Chapter 6 Exercises

Review Questions

1. Energy is stored in the long term in the bonds of _____ and used in the short term to perform work from a(n) _____ molecule.

a. ATP; glucose
b. an anabolic molecule; catabolic
c. glucose; ATP
d. a catabolic molecule; anabolic

2. DNA replication involves unwinding two strands of parent DNA, copying each strand to synthesize complementary strands, and releasing the parent and daughter DNA. Which of the following accurately describes this process?

a. This is an anabolic process.
b. This is a catabolic process.
c. This is both anabolic and catabolic.
d. This is a metabolic process but is neither anabolic nor catabolic.

3. Consider a pendulum swinging. Which type(s) of energy is/are associated with the pendulum in the following instances:

i. The moment at which it completes one cycle, just before it begins to fall back towards the other end
ii. The moment that it is in the middle between the two ends
iii. Just before it reaches the end of one cycle (just before instant i)

a. i. potential and kinetic, ii. potential and kinetic, iii. kinetic
b. i. potential, ii. potential and kinetic, iii. potential and kinetic
c. i. potential, ii. kinetic, iii. potential and kinetic
d. i. potential and kinetic, ii. kinetic, iii. kinetic

4. Which of the following comparisons or contrasts between endergonic and exergonic reactions is false?

a. Endergonic reactions have a positive ΔG, and exergonic reactions have a negative ΔG.
b. Endergonic reactions consume energy, and exergonic reactions release energy.
c. Both endergonic and exergonic reactions require a small amount of energy to overcome an activation barrier.
d. Endergonic reactions take place slowly, and exergonic reactions take place quickly.

5. Which of the following is the best way to judge the relative activation energies between two given chemical reactions?

a. Compare the ΔG values between the two reactions.
b. Compare their reaction rates.
c. Compare their ideal environmental conditions.
d. Compare the spontaneity between the two reactions.

6. Which of the following is *not* an example of an energy transformation?

a. turning on a light switch
b. solar panels at work
c. formation of static electricity
d. none of these

7. In each of the three systems, determine the state of entropy (low or high) when comparing the first and second:

i. The instant that a perfume bottle is sprayed compared with 30 seconds later
ii. An old 1950s car compared with a brand-new car
iii. A living cell compared with a dead cell

a. i. low, ii. high, iii. low
b. i. low, ii. high, iii. high
c. i. high, ii. low, iii. high
d. i. high, ii. low, iii. low

8. The energy released by the hydrolysis of ATP is _____.
- **a.** primarily stored between the alpha and beta phosphates
- **b.** equal to –57 kcal/mol
- **c.** harnessed as heat energy by the cell to perform work
- **d.** providing energy to coupled reactions

9. Which of the following molecules is likely to have the most potential energy?
a. sucrose **b.** ATP **c.** glucose **d.** ADP

10. Which of the following is *not* true about enzymes?
- **a.** They increase ΔG of reactions.
- **b.** They are usually made of amino acids.
- **c.** They lower the activation energy of chemical reactions.
- **d.** Each one is specific to the particular substrate(s) to which it binds.

11. An allosteric inhibitor does which of the following?
- **a.** binds to an enzyme away from the active site and changes the conformation of the active site, increasing its affinity for substrate binding
- **b.** binds to the active site and blocks it from binding substrate
- **c.** binds to an enzyme away from the active site and changes the conformation of the active site, decreasing its affinity for the substrate
- **d.** binds directly to the active site and mimics the substrate

12. Which of the following analogies best describes the induced-fit model of enzyme-substrate binding?
- **a.** a hug between two people
- **b.** a key fitting into a lock
- **c.** a square peg fitting through the square hole and a round peg fitting through the round hole of a children's toy
- **d.** the fitting together of two jigsaw puzzle pieces

Critical Thinking Questions

13. Does physical exercise involve anabolic and/or catabolic processes? Give evidence for your answer.

14. Name two different cellular functions that require energy that parallel human energy-requiring functions.

15. Explain in your own words the difference between a spontaneous reaction and one that occurs instantaneously. What causes this difference?

16. Describe the position of the transition state on a vertical energy scale, from low to high, relative to the position of the reactants and products for both endergonic and exergonic reactions.

17. Imagine an elaborate ant farm with tunnels and passageways through the sand where ants live in a large community. Now imagine that an earthquake shook the ground and demolished the ant farm. In which of these two scenarios, before or after the earthquake, was the ant farm system in a state of higher or lower entropy?

18. Energy transfers take place constantly in everyday activities. Think about these two scenarios: cooking on a stove and driving. Explain how the second law of thermodynamics applies to these two scenarios.

19. Do you think that the E_A for ATP hydrolysis is relatively low or high? Explain your reasoning.

20. With regard to enzymes, why are vitamins necessary for good health? Give examples.

21. Explain in your own words how enzyme feedback inhibition benefits a cell.