Green Chemistry and Process Metrics

g11_u08_w30

Purpose and boundary

Use original fictional route tables only. No synthesis, chemical handling, process operation, disposal, purchasing, or regulatory decision is requested.

Targets: I can calculate stated atom economy, yield, and E-factor models while avoiding single-metric conclusions. **Vocabulary:** atom economy, yield, waste, E-factor, system boundary, tradeoff. **Prerequisites:** mass conservation, percent, stoichiometry, evidence limits.

For this packet, use atom economy $= m_{\text{desired}}/m_{\text{reactants}} \times 100\%$, percent yield $= m_{\text{actual}}/m_{\text{theoretical}} \times 100\%$, and E-factor $= m_{\text{waste}}/m_{\text{product}}$. All masses are fictional paper-model values.

1. Distinguish atom economy from percent yield.

2. Why can a route have high yield and low atom economy?

3. Why must an E-factor state its system boundary?

4. Route A has $m_{\text{desired}} = 60.0$ g and $m_{\text{reactants}} = 100.$ g. Find atom economy.

5. Route A has $m_{\text{actual}} = 48.0$ g and $m_{\text{theoretical}} = 60.0$ g. Find percent yield.

6. Route A lists 72.0 g waste and 48.0 g product. Find E-factor.

7. Route B has atom economy 75.0%, yield 65.0%, and E-factor 0.80. Compare one favorable metric and one unfavorable metric with Route A.

8. Why does item 7 not choose a universally better route?

9. A route omits water mass from its waste boundary. How could that change E-factor interpretation?

10. Explain why a metric is not a full safety or environmental assessment.

11. A fictional route uses 120. g reactants to model 90.0 g desired theoretical product. Find atom economy.

12. The route produces 54.0 g actual product. Find percent yield.

13. It lists 66.0 g waste. Find E-factor based on actual product.

14. Compare Route A and item 11–13 using two stated metrics.

15. Name one missing metric or context that could reverse a simple ranking.

16. A student calls all waste hazardous. Correct the claim.

17. A student calls all low E-factor routes safe. Correct the claim.

18. State one evidence claim a route table can support.

19. State one claim a route table cannot support without more data.

20. Write a two-sentence bounded route comparison that names a tradeoff.