Chapter 6—Water

1. The hydrogen atoms in a water molecule tend to bond to:
   a. each other.
   b. oxygen atoms of another water molecule.
   c. hydrogen atoms of another water molecule.
   d. all positively charged ions.
   e. none of these
   REF: p. 122

2. The hydrogen bonds of water molecules account for which of the following?
   a. Water is the universal solvent.
   b. Water has a high surface tension.
   c. Water has a high boiling point.
   d. Water has a high heat capacity.
   e. all of these
   REF: p. 122-123 | p. 129

3. The average salinity of the world ocean is about ____.
   a. 34%
   b. 21.5~
   c. 34~
   d. 52%
   e. 52~
   REF: p. 130

4. The term "salinity" refers to:
   a. the total amount of dissolved solids in the ocean.
   b. the total amount of sodium chloride dissolved in the ocean.
   c. the total amount of chlorine in one kilogram of water.
   d. the total amount of chloride ion in the water.
   e. none of these
   REF: p. 129-130

5. The two most abundant elements (ions) dissolved in seawater are:
   a. fluorine and iodine.
   b. gold and silver.
   c. bromine and boron.
   d. sodium and chloride.
   e. none of these
   REF: p. 130

6. The amount of oxygen that seawater can hold in solution will be greater:
   a. in colder water.
   b. in warmer water.
   c. in water with a higher salinity.
   d. in water with less pressure and density.
   e. none of these
   REF: p. 133
7. Oxygen enters seawater:
   a. through the respiration of animals.
   b. as a byproduct of photosynthesis and diffusion from the surface.
   c. as a result of decomposition of plant and animal remains.
   d. through the oxidation of metal ions in seawater.
   e. none of these
REF: p. 134

8. As carbon dioxide enters the ocean it:
   a. is used by animals for respiration.
   b. bonds to water molecules to increase the salinity of the ocean.
   c. forms carbonic acid.
   d. becomes a product of photosynthesis.
   e. all of these
REF: p. 133

10. The principle of constant proportions states:
    a. that the total amount of dissolved solids in the ocean is a constant.
    b. that the salinity of the ocean is a constant.
    c. that the excess volatile ratio of the ocean is a constant.
    d. that the ratio of major salts in samples of seawater from various places is a constant.
    e. none of these
REF: p. 131

11. Residence time is:
    a. the same for all elements in the ocean.
    b. the average length of time an element spends in the ocean.
    c. a measure of tenure for a professor of oceanography.
    d. the same as mixing time.
    e. none of these
REF: p. 132

12. What is the approximate mixing time of the world ocean?
    a. about 1,000 years
    b. about 100,000 years
    c. about 100,000,000 years
    d. about 1 million years
    e. about 1 billion years
REF: p. 132

14. The salinity of the ocean, at the present time, seems to be:
    a. increasing due to evaporation as the Earth warms up.
    b. decreasing due to several years of excessive rainfall.
    c. increasing due to pollution.
    d. in equilibrium, with dissolved components entering equal to dissolved components leaving.
    e. none of these
REF: p. 132

15. The deepest layers of the ocean originate from:
    a. surface waters at low latitudes.
    b. bottom waters at low latitudes.
    c. waters of the Mediterranean Sea.
d. surface waters especially at high latitudes.
e. none of these
REF: p. 137

16. The ocean is stratified with respect to:
a. density
b. temperature
c. salinity
d. all of these
e. none of these
REF: p. 135

19. The property of water that accounts for the ability of liquid water to absorb heat and change only very little in temperature is called:
a. high heat capacity.
b. latent heat of evaporation.
c. latent heat of fusion.
d. freezing coefficient.
e. none of these
REF: p. 123

20. If our planet were without its ocean, but otherwise the same as it is today, surface temperatures would be:
a. more extreme.
b. less extreme.
c. about the same as we know today.
d. impossible to tell without more information.
e. none of these
REF: p. 127

21. The ocean's deep sound channel (sofar layer) is characterized as a zone in which:
a. sound is horizontally concentrated rather than diffused as it moves through the water.
b. acoustical energy losses are relatively small.
c. sound waves travel great horizontal distances.
d. sound velocity is at a minimum.
e. all of these
REF: p. 139-140

22. The depth to which light can penetrate the ocean depends on:
a. the dust, cloud cover, and gases in the atmosphere.
b. the angle of the sun above the horizon.
c. the smoothness or roughness of the sea surface.
d. the amount of suspended material in the water.
e. all of these
REF: p. 137

23. The wavelength(s) of light that penetrate deepest into the ocean are:
a. red and violet.
b. red and yellow.
c. blue and red.
d. green and blue.
e. All wavelengths penetrate equally.
REF: p. 137
25. About what percentage of the incoming sunlight is absorbed by the Earth's land and water surface?
   a. 20%
   b. 33%
   c. 51%
   d. 67%
   e. 42%
   REF: p. 135

Chapter 7—Atmospheric Circulation

1. The most abundant gaseous components of the Earth's atmosphere are:
   a. carbon dioxide and oxygen.
   b. nitrogen and hydrogen.
   c. nitrogen and carbon dioxide.
   d. nitrogen and oxygen.
   e. none of these
   REF: p. 148

2. Warm air ____ and cool air ____.
   a. expands; rises
   b. contracts; expands
   c. expands and rises; contracts and sinks
   d. expands and rises; expands and sinks
   e. rises; expands
   REF: p. 150

3. Seasons are caused by:
   a. changes in the weather.
   b. annual variation in the energy output of the sun.
   c. the Earth's orbital tilt relative to the plane of its orbit around the sun.
   d. our being closer to the sun in summer.
   e. none of these
   REF: p. 150

5. According to the atmospheric circulation model developed in the text, air tends to
   a. rise at 30° north and fall at 60° north.
   b. rise at 60° north and fall at 30° north.
   c. rise at 30° north and fall at 0° north.
   d. rise at 30° north and rise at 60° north.
   e. none of these
   REF: p. 154

6. There are ____ main wind bands in each hemisphere of the Earth.
   a. 2
   b. 3
   c. 4
   d. 5
   e. 6
   REF: p. 154

7. The Coriolis effect causes objects moving in the northern hemisphere to veer off course:
9. The dependable surface winds of the Earth centered at about 15° north and south latitudes are called:
   a. the westerlies.
   b. the northerlies.
   c. the trade winds.
   d. the doldrum winds.
   e. the easterlies.
   REF: p. 155

10. Winds generally move across the United States:
    a. from north to south.
    b. from east to west.
    c. from south to north.
    d. from west to east.
    e. none of these
    REF: p. 169

12. The boundary between two air masses is called a(n):
    a. Hadley line.
    b. ITCZ.
    c. Hadley cell.
    d. front.
    e. doldrum.
    REF: p. 158

14. Weather may be defined as:
    a. long-term temperature and rainfall trends.
    b. short-term, localized characteristics of the atmosphere.
    c. long-term changes in the composition of the atmosphere.
    d. short-term changes in the composition of the atmosphere.
    e. none of these
    REF: p. 148

17. When air masses come together:
    a. very little weather activity results.
    b. a tropical cyclone forms.
    c. one air mass may ride up and over the other and form a front.
    d. one air mass may ride up over the other and form a storm surge.
    e. none of these
    REF: p. 158

18. The power for tropical cyclones comes from:
    a. static electricity.
    b. the condensation of warm, dry air.
    c. the Coriolis effect.
    d. the condensation of warm, moist air.
    e. none of these
21. Tropical cyclones tend to move:
   a. equatorward in both hemispheres.
   b. eastward and poleward in both hemispheres.
   c. westward and poleward in both hemispheres.
   d. poleward in both hemispheres.
   e. none of these

24. The long-term average of weather factors in a geographic region is called:
   a. weather.
   b. cyclonic circulation.
   c. Coriolis.
   d. climate.
   e. none of these

Chapter 8—Ocean Circulation

1. A system of four currents completing a flow circuit around the periphery of an ocean basin is collectively called:
   a. a cell.
   b. a gyre.
   c. a microscale current.
   d. convection cells.
   e. none of these

2. The ultimate source of most of the energy for ocean currents is:
   a. weather.
   b. wind.
   c. the sun.
   d. the tides.
   e. the moon.

3. The immediate source of surface currents is:
   a. weather.
   b. wind.
   c. the sun.
   d. the tides.
   e. the moon.

5. The Earth's rotation influences currents by a "force" known as:
   a. Ekman spiral.
   b. geostrophism.
   c. gyre counter rotation.
   d. Coriolis effect.
   e. none of these
6. Currents tend to move in large ____ patterns in the northern hemisphere.
   a. irregular
   b. counterclockwise
   c. clockwise
   d. random
   e. none of these
   REF: p. 172

7. The only ocean current that continues in an uninterrupted circle around the circumference of the Earth without encountering land is the:
   a. Gulf Stream.
   b. Kuroshio, or Japan, Current.
   c. Antarctic Circumpolar Current.
   d. Canary Current.
   e. none of these
   REF: p. 175

8. Generally the fastest and deepest ocean currents are:
   a. northern boundary currents.
   b. eastern boundary currents.
   c. western boundary currents.
   d. southern boundary currents.
   e. none of these
   REF: p. 175

10. England's weather is ____ than would be expected at that latitude because of the influence of surface currents.
    a. colder
    b. drier
    c. less humid
    d. warmer and wetter
    e. cooler and drier
    REF: p. 181

11. San Francisco's characteristic cold and foggy weather is caused by a:
    a. cold eastern boundary current.
    b. warm eastern boundary current.
    c. cold western boundary current.
    d. warm western boundary current.
    e. none of these
    REF: p. 182

14. The densest water in ocean currents is the:
    a. warmest and saltiest.
    b. coldest and saltiest.
    c. warmest and freshest.
    d. coldest and freshest.
    e. none of these
    REF: p. 189

17. Which current within a northern hemisphere gyre would you expect to have the lowest salinity and temperature?
20. Which ocean surface current carries the greatest volume of water?
   a. The Kuroshio (or Japan) Current
   b. The North Equatorial Current in the Pacific
   c. The South Equatorial Current in the Pacific
   d. The Antarctic Circumpolar Current
   e. The Canary Current
   REF: p. 175

21. Most deep bottom water forms:
   a. near the ocean floor in the arctic.
   b. near the ocean floor in the Antarctic.
   c. near the ocean surface in the arctic.
   d. near the ocean surface in the Antarctic.
   e. near the ocean floor in the Arctic.
   REF: p. 189-190

22. The main force driving thermohaline circulation is:
   a. wind.
   b. Coriolis effect.
   c. gravity.
   d. electromagnetic attraction.
   e. current activity.
   REF: p. 189

23. A sverdrup (sv) is a measure of:
   a. wind speed.
   b. current speed and direction.
   c. the volume of water transported in an ocean current.
   d. the amount of heat transferred to water from the sun.
   e. none of these
   REF: p. 177

24. The largest of the western boundary currents is the:
   a. Gulf Stream.
   b. California Current.
   c. East Pacific Gyre.
   d. Canary Current.
   e. none of these
   REF: p. 177

Chapter 9—Waves

1. Which of these lists is arranged in order from smallest wavelength to longest wavelength?
   a. seiches, tsunami, wind waves, tides
   b. wind waves, seiches, tsunami, tides
   c. wind waves, tsunami, seiches, tides
d. tides, seiches, tsunami, wind waves
e. seiches, tides, wind waves, tsunami
REF:  p. 202

2. Water particles in a deep-water wave:
a. move rapidly toward the shore.
b. move in circular orbits.
c. do not move; only the wave form moves.
d. move in flat elliptical circles.
e. none of these
REF:  p. 200

3. In shallow water, the motion of water particles:
a. ceases completely.
b. forms large circular orbits.
c. becomes a back-and-forth motion near the bottom.
d. becomes an up-and-down motion near the bottom.
e. none of these
REF:  p. 203

5. Unlike other moving things, wind waves travel over great distances in virtually straight lines. This is physically possible because:
a. while the wave is moving, some water molecules are traveling in closed circles.
b. the waves don't move as fast as speeding cannon balls, so the Coriolis effect has no influence on them.
c. waves carry only energy, and energy has no mass, and is therefore not subject to Coriolis deflection.
d. waves curve one way in the southern hemisphere and the other way in the northern hemisphere. Waves only look like they are coming in a straight line from their point of origin. It's all a gigantic optical illusion, actually.
e. none of these
REF:  p. 223

6. The distance measured from trough to trough of a wave is:
a. the wavelength.
b. the wave height.
c. the wave period.
d. the orbit.
e. none of these
REF:  p. 200

7. The period of wind waves is usually expressed in:
a. feet or meters.
b. miles per hour, or kilometers per hour.
c. seconds.
d. feet or meters per hour.
e. minutes.
REF:  p. 202

8. Waves with the greatest propagation rate or celerity:
a. have the longest wavelengths.
b. occur in shallow water only.
c. form when the wind is blowing less than 0.5 nautical miles per hour.
d. have wave periods of less than one second.
e. none of these
REF: p. 203

9. The first waves to form on the ocean surface when the wind starts to blow are:
a. gravity waves.
b. internal waves.
c. swell.
d. capillary waves.
e. tidal waves.
REF: p. 201

11. The ultimate height of a wind wave will depend on:
a. the fetch.
b. the length of time the wind blows.
c. the velocity of the wind.
d. all of these
e. none of these
REF: p. 206

12. As wind waves move out of a storm area:
a. the short waves move out first and form "chop."
b. the short-period waves overtake the long-period waves.
c. the waves are sorted by velocity and form the swell.
d. the sea becomes flat outside the storm area.
e. none of these
REF: p. 204

13. When waves approach the shore, a series of changes takes place. One change is that the:
a. wave crest forms a steep peak.
b. wavelength increases.
c. wave height decreases.
d. wave velocity increases.
e. none of these
REF: p. 210

16. Waves tend to be parallel to the shore when they break due to the process of:
a. diffraction.
b. reflection.
c. refraction.
d. reaction.
e. none of these
REF: p. 211

17. Rogue waves are best described as:
a. the highest waves of a tsunami.
b. a breaking internal wave.
c. a strong rocking motion within a harbor.
d. a single massive wave that develops in the open ocean.
e. none of these
REF: p. 209
20. What wave form typically carries the greatest amount of energy through the ocean surface at any given time?
   a. wind waves
   b. tsunami
   c. seiches
   d. tides
   e. none of these
   REF: p. 202

21. Tsunami or seismic sea waves are generated by:
   a. storms at sea.
   b. tidal currents in the open sea.
   c. breaking internal waves.
   d. coastal or submarine earthquakes.
   e. none of these
   REF: p. 201

22. In the open sea, tsunami:
   a. are giant breaking waves that are dangerous to ships.
   b. are slow-moving waves, slower than the swell.
   c. are long-period waves, often of 15-20 minutes.
   d. have short wavelengths of 100-200 feet, similar to wind waves.
   e. all of these
   REF: p. 202

23. In the open sea, tsunami reach an average wave height of about:
   a. 1 meter.
   b. 10 meters.
   c. 100 meters.
   d. 1,000 meters.
   e. 10,000 meters.
   REF: p. 218

24. When a tsunami reaches shore,
   a. the wave height is increased by entry into shallow water.
   b. it always arrives at the time of a high tide.
   c. the wave will appear as a single huge breaking wave.
   d. it will always race hundreds of meters inland.
   e. none of these
   REF: p. 217

**Chapter 10—Tides**

1. A wave of water moving up a river, initiated by tidal action and normal resonances within a river estuary, is called a:
   a. tidal node.
   b. tidal wave.
   c. tidal bore.
   d. tidal current.
   e. none of these
   REF: p. 237
2. Which body has the greatest influence on ocean tides?
   a. Sun
   b. Moon
   c. Jupiter
   d. Venus
   e. none of these
   REF:  p. 228

3. The primary force(s) that cause(s) tides in the sea is (are):
   a. coastal earthquakes and landslides.
   b. wind and storms at sea.
   c. the gravitational attraction of the moon and the sun.
   d. the gravitational attraction of Mars and Venus.
   e. none of these
   REF:  p. 228

6. The tidal pattern characteristic of the west coast of the United States is:
   a. mixed tides.
   b. diurnal tides.
   c. reversing tides.
   d. amphidromic tides.
   e. none of these
   REF:  p. 236

7. The side of the Earth facing the moon will experience a high tide, while the opposite side of the Earth
   will have a:
   a. low tide.
   b. time of no tidal action.
   c. high tide also.
   d. tide that cannot be predicted.
   e. none of these
   REF:  p. 229-230

8. When the sun and moon are in a line with the Earth, the:
   a. gravitational attraction will be less.
   b. difference between high and low tides will be minimal.
   c. arrival of high tide will be delayed.
   d. highest high and lowest low tides will occur.
   e. none of these
   REF:  p. 233

9. A tide pattern of one high and one low each day describes a
   a. diurnal tide.
   b. mixed tide.
   c. solar tide.
   d. semidiurnal tide.
   e. none of these
   REF:  p. 235

12. Tidal bores usually occur:
    a. in rivers or long narrow bays.
    b. in open ocean far from land.
    c. around islands.
d. in enclosed basins such as the Mediterranean.
e. none of these
REF: p. 237

13. An amphidromic point is a:
a. no tide point in the ocean around which the tide crest rotates through one tidal cycle.
b. place in the ocean where tides are highest.
c. place in the ocean where tidal datum is displaced to the right (in the northern hemisphere), or to the south (in the southern hemisphere).
d. no tide point at the coast where there is a daily high tide, but no low tide.
e. none of these
REF: p. 235

16. World-wide, the most common type of tides are:
a. semidiurnal.
b. mixed diurnal.
c. diurnal.
d. mixed node tides.
e. none of these
REF: p. 235

17. The height of the ocean averaged over a few years' time is called:
a. mean high water.
b. mean low water.
c. tidal datum.
d. mean sea level.
e. none of these
REF: p. 237

23. What body generates the strongest tractive forces?
a. The moon
b. The sun
c. The Earth
d. the moon and the sun
e. none of these
REF: p. 228

24. The type of tide associated with the full and new moons are:
a. neap tides.
b. spring tides.
c. diurnal tides.
d. tidal currents.
e. none of these
ANS: B PTS: 1 REF: p. 233

25. Which of the following statements best characterizes neap tides?
a. Neap tides occur when the moon, Earth and sun form a right angle.
b. Neap tides represent extreme tidal ranges.
c. Neap tides occur at the new and full moons every month.
d. Neap tides correspond with the timing of spring tides.
e. none of these
REF: p. 233
MULTIPLE CHOICE

1. The present shorelines of the world are considered to be:
   a. geologically stable zones separating land and sea.
   b. features of great geological antiquity.
   c. a dynamic environment affected by both long-term and short-term cycles.
   d. that part of the marine environment most resistant to change.
   e. none of these
   REF: p. 247

2. Oceanographers believe that during the Pleistocene Ice Age of the last 1-2 million years major changes occurred in the ocean. The evidence indicates that:
   a. the sea froze even in the tropics.
   b. sea level was lowered about 120 meters (400 feet) during maximum advances of the ice.
   c. the dinosaurs in the ocean were finally killed off by the cold water.
   d. most of the continents were flooded as the sea expanded inland.
   e. none of these
   REF: p. 247

3. The single most influential agent changing the shore and coast is:
   a. wave action.
   b. the tidal range.
   c. alternate freezing and thawing of coastal cliffs.
   d. prevailing winds.
   e. none of these
   REF: p. 246

4. The origin of sea cliffs, sea stacks, sea caves, blowholes, and arches is related to:
   a. longshore currents.
   b. high tides.
   c. human activities.
   d. erosion by waves.
   e. none of these
   REF: p. 249

5. The highest point on a summer beach profile is:
   a. the berm.
   b. the backshore.
   c. the foreshore.
   d. the low-tide terrace.
   e. none of these
   REF: p. 252

7. The downcoast transport mechanism for beach sand along much of the Pacific coast is called:
   a. the longshore current, a current that moves sand north-to-south along the coast, parallel to shore, at a great distance away from land.
   b. the longshore current, a current that moves sand south-to-north along the coast, parallel to shore, at a great distance away from land.
   c. the longshore current, a current that moves sand north-to-south along the coast, parallel to
shore, close to shore.
d. the longshore current, a current that moves sand south-to-north along the coast, parallel to shore, close to shore.
e. none of these
REF: p. 254

8. Steep, narrow, rocky beaches are usually found in areas of:
a. summer beach conditions.
b. wave deposition.
c. high wave energy.
d. small inlets and bays.
e. none of these
REF: p. 248-249

9. The energy that drives the longshore currents is derived from:
a. hurricanes and cyclones.
b. major surface currents, such as the Gulf Stream.
c. monthly high tides.
d. wind waves approaching the beach front at an angle.
e. none of these
REF: p. 254

10. A summer beach is characteristically:
a. a rocky platform.
b. steep and narrow.
c. covered with boulders and cobbles.
d. broad and covered with sand.
e. none of these
REF: p. 253

13. Oceanographers usually classify coasts by:
a. the type of sand found on the beach.
b. the physical processes shaping the coasts.
c. the direction the coast faces.
d. the latitude in which the coast resides.
e. none of these
REF: p. 246

14. Most of the minerals found in the sand of continental beaches are supplied by:
a. erosion of local coastal cliffs.
b. currents from the deep ocean floor.
c. glacial processes.
d. rivers and streams.
e. rivers, streams, and glacial processes.
REF: p. 252

15. A problem facing many beaches along the U.S. east and west coasts is:
a. excess sand being deposited around seaside installations.
b. the rapid growth of deltas at the mouths of rivers.
c. the development of barrier beaches across harbors.
d. the loss of sand and the erosion of beaches.
e. none of these
REF: p. 248
16. Human activities that have contributed to shoreline erosion include:
   a. building of dams across the rivers carrying sediment to the shore.
   b. construction of jetties along the beach.
   c. placement of seawalls along the shoreline.
   d. building artificial breakwater that slow the longshore current system.
   e. all of these
   REF: p. 266-267

17. If a beach is wide, gently sloping with fine sands, we would expect to see:
   a. very heavy wave action.
   b. a beach facing into Arctic storms.
   c. generally small waves winter and summer.
   d. high-energy waves all year around.
   e. none of these
   REF: p. 252

18. The steep cliffs and rugged coast of much of the West Coast of the United States are primarily the result of:
   a. faulting and earth movement.
   b. marine deposition.
   c. river deposition.
   d. glacial erosion.
   e. none of these
   REF: p. 262

23. Which of the following statements is FALSE concerning estuaries?
   a. Many organisms live in estuaries.
   b. Estuaries are very vulnerable to pollution.
   c. The salinity in estuaries varies because of mixing.
   d. An estuary is a type of delta.
   e. none of these
   REF: p. 262

25. The Atlantic coast is an example of:
   a. a passive margin.
   b. a tectonically active region.
   c. an active margin.
   d. an area where glaciers have contributed to the shape of the coast.
   e. two of the above
   REF: p. 265