Dynamic equilibrium: moving counters, steady totals

Student activity • observation and reasoning

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The question

Can the totals stay constant while both directions continue?

Use a closed counter model to distinguish equal forward/reverse rates from equal amounts. Record transfers separately from the amounts remaining.

Equipment

• Booklet, 30 reusable counters per pair and two labelled areas

Desk activity only; keep small model pieces away from mouths.

Course coverage: Chemistry only: 3.19C–3.20C. A deliberately simplified discrete model, not measured reaction kinetics.

Plan, model or apparatus sketch

Draw a labelled structure or model to explain your reasoning for this lesson.

Method and reasoning

Read the whole sequence before starting

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1. Place 30 counters in area A and zero in B; keep every counter inside the two-area system.

2. At the start of each round, calculate one fifth of A and one tenth of B, rounding each down to whole counters.

3. Move those calculated numbers simultaneously A→B and B→A; do not recalculate midway through the exchange.

4. Record start amounts, both transfers and end amounts for successive rounds until the totals stop changing.

5. Continue at least two more rounds to see whether transfers still occur despite constant amounts.

6. Explain the closed-system requirement and compare the equilibrium amounts with the forward/reverse transfer rates.

Cleanup

- Return shared equipment and retain corrected reasoning.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Model rule: transfer floor(A/5) from A to B and floor(B/10) from B to A, using start-of-round values simultaneously. Begin A=30, B=0. The total stays 30. Whole-counter rounding and arbitrary fractions are modelling choices; do not treat a round as a measured time or this rule as a real rate law.

Round	A→B / B→A	A / B after round
Round 1		
Round 2		
Steady state		
Later round		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Calculate the first-round transfers and final amounts.

2. At A=10 and B=20, calculate both transfers.

3. Do reactions stop in the steady state of this model?

4. Are equal forward/reverse rates the same as equal amounts?

5. Why must counters not leave the model system?

6. Give one limitation of the counter model.