

## Section 16.5 Reaction Spontaneity

In your textbook, read about spontaneous processes and about entropy, the universe, and free energy.

Use each of the terms below to complete the statements.

spontaneous process

entropy

law of disorder

free energy

1. A(n) \_\_\_\_\_ is a physical or chemical change that occurs with no outside intervention.
2. A measure of disorder or randomness of the particles that make up a system is called \_\_\_\_\_.
3. The \_\_\_\_\_ states that spontaneous processes always proceed in such a way that the entropy of the universe increases.
4. \_\_\_\_\_ is the energy that is available to do work.

For each statement below, write *true* or *false*.

- \_\_\_\_\_ 5. A process cannot be spontaneous if it is exothermic and there is an increase in disorder.
- \_\_\_\_\_ 6. A process cannot be spontaneous if it is endothermic and there is a decrease in disorder.
- \_\_\_\_\_ 7. A process cannot be spontaneous if it is exothermic and there is a decrease in disorder as long as the temperature remains low.
- \_\_\_\_\_ 8. A process cannot be spontaneous if it is endothermic and there is an increase in disorder as long as the temperature remains high.
- \_\_\_\_\_ 9. A process can never be spontaneous if the entropy of the universe increases.
- \_\_\_\_\_ 10. When  $\Delta G$  for a reaction is negative, the reaction is spontaneous.
- \_\_\_\_\_ 11. When  $\Delta G$  for a reaction is positive, the reaction is not spontaneous.
- \_\_\_\_\_ 12. When  $\Delta H$  for a reaction is negative, the reaction is never spontaneous.
- \_\_\_\_\_ 13. When  $\Delta H$  for a reaction is large and positive, the reaction is not expected to be spontaneous.