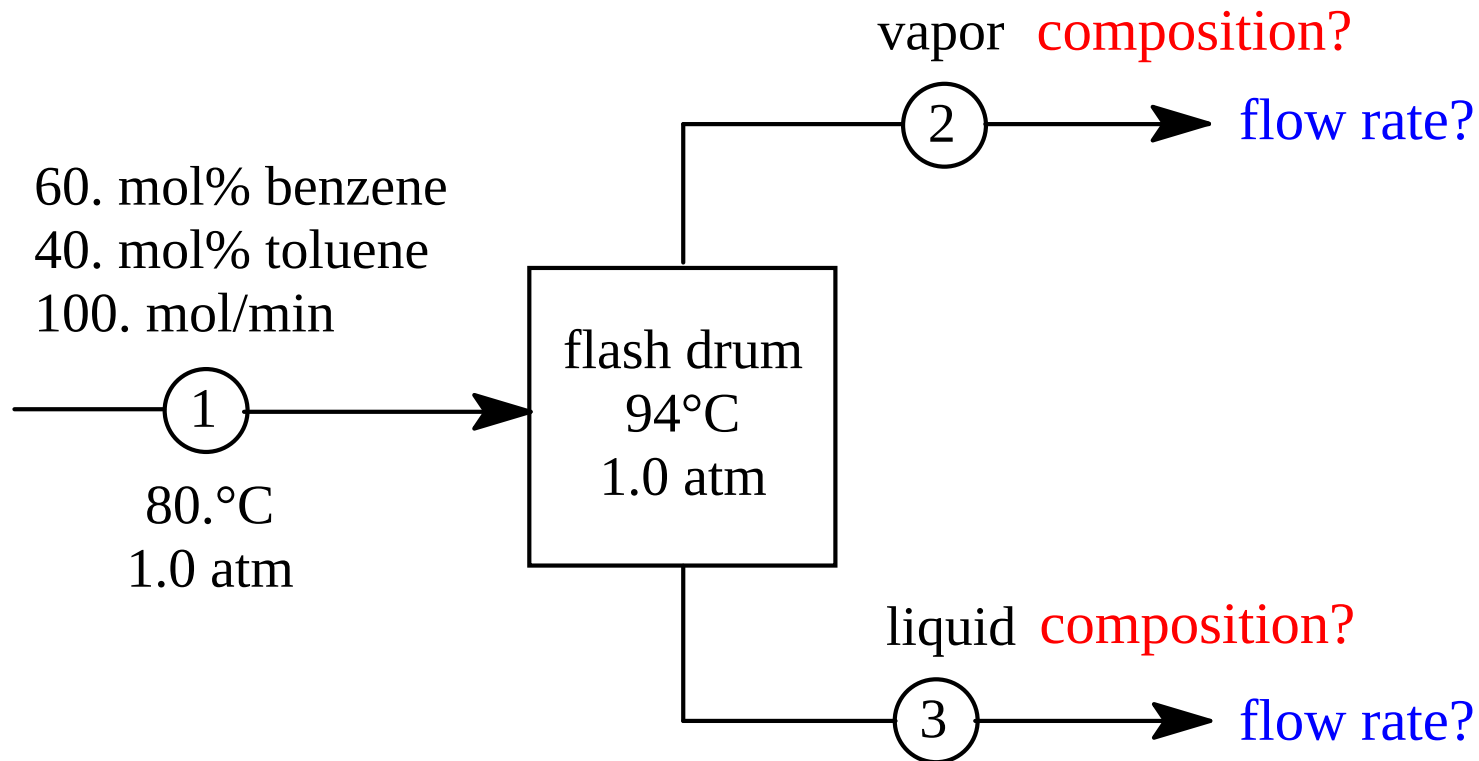
$$\frac{y_1 - z_1}{y_1 - x_1} = \frac{L}{V}$$

$$\frac{y_1 - z_1}{y_1 - x_1} = \frac{L}{V}$$



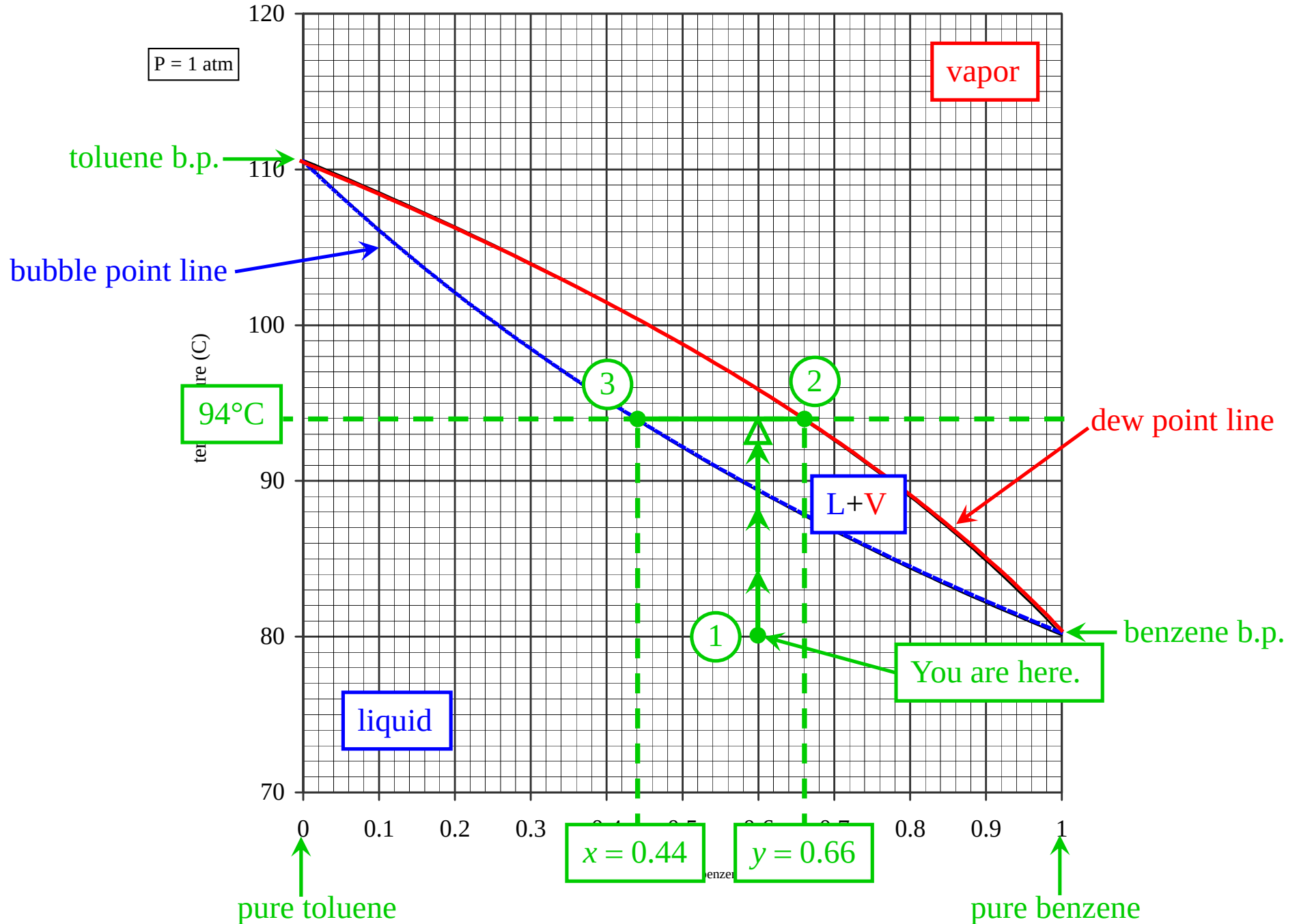
Lecture 10/23/23 by Joshua Lequeieu, B.S. ChemE Cornell 2010.
Assistant Professor of Chemical Engineering, Drexel University

Flash Drums: Example 3

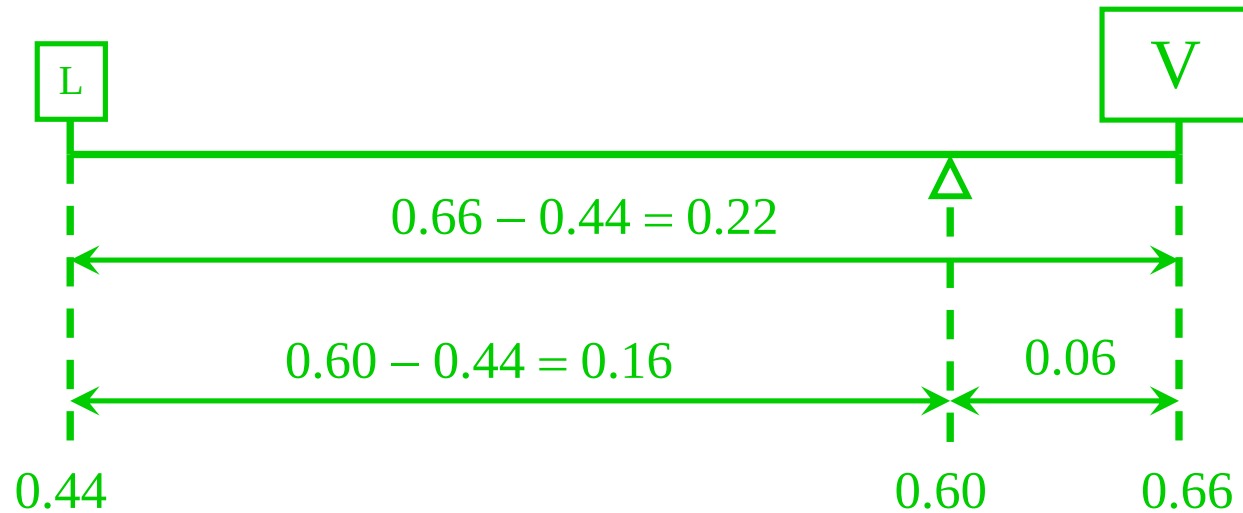


Example 3.

Benzene+Toluene Mixtures at Equilibrium



Example 3: Apply the Lever Rule to the Tie Line



$$\begin{aligned} \text{vapor flow rate} &= \left(\frac{0.16}{\cancel{0.06}} \right) \times 100 \text{ mol/min} = \cancel{27.27 \text{ mol/min}} \\ &= \cancel{73.73 \text{ mol/min}} \\ &= 74 \text{ mol/min} \end{aligned}$$

Distance from $x = 0$ to $x = 1$ is 143 mm.

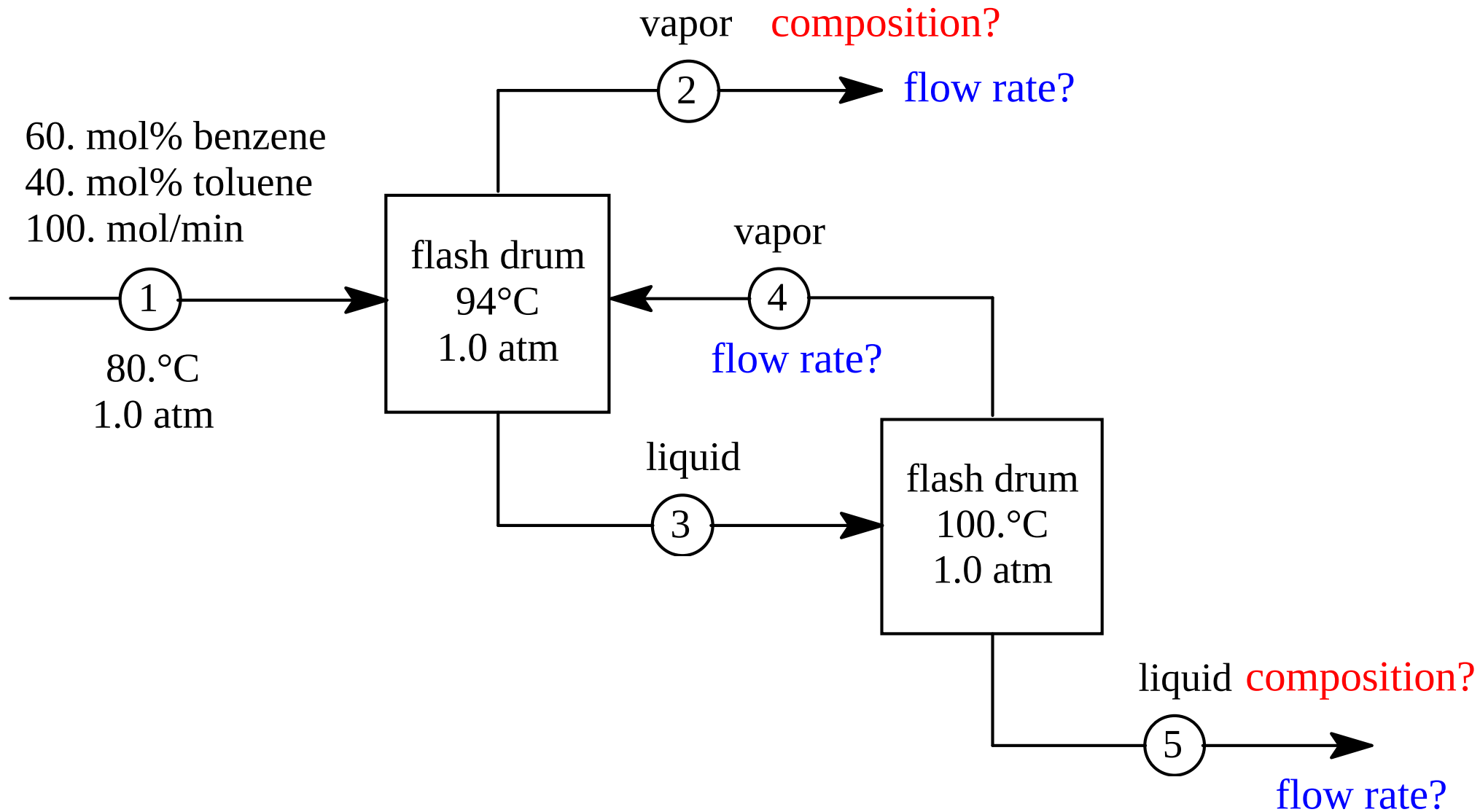
Accuracy of $\Delta x = \pm 0.1$ requires resolution of ± 14 mm.

Accuracy of $\Delta x = \pm 0.01$ requires resolution of ± 1.4 mm.

Accuracy of $\Delta x = \pm 0.001$ requires resolution of ± 0.14 mm.

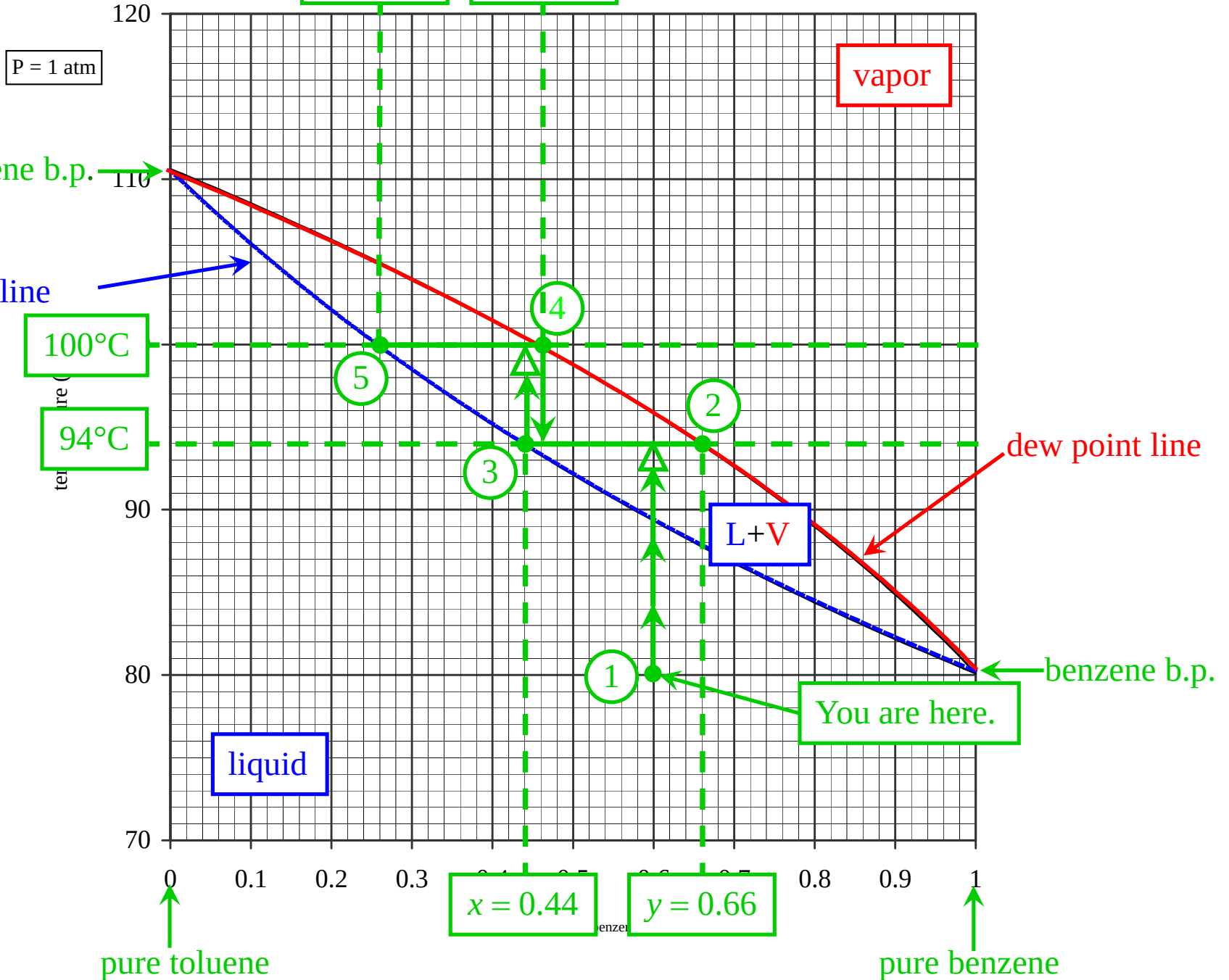
*Are you confident the length of the tie line is $\Delta x = 0.220$ and not 0.199 or 0.221? **No!***

Flash Drums: Example 3, cont'd

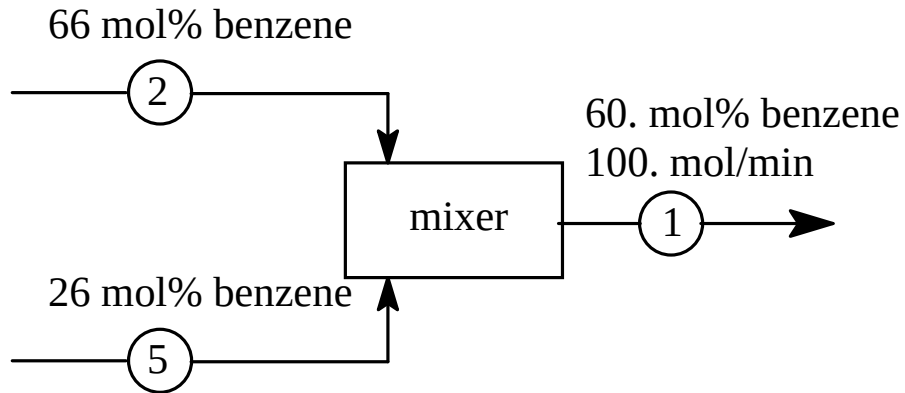


Example 3, continued

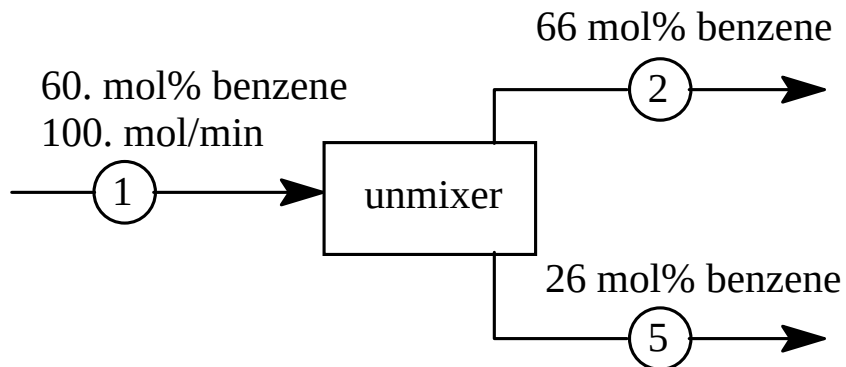
Ben $x = 0.26$ u $y = 0.46$ res at Equilibrium



Example 3, cont'd: Mixing Lines and Unmixing lines

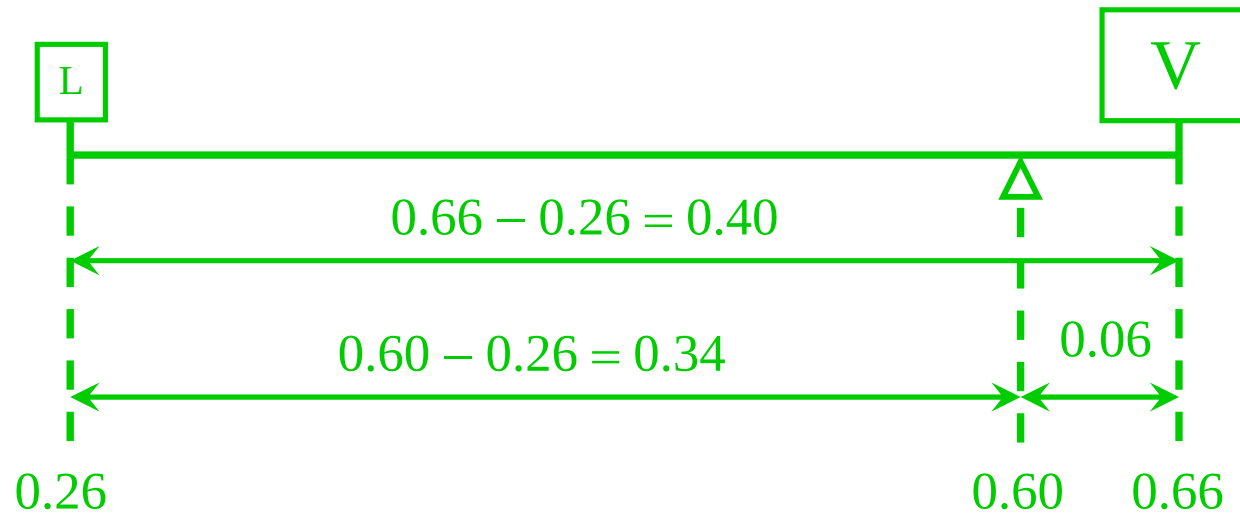


Use a *mixing* line for graphical analysis:
fulcrum at $x = 0.60$, endpoints at 0.66 and 0.26.



Use an *unmixing* line for graphical analysis:
fulcrum at $x = 0.60$, endpoints at 0.66 and 0.26.

Example 3: Apply the Lever Rule to the Unmixing Line

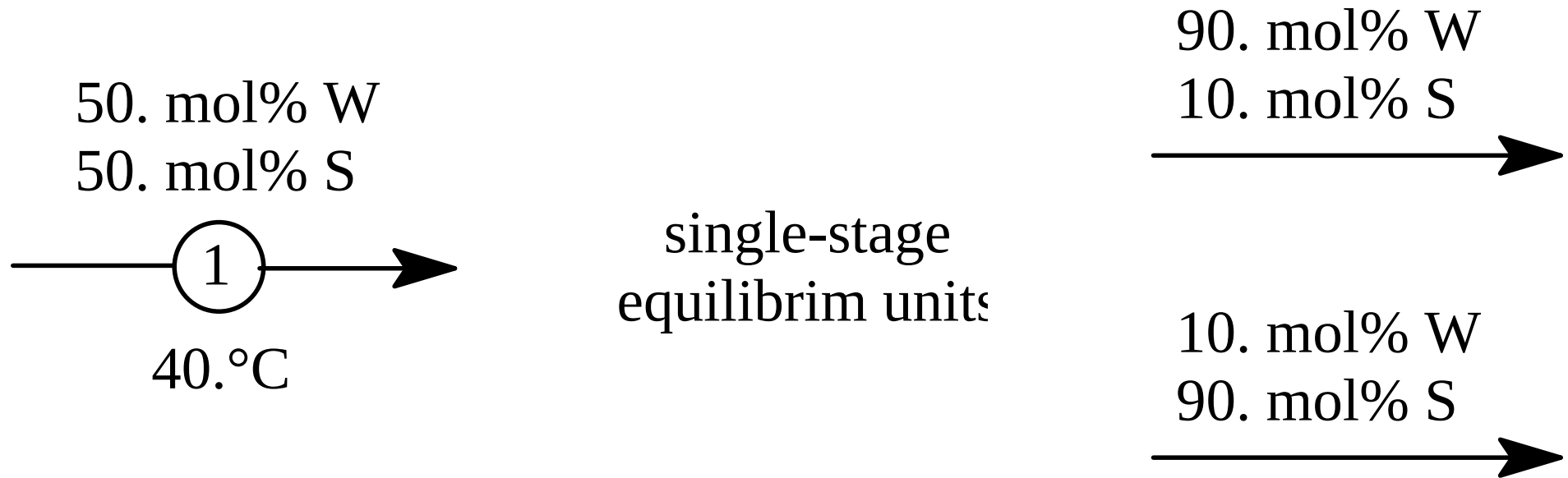


$$\text{liquid flow rate} = \left(\frac{0.06}{0.40} \right) \times 100 \text{ mol/min} = 15 \text{ mol/min}$$

$$\text{vapor flow rate} = 85 \text{ mol/min.}$$

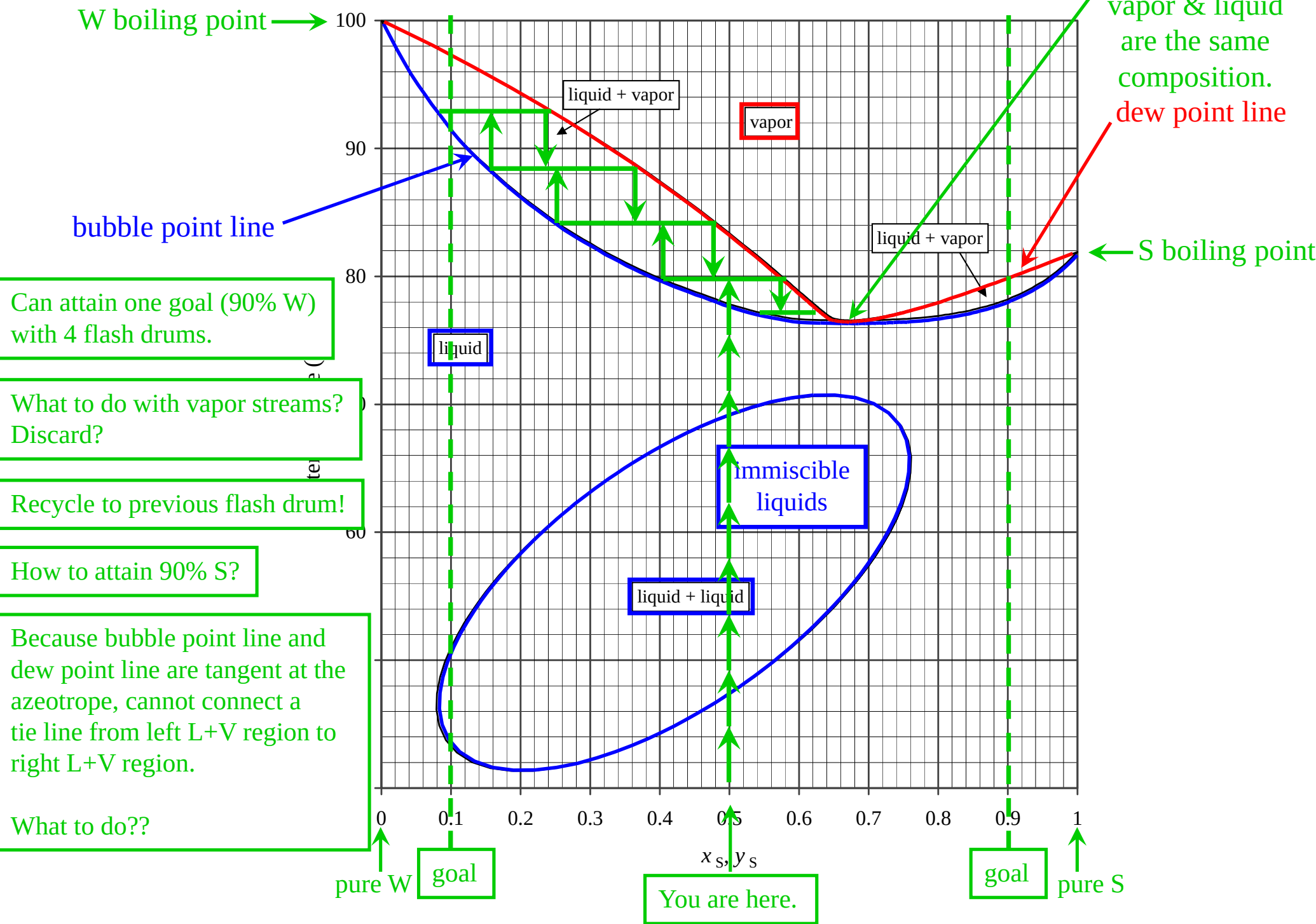
You should be able to calculate
stream 4 = 135 mol/min and
stream 3 = 150. mol/min.

Example 4 (like exercise 4.109)



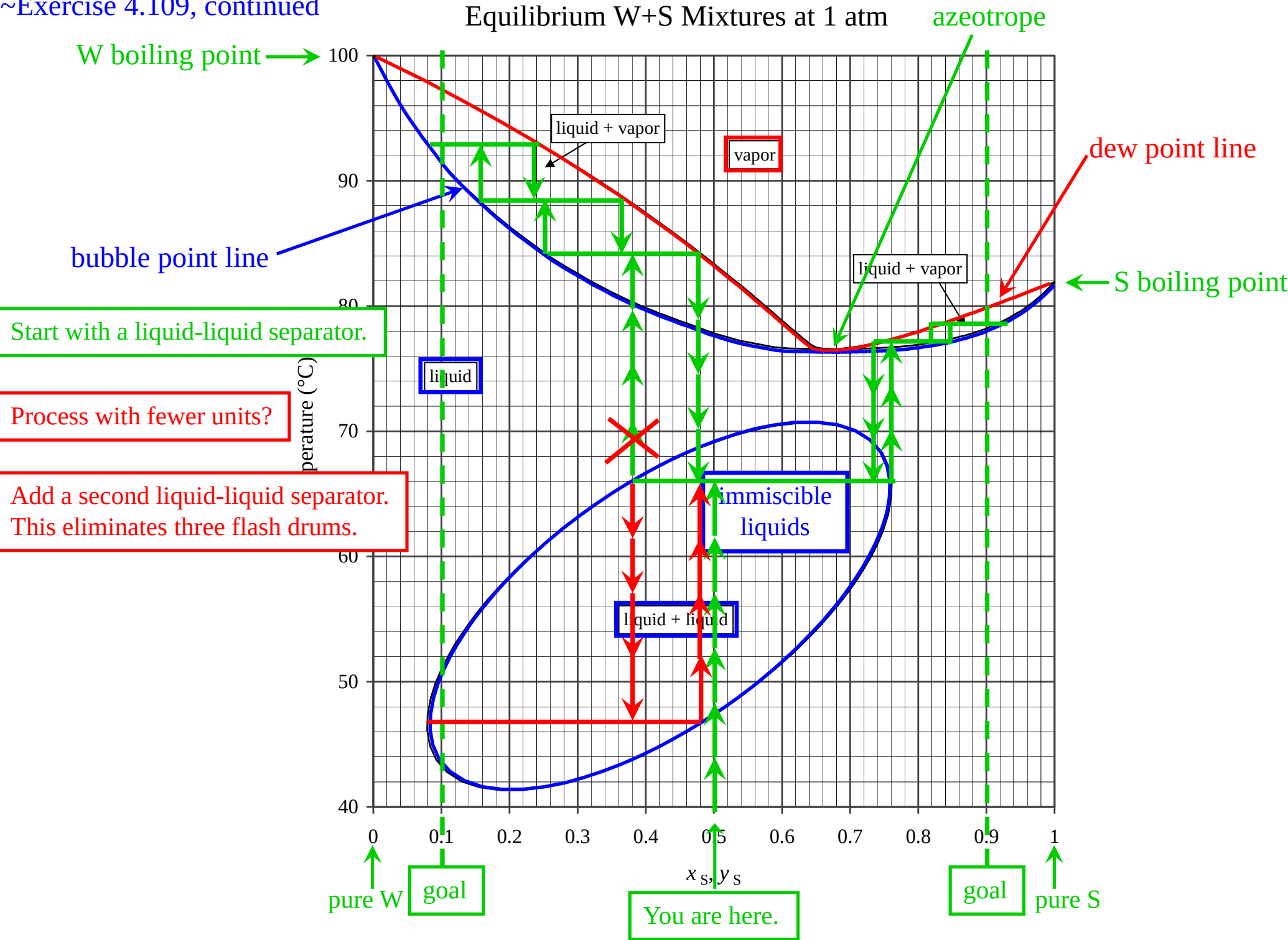
~Exercise 4.109 - solution is posted.

Equilibrium W+S Mixtures at 1 atm



~Exercise 4.109, continued

Equilibrium W+S Mixtures at 1 atm



~Exercise 4.109, continued

