

Consistency before LLE

Page 1: minutes 0-50 | Write on this sheet or in a notebook using the same question labels.

Start at [week03-study.html](#). Read the Week 3 slides in order. Use the lab guide only when directed. All required work fits within 180 minutes; the background reading is optional.

A. Retrieve the VLE ideas | 0-15 min

A1. Define x_1 , y_1 , z_1 and γ_1 . Which describes the liquid composition?

A2. Calculate $\gamma_1 = y_1 P / (x_1 P_1^{\text{sat}})$ using $y_1=0.704857144627$, $P=158.707198211$ kPa, $x_1=0.5$ and $P_1^{\text{sat}}=150$ kPa. Compare with $\exp(0.399813)$. State the vapor assumption.

A3. What does a small fitted residual show? What thermodynamic question remains?

B. Read the constraint and its scope | 15-35 min

B1. At fixed T and P, complete: $x_1 d \ln \gamma_1 + (1-x_1) d \ln \gamma_2 = \underline{\hspace{2cm}}$. Can the two coefficients vary independently?

B2. For isothermal VLE, P may vary with composition. Which pressure-related term does our teaching diagnostic neglect? For an isobaric path, which independent property is needed for the local temperature correction?

B3. If a method says “not assessed” or “not applicable,” may you record “passed”? Explain.

C. Integrate by hand | 35-50 min

x_1	0	0.25	0.50	0.75	1
$L = \ln(\gamma_1/\gamma_2)$	2	1	0	-1	-2

C1. Use $S = \sum \frac{1}{2}(L_j + L_{j+1})(x_{j+1} - x_j)$. Find the positive, negative and signed areas. C2. Add 0.20 to every L and recalculate S. C3. Explain why a small S does not certify all observations. These synthetic endpoint limits are supplied analytically.

Compare evidence, then explain

Page 2: minutes 50-90 | Open Lab 03 and lab-guide pages 1-2. Do not upload the Lab 08 data here.

[Open Lab 03: Consistency tests](#)

D. Controlled Lab 03 comparison | 50-80 min

D1. Select **Synthetic · isothermal, 350 K, Consistent reference** and **41 points**. Read the area and local-residual cards and both charts. Record D1. Save the reference evidence before changing the setting; wait until D4 to run the model fit.

D2. Change only **Controlled perturbation** to **Canceling errors · zero net area**; set **Amplitude = 0.25**. Record both scores and the local pattern. **D3.** Change only the perturbation to **Localized defect near $x_1 = 0.35$** . Inspect the peak as well as the averaged score.

41-point isothermal case	Area D (%) / status	Local score / status	Pattern in residual chart
D1. Consistent reference			
D2. Canceling, +0.25			
D3. Localized, +0.25			

D4. At minutes 74-80, return to Consistent reference and click Run modeling test → once. Record clean-reference Δp (%) and Δy (percentage points). Why is Herington not applicable here? What does the modeling test establish?

For each case, type a short note in **Your conclusion** and click **Export all results**. Rename the downloaded JSON as clean, canceling or localized. Changing settings clears the previous fit. Optional, only within this block: compare 41 with 161 points.

E. Correct an overclaim | 80-90 min

E1. Explain how the area criterion can be met while the local relationship fails. Why might an averaged local score also miss a narrow defect?

E2. Write one conclusion with (i) a claim, (ii) numerical/chart evidence, and (iii) an assumption or limitation.

90-100 min: take a 10-minute break. Resume on practice page 3.

From a consistent model to two liquids

Page 3: minutes 100-165 | Read the LLE slides, then open Lab 04 and lab-guide page 3.

F. Stability and a hand calculation | 100-120 min

F1. Does an equal-chemical-potential or stationary solution automatically give stable equilibrium? State the global criterion.

F2. For this hand example only, a supported tie line has $x^\alpha=0.20$ and $x^\beta=0.80$. Find $f_\beta=(z_1-x^\alpha)/(x^\beta-x^\alpha)$ and $f_\alpha=1-f_\beta$ for $z_1=0.50$ and 0.35 ; verify the component-1 balance.

F3. A common tangent must support the entire admitted Gibbs-energy curve from below. Why is “touches at two points” insufficient?

G. Individual Lab 04 investigation | 120-165 min

[Open Lab 04: Liquid stability and LLE](#)

G1. Predict first. Select **Liquid model: Margules · 1 parameter**, enter **A = 3** and **Feed mole fraction $z_1 = 0.50$** , then click **Find equilibrium** →. Use **View: Gibbs energy & common tangent**. Record the actual computed endpoints and fractions below.

G2. Change **only z_1 to 0.35** and click **Find equilibrium** →. Keep A and the model fixed. This lab represents one fixed thermodynamic condition; there are no T or P controls. The hand-example endpoints above are **not** the expected Lab 04 outputs.

z_1	x_1^α	x_1^β	f_α	f_β	Feed state
0.50					
0.35					

G3. Independently evaluate $f_\alpha x^\alpha + f_\beta x^\beta$ for $z_1=0.35$. Compare with “Verify the equilibrium.”

G4. Which quantities stay fixed as z changes? Which change? Use the tangent and energy decrease to justify two liquids.

Save each run using **Export study JSON**; rename with z050 or z035. Add your explanation before exporting. Stop after G4. LLE fitting and VLLE are optional later extensions, not required today.

Check understanding and close the lesson

Page 4: minutes 165-180 | Attempt H1-H4 before opening the separate worked solutions.

H. Self-review | 165-172 min

H1. The area criterion is met. Does that guarantee every point is thermodynamically consistent? Give one reason.

H2. A local diagnostic is outside its criterion. What should you check before attributing the discrepancy to experimental error?

H3. A model has small Δp and Δy on the fitting data. Does this establish predictive accuracy on new data? Explain.

H4. For supported $x^a=0.20$, $x^b=0.80$ and $z_1=0.35$, give f^b and the balance. State the additional condition that makes this a stable tie line.

[After attempting H1-H4: open worked solutions](#)

I. Exit ticket, feedback and saved evidence | 172-180 min

172-177 min: open the existing **Session 3** form. In its **concept** response, answer the existing LLE question using your Lab 04 result. In its **evidence** response, include the Lab 03 area-versus-differential comparison: name the case, scores and one limitation. Use your own explanation.

177-180 min: complete the feedback section and submit. Save this practice record and your Lab 03 / Lab 04 JSON files or screenshots in your own folder. Lab exports save files locally; they do not submit to a server. The anonymous form does not establish individual attendance.



Session 3 exit ticket + feedback

Scan the QR or use the clickable link below. The form is anonymous. It is not an attendance-identification form.

[Open the Session 3 form](#)

Finished: completed A-I; attempted before solutions; compared charts and criteria; checked a material balance; submitted Session 3 exit ticket and feedback. No compulsory extra homework or pre-reading.