### Physical Oceanography

#### SECTION 15.1  The Oceans

*In your textbook, read about modern oceanography.*

For each item in Column A, write the letter of the matching item in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. German research ship that studied the oceans during the 1920s</td>
<td>a.</td>
</tr>
<tr>
<td>2. Satellite used to monitor ocean surface temperatures</td>
<td>b.</td>
</tr>
<tr>
<td>3. Device that uses echoes to map features of the ocean floor</td>
<td>c.</td>
</tr>
<tr>
<td>4. First ship to use sophisticated measuring devices to study the ocean</td>
<td>d.</td>
</tr>
<tr>
<td>5. Scientific study of Earth’s oceans</td>
<td>e. Meteor</td>
</tr>
</tbody>
</table>

*In your textbook, read about the origin of the oceans.*

Circle the letter of the choice that best completes the statement.

6. Oceans on Earth have existed for
   a. 4.6 million years.  
   b. almost 4.6 billion years.  
   c. 46 billion years.  
   d. half as long as Earth has existed.

7. One possible source of Earth’s water is
   a. asteroids.  
   b. earthquakes.  
   c. comet impacts.  
   d. violent storms.

8. Gases emitted by volcanoes contain mostly
   a. water vapor and ultraviolet radiation.  
   b. carbon dioxide and oxygen.  
   c. water vapor and carbon dioxide.  
   d. water vapor and nitrogen.

9. In Earth’s early history, water vapor in the atmosphere condensed into the
   a. crust.  
   b. oceans.  
   c. continents.  
   d. mountains.

10. Water is still being added to Earth’s hydrosphere by
    a. volcanism.  
    b. ultraviolet radiation.  
    c. comet impacts.  
    d. earthquakes.

11. The total amount of water on Earth stays the same because water molecules in the atmosphere are destroyed by
    a. ozone.  
    b. meteors.  
    c. evaporation.  
    d. ultraviolet radiation.
SECTION 15.1  The Oceans, continued

In your textbook, read about the distribution of Earth’s water.
Use the terms in the list to complete the statements.

sea level  rising  tectonic  oceans  frozen ice caps

12. The ________________ contain 97 percent of the water found on Earth.

13. Approximately 3 percent of Earth’s water is located in the ________________
of Greenland and Antarctica, and in rivers, lakes, and underground sources.

14. Global ________________ has risen and fallen by hundreds of meters in
response to warm periods and ice ages.

15. ________________ forces that lift or lower portions of the seafloor also
affect sea level.

16. Today average global sea level is slowly ________________ at a rate of
1 to 2 mm per year.

Answer the following questions.

17. Why is Earth known as the blue planet?

18. What is the average depth of the oceans?

19. How much of the northern hemisphere is covered by oceans?

20. How much of the southern hemisphere is covered by oceans?

In the space at the left, write true if the statement is true; if the statement is false,
change the italicized word or phrase to make it true.

21. The three major oceans are the Atlantic, the Pacific, and the Arctic.

22. The Pacific is Earth’s largest ocean.

23. The Atlantic Ocean extends for more than 20 000 km from north to south.

24. North of the antarctic circle, the Atlantic is known as the Arctic Ocean.

25. The Indian Ocean is located mainly in the northern hemisphere.
SECTION 15.2 Seawater

In your textbook, read about the chemical properties of seawater.
Circle the letter of the choice that best answers the question.

1. About what percentage of seawater is dissolved salts?
   a. 96.5 percent  
   b. 9.65 percent  
   c. 3.5 percent  
   d. 35 percent

2. Which of the following salts is most abundant in seawater?
   a. sodium chloride  
   b. magnesium sulfate  
   c. potassium chloride  
   d. calcium chloride

3. What is salinity?
   a. the amount of dissolved salts in seawater  
   b. the amount of water in the oceans  
   c. the amount of dissolved gases in seawater  
   d. another name for salt

4. What unit is commonly used to measure the salt content of water?
   a. parts per liter  
   b. grams per liter  
   c. kilograms per cubic liter  
   d. parts per thousand

5. In addition to salts, which of these substances is dissolved in seawater?
   a. sugars  
   b. nutrients  
   c. shells  
   d. seaweed

6. Which of the following would cause surface ocean water to have a higher salt content?
   a. a river flowing into the ocean  
   b. the melting of sea ice  
   c. high rates of evaporation and low rates of precipitation  
   d. low rates of evaporation and high rates of precipitation

7. What evidence indicates that the salt content of ancient oceans was about the same as it is today?
   a. seafloor sediments  
   b. comparisons of modern seashells and fossil shells  
   c. ancient lava flows that formed in seawater  
   d. salt content in surface water versus the salt content in bottom water

8. Which process does NOT add salts to seawater?
   a. weathering of crustal rock  
   b. decay of hard-shelled sea creatures  
   c. volcanic gases  
   d. flow of rivers into the ocean

9. Which process removes salt from seawater?
   a. ultraviolet radiation  
   b. weathering of feldspars  
   c. evaporation of elements near arid coastal regions  
   d. consumption of sediments by bottom-feeding organisms
SECTION 15.2  Seawater, continued

In your textbook, read about ocean layering.
Use the terms below to label the diagram of ocean temperatures.

- surface layer
- bottom layer
- thermocline

In your textbook, read about water masses.
Use the letters A through D to sequence the stages of water-mass movement.

16. Cold, salty water sinks.
17. Sea ice forms during the winter.
18. Salty water migrates along the ocean floor toward the equator.
19. Salt ions accumulate beneath the ice.
SECTION 15.3  Ocean Movements

In your textbook, read about wave characteristics. Use the diagram to answer the following questions.

1. Describe the rhythmic movement of a wave. What is the direction of its energy?

2. What is the highest point of a wave called?

3. What is the lowest point of a wave called?

4. What is the vertical distance between the highest and lowest points of a wave?

5. What is the horizontal distance between the top of one wave and the top of the next?

6. What is the relationship between the wave speed in deep water and wavelength?

7. How does an ocean wave become a breaker at the shoreline?

SECTION 15.3  Ocean Movements, continued

In your textbook, read about tides and the causes of tides. For each item in Column A, write the letter of the matching item in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Periodic rise and fall of sea level</td>
<td>a. gravitational and centrifugal forces</td>
</tr>
<tr>
<td>9. Difference between high tide and low tide</td>
<td>b. spring tides</td>
</tr>
<tr>
<td>10. Forces exerted by the Sun and the Moon that generate tidal bulges</td>
<td>c. neap tides</td>
</tr>
<tr>
<td>11. Type of tide with the highest high tides and lowest low tides</td>
<td>d. tide</td>
</tr>
<tr>
<td>12. Type of tide that occurs when the Sun, the Moon, and Earth form a right angle</td>
<td>e. tidal range</td>
</tr>
</tbody>
</table>

In your textbook, read about ocean currents. In the space at the left, write true if the statement is true; if the statement is false, change the italicized word or phrase to make it true.

13. A current caused by differences in the temperature and salinity of ocean water is called a gyre.
14. Surface currents are caused by wind.
15. The gyres of the northern hemisphere circulate in a counterclockwise direction.
16. Examples of warm, poleward-flowing currents are the Gulf Stream and the Kuroshio Current.

In your textbook, read about upwelling. Use each of the terms just once to complete the passage.

cold nutrients offshore trade-wind upwelling vertically

In addition to moving horizontally, ocean water moves (17) ___________________. The upward motion of ocean water is called (18) ___________________. Upwelling waters originate from the bottom of the ocean and are (19) ___________________. Areas of upwelling exist mainly off the western coasts of continents in the (20) ___________________ belts. The trade winds blow surface water (21) ___________________, and the surface water is replaced by upwelling deep water. Upwelling waters are rich in (22) ___________________, which support abundant marine life populations.