Unit 5: Multiphase Systems

Reminders

- HW 4 is posted and is due on Monday, October 14
- Quiz 1 regrade requests will go through Canvas (I'll add that tonight)

Office Hours:

Posted here and on the Canvas homepage.

Day	Time	Location	Personnel
Monday	4 – 5 PM	AW Smith 105	Duval
Tuesday	1 -2 PM	AW Smith, 152	TA
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Helpful sections of the book:
Chapter 4 (Sections 4.6- 4.10)

Learning Objectives

- After the next 2 classes students should be able to:
  - Differentiate between:
    - Saturated vapor, superheated vapor
    - Partial pressure, vapor pressure, saturation pressure
  - Use the Antoine Equation to calculate P^{sat} for a pure species
  - Use Raoult's law for a system with one single condensable (or vaporizable) species

Multi-Phase Systems involve more than one phase of matter

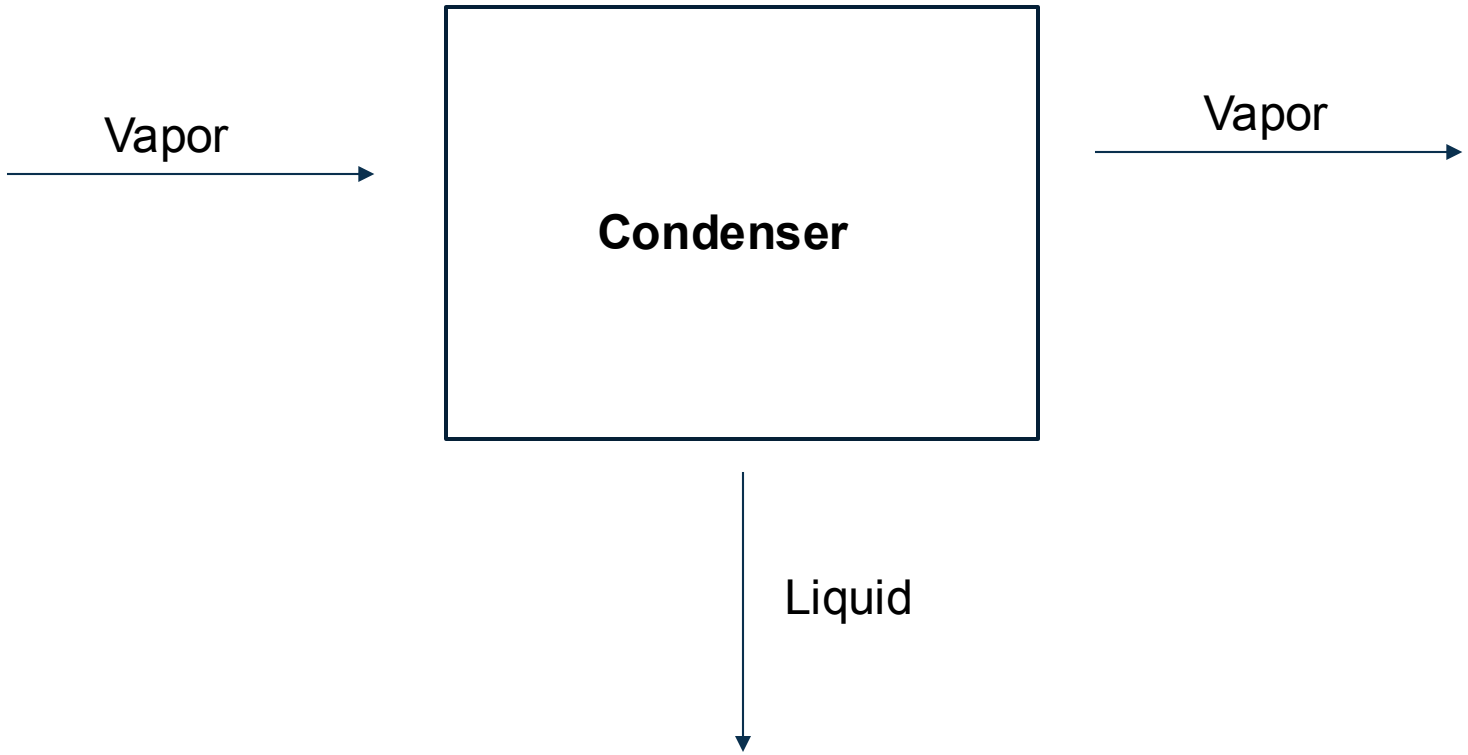
Evaporators
Dewatering or concentration of solids

Distillation
Converts liquid to vapor

Condenser
Converts a vapor to a liquid

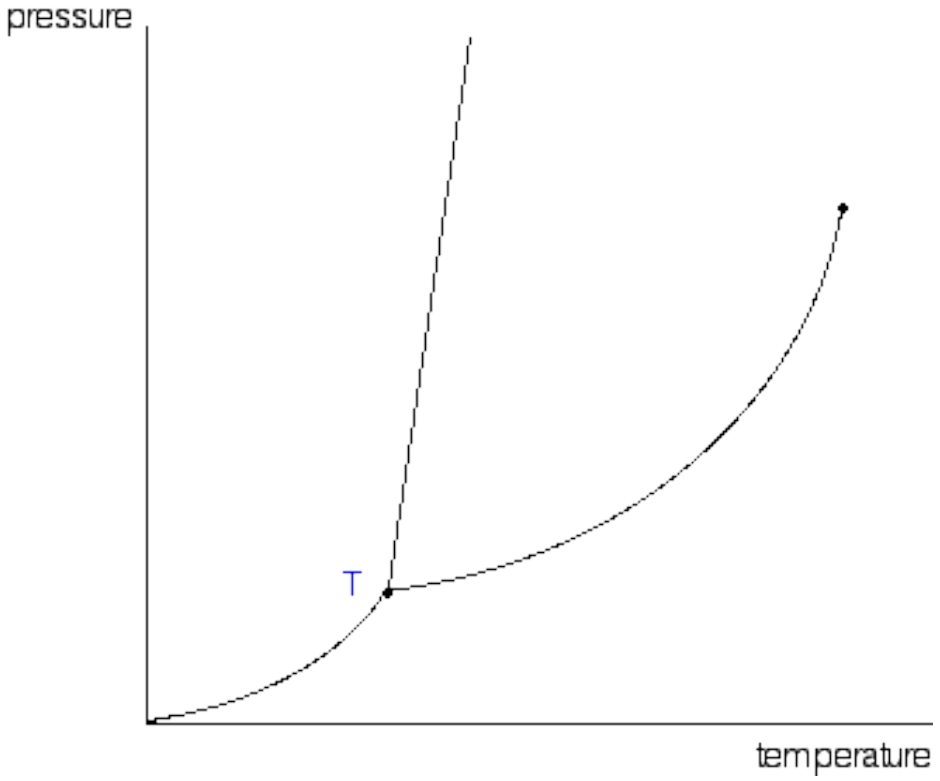
Multi-Phase Systems

- Most **thermally driven** separation processes rely on liquid-vapor systems



Tools from chemistry class

Phase Diagram:



- Steam tables
- Cox charts
- **Antoine Equation**

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- HW 5B will be posted by October 18 and will be due October 28
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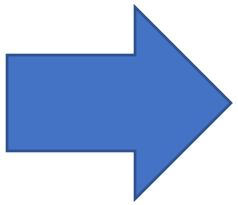
Previously in ECHE 260…



Raoult's Law

- No chemical reactions
- Vapor-liquid equilibrium
- Liquid phase behaves ideally
- Vapor phase behaves ideally

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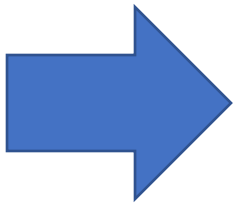

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Helpful sections of the book: Chapter 6

Is the next month looking stressful or busy?

- Prioritize your needs!

- How much is that 2 points on the homework worth?
  - 4% on the assignment
  - 0.4% on your homework grade for the class
  - 0.08% of your final grade in the course

- One of your quizzes gets dropped
- One HW gets dropped

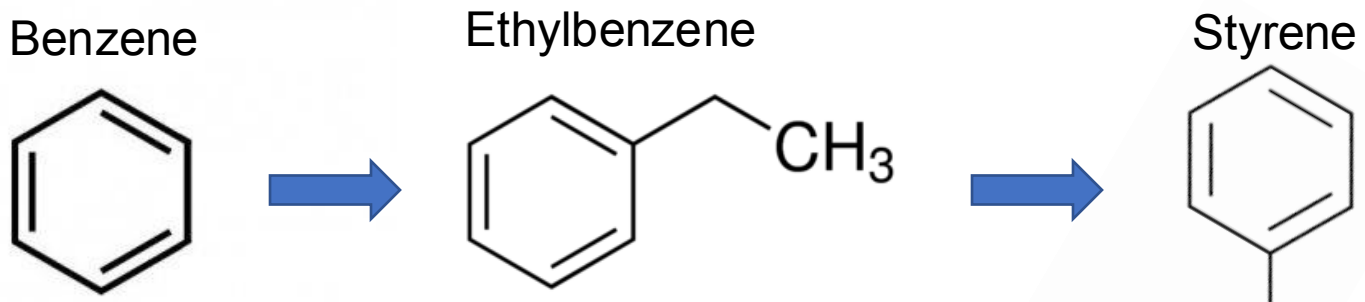
Learning Objectives

- After today's class students should be able to:
  - Calculate **dew point** or **bubble point** for a VLE system with multiple condensable or vaporizable components
  - Use Raoult's law to calculate any of these quantities for a VLE system with multiple condensable or vaporizable components:
    - T, P, xi, yi

Also, why do we care?

- Most ChemE separations are based on VLE!
  - Problem: Need to separate 2 species from each other but they are in the same phase
  - Solution: Manipulate T and P so one species changes phase

Consumer products



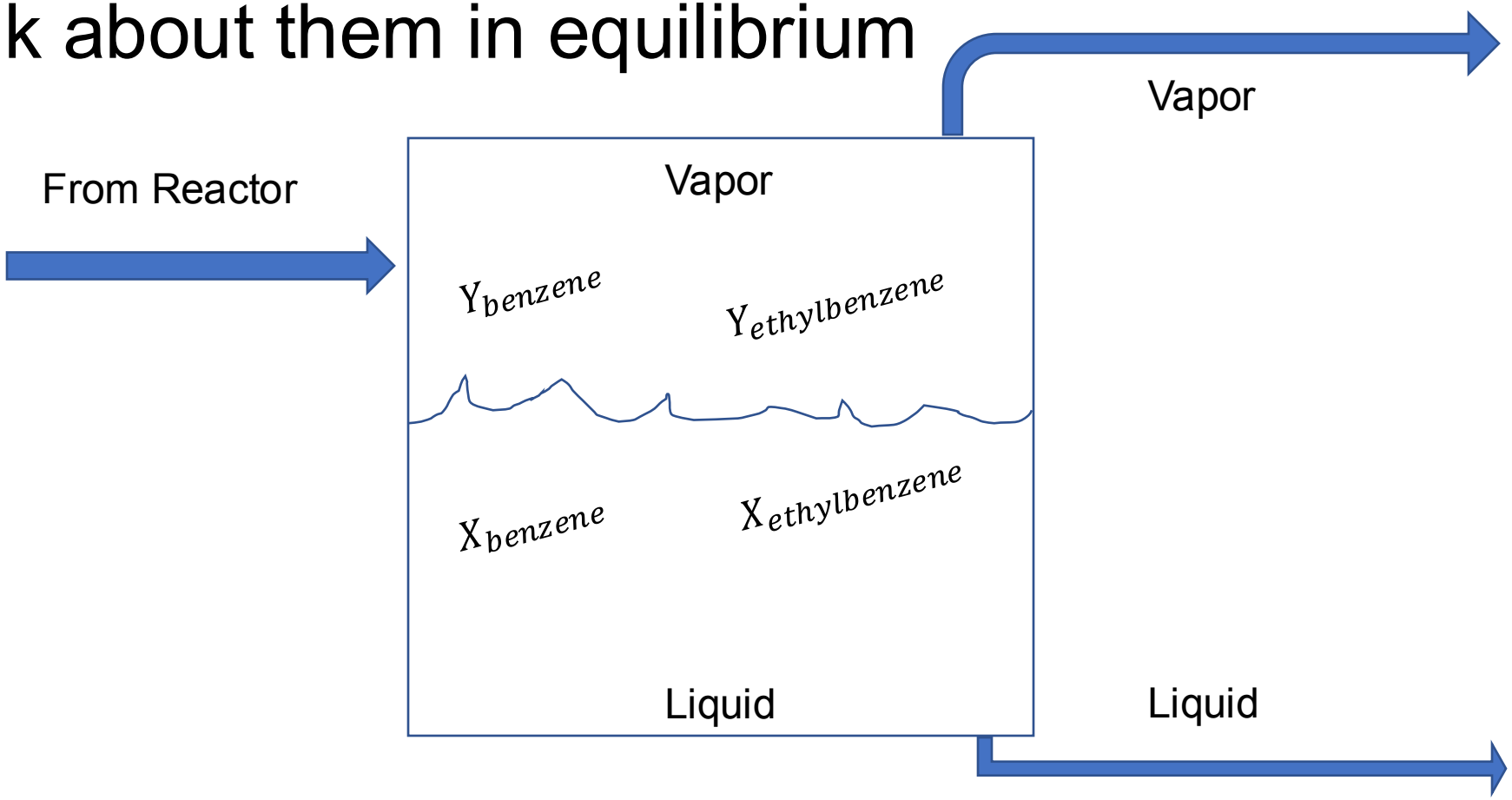
Production of Styrofoam precursors

- Imagine the reactor effluent of the benzene → ethylbenzene reactor.

If we want to separate benzene and ethyl benzene—how do we do it?

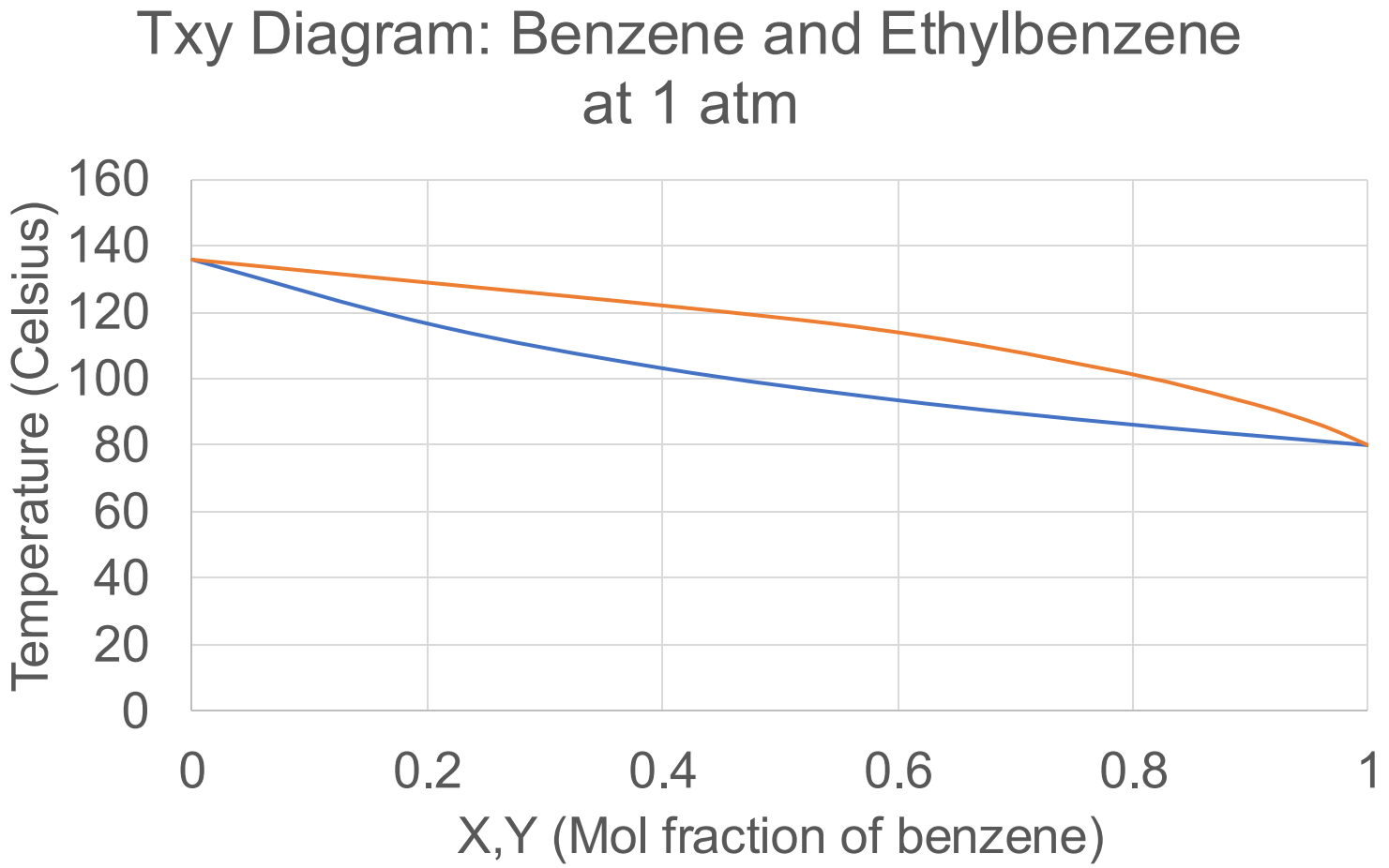
  - BP of benzene is 80.1^{o}C
  - BP of ethylbenzene is 136^{o}C

Think about them in equilibrium



- How do we predict the composition of the vapor phase?
- How do we manipulate T and P to give us a vapor phase enriched in one species?

Txy Diagrams



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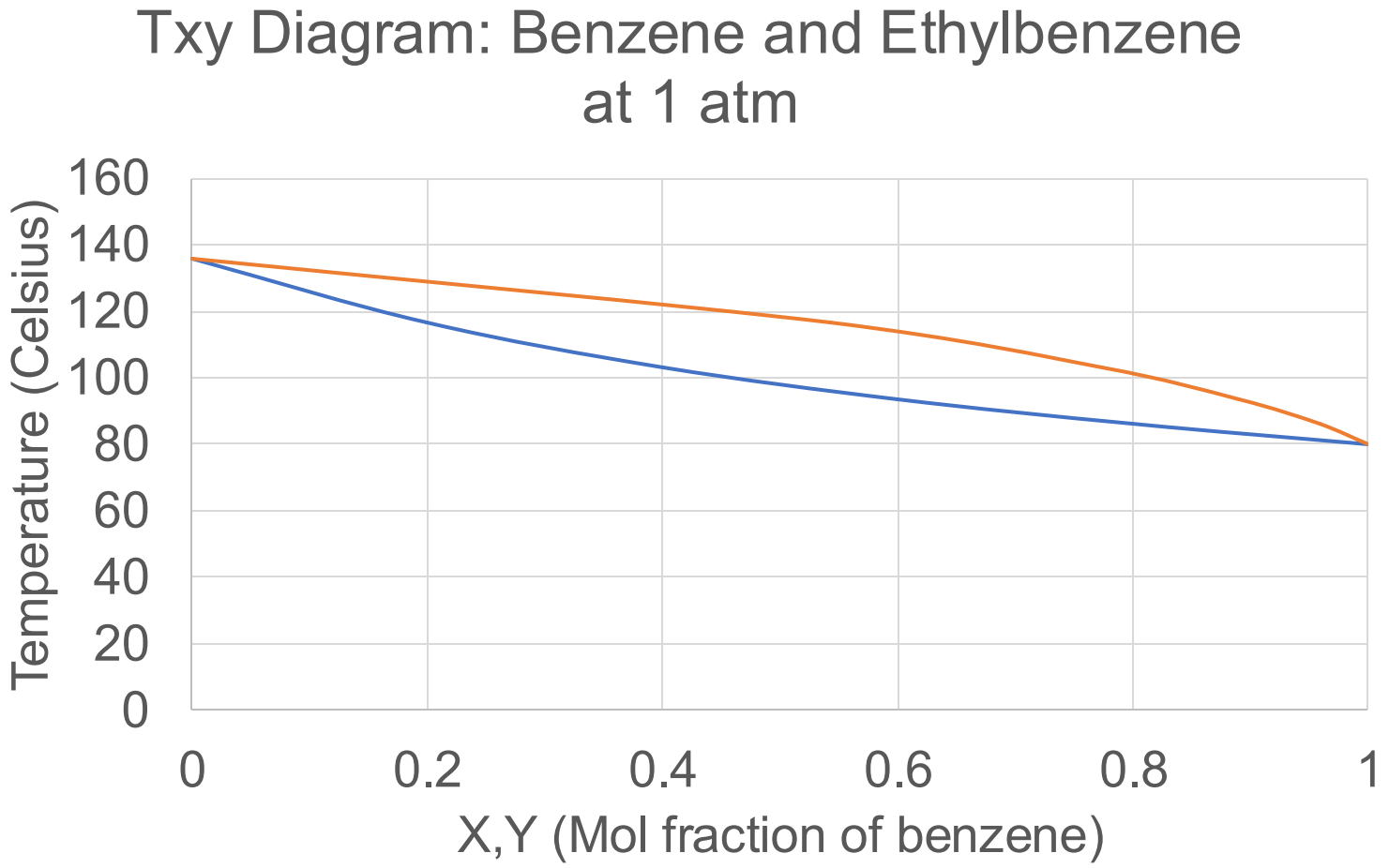

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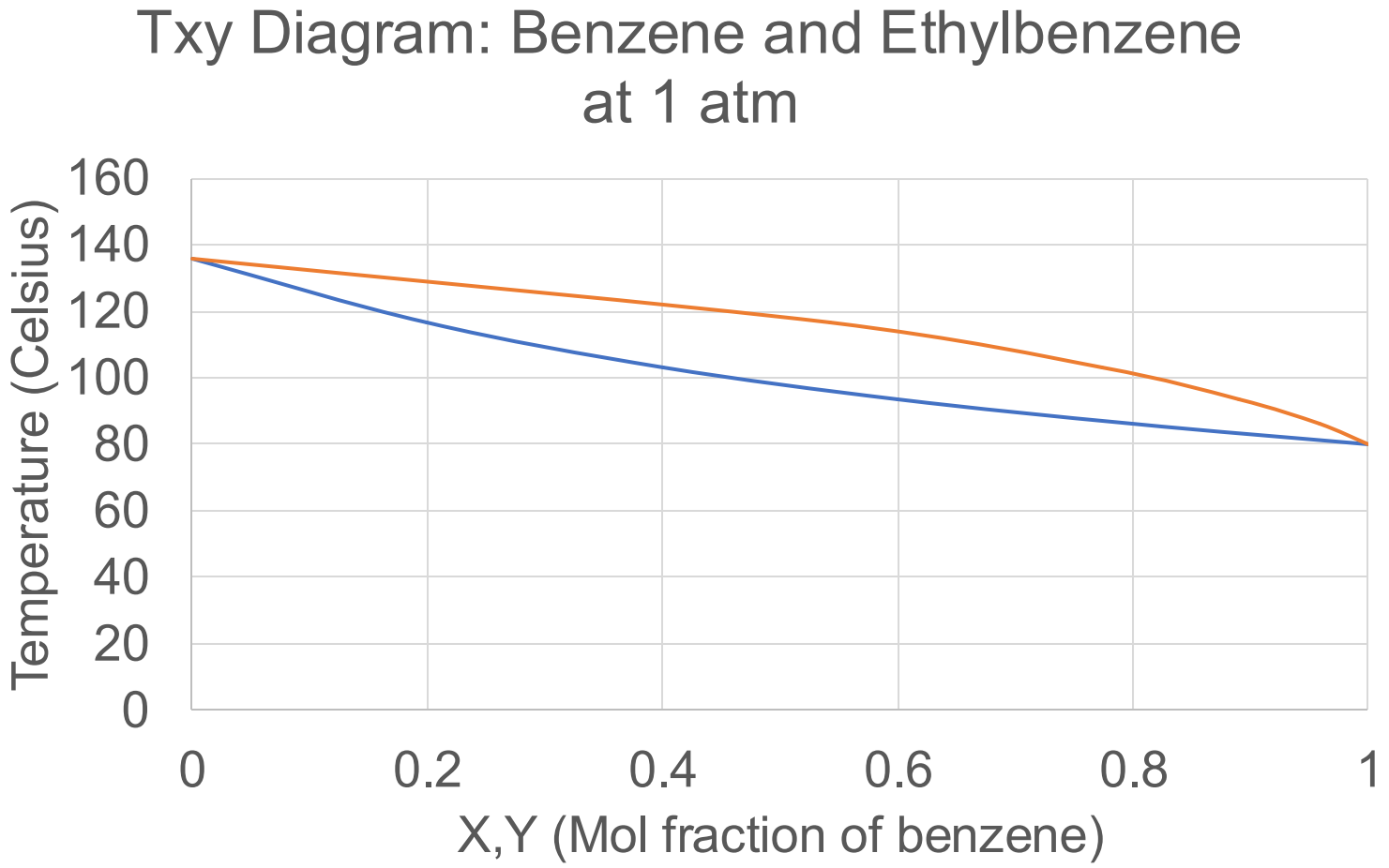

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Week of October 20

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