

CHAPTER 7 CHEMICAL SYSTEMS IN EQUILIBRIUM

Reflect on Your Learning

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1. This is not an example of dynamic equilibrium because there are no opposing processes taking place – even at the microscopic level. “Dynamic” implies change, or movement.
2. Household examples of dynamic equilibrium are:
 - dissolved carbon dioxide in soft drinks in equilibrium with gaseous carbon dioxide in the air space above the soft drink in the bottle;
 - undissolved sugar at the bottom of a cup of tea in equilibrium with dissolved sugar;
 - the temperature of a house staying steady as the furnace warms the air inside, but heat leaks out through cracks and by radiation.
3. The presence of the iodide ion prevents some of the lead iodide from dissolving.
4. (a) The double arrow implies that two opposite chemical reactions are occurring at the same rate.
(b) Heating the container would decrease the production of carbon dioxide since the reverse reaction consumes the applied heat.
5. (Most students will probably conclude that they are not able to answer the question at this stage.) The reaction should proceed spontaneously as written because its products are in a more random state than the reactant.

Try This Activity: Shakin’ the Blues

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- (a) Some chemical reactions are reversible.
- (b) The solution turns blue after being shaken and then returns to colourless after being allowed to stand for a few moments. This cycle can be repeated.
- (c) The colour changes will continue forever.
- (d) The blue–colourless cycle continues even after 10 cycles. (Note: After a considerable amount of time, the solution turns yellow and the colour changes stop.)

7.1 DYNAMIC EQUILIBRIUM IN CHEMICAL SYSTEMS

Try This Activity: The Coin Exchange: Establishing Dynamic Equilibrium

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- (a) The player with the smaller exchange rate gained pennies until a maximum was reached. The player with the larger exchange rate lost pennies until a minimum number was reached.
- (b) Groups with the largest difference in the initial amount of pennies had the most exchanges before the equilibrium was established. Groups with exchange rates that were similar took longer to reach equilibrium. This is because the pennies from one side were replacing almost all the pennies taken from the other pile.
- (c) The partner with the larger exchange rate always had less pennies. The number of pennies never reaches zero because some are always returned.
- (d) During the course of the activity, the number of pennies approaches a constant value.

Try This Activity: Digesting a Precipitate

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- (a) The settling time decreases over the course of one week.
- (b) The size of the crystals increases.
- (c) For the system to be at equilibrium, two opposing reactions need to be occurring at the same rate in the closed system. The solution had to be saturated because crystals were always present at the bottom of the flask. Over the course of the week the crystals grew, implying that crystallization was still occurring. However, the number of crystals also decreased, proof that dissolving was occurring. If the rate of crystallization and dissolving were not equal, the crystals would have either disappeared or grown in number and size.