

Chapter 6, Sections 6.1 through 6.4

1. The water molecule (H_2O) is a polar molecule because
 - a) water is found near both the north and south poles of the earth.
 - b) the water molecule is positively charged.
 - c) the water molecule is negatively charged.
 - d) the water molecule is bent, and the oxygen is positively charged whereas the hydrogen is negatively charged.
 - e) the water molecule is bent, and the oxygen is negatively charged whereas the hydrogen is positively charged.

2. A hydrogen bond occurs in water
 - a) between the hydrogen and the oxygen in a molecule of H_2O .
 - b) between the two hydrogen atoms in a molecule of H_2O .
 - c) between a hydrogen atom in one molecule and an oxygen atom in another molecule of H_2O .
 - d) between hydrogen atoms in different molecules of H_2O .

3. The polar nature of water molecules accounts for which of the following facts?
 - a) Water can dissolve many other compounds.
 - b) Water has a high surface tension.
 - c) Water is a liquid at room temperature rather than a gas.
 - d) Water has a high heat capacity.
 - e) All the above are relevant.

4. Which of the following is true about temperature and heat?
 - a) temperature is measured in degrees and heat is measured in calories.
 - b) temperature is measured in calories and heat is measured in degrees.
 - c) temperature is the energy produced by random vibration of atoms or molecules.
 - d) both a) and c).
 - e) both b) and c).

5. The ocean is slow to change temperature. This is related to a property of water known as
 - a) density.
 - b) high heat capacity.
 - c) low heat capacity.
 - d) boiling point.
 - e) freezing point.

6. The latent heat of vaporization for water is
 - a) about 80 calories per gram.
 - b) the energy required to convert water from a solid to a liquid.
 - c) the energy required to convert water from a liquid to a gas.
 - d) a) and b)
 - e) a) and c)

7. The density characteristics of pure water are unusual for the following reason or reasons:
 - a) Density increases with increasing temperature from 4°C to 20°C .
 - b) Density is maximum at about 4°C , and less at higher and lower temperatures.
 - c) Ice floats.
 - d) a) and c)
 - e) b) and c).

8. Ice floats because
- it is less dense than water.
 - the crystal lattice of ice uses 24 molecules of H₂O in a volume that could hold 27 molecules in liquid form.
 - the latent heat of vaporization of water is 80 calories per gram.
 - all the above.
 - a and b.
9. You are boiling a pot of water at the beach. As the water boils
- the temperature slowly increases from room temperature to 212°C.
 - the temperature slowly decreases from 212°C to room temperature.
 - the temperature stays constant at 212°C.
 - the temperature stays constant at 100°C.
10. Seawater is different from freshwater in that
- seawater evaporates more readily than freshwater because of the dissolved salts.
 - seawater does not evaporate as readily as freshwater because of the dissolved salts.
 - at typical salinity for the ocean (35 ppt) seawater is densest at its freezing point, whereas freshwater is densest about 4°C above the freezing point.
 - a) and c)
 - b) and c)

Chapter 7

11. The average salinity of the world ocean is closest to which of the following? BE CAREFUL
- 3.5 ‰
 - 21 ‰
 - 35 ‰
 - 52 ‰
 - 96 ‰
12. Other than hydrogen and oxygen, the two most abundant elements or ions dissolved in seawater are
- fluorine and iodine.
 - gold and silver.
 - bromine and boron.
 - sodium and chloride.
 - carbonate and sulfate.
13. The term salinity refers to
- the total amount of table salt dissolved in the water.
 - the total amount of chlorine in the water.
 - the total amount of chloride ion in the water.
 - the total amount of sodium in the water.
 - the total amount of dissolved solids in the water.
14. The chemical composition of salts in seawater and in river water is
- the same, suggesting that river water is practically the same as seawater.
 - the same, although seawater is much saltier than river water because of evaporation.
 - different, suggesting that the salts in seawater has other sources in addition to river water.
 - different because seawater is much saltier than river water.
15. The property of seawater used by salinometers to measure salinity is
- density.
 - surface tension.
 - electrical conductivity.
 - heat capacity.
 - optical refraction.

16. The Principle of Constant Proportions states
- that the total amount of dissolved solids in the ocean is a constant.
 - that the salinity of the ocean is a constant.
 - that the excess volatile ratio of the ocean is a constant.
 - that the ratio of major salts in seawater from various places is a constant.
17. Residence time is
- the same for all elements in the ocean.
 - the average length of time an atom of an element spends in the ocean.
 - a measure of tenure for a professor of oceanography.
 - the same as mixing time.
18. In the context of oceanography, a nonconservative constituent is
- a voter who tells his or her congressperson to vote for the Clean Water Act.
 - a voter who tells his or her congressperson to vote against the Clean Water Act.
 - a substance with a short residence time relative to the mixing time of the ocean.
 - a substance with a long residence time relative to the mixing time of the ocean.
19. The amount of gas that seawater can hold in solution is greater in
- colder water.
 - warmer water.
 - lower pressure water.
 - clearer water.
 - saltier water.
20. Which of the following is true about dissolved oxygen gas in seawater?
- the concentration is generally highest near the surface due to photosynthesis and exchange with the air.
 - the concentration is generally low near the surface due to photosynthesis.
 - the concentration in very deep water can be slightly higher than at intermediate depths.
 - a) and c) above.
 - b) and c) above.
21. Most of Earth's surface carbon is found in
- the living tissues of plants, animals, and bacteria.
 - the atmosphere.
 - the ocean.
 - sediments, including sedimentary rocks.
22. Dissolved CO₂ in seawater does which of the following?
- It forms carbonic acid
 - It forms carbonate and bicarbonate ions.
 - It acts to buffer seawater from fluctuations in acidity.
 - All of the above.
 - a) and c) above.

Chapter 6, Sections 6.5 – 6.8

23. The ocean is stratified with respect to
- density.
 - temperature.
 - salinity.
 - all the above.
 - none of the above.

24. In a stable situation
- a) Denser fluid will always form a layer on top of less dense fluid.
 - b) Denser fluid will always form a layer underneath less dense fluid.
 - c) Warmer fluid will always form a layer underneath less warm fluid.
 - d) a) and c)
 - e) b) and c)
25. Most of the world ocean has the temperature properties of
- a) the mixed layer.
 - b) the thermocline.
 - c) the deep zone.
 - d) the continents.
 - e) the atmosphere.
26. The density of a parcel of seawater will increase
- a) when the temperature increases.
 - b) when the salinity decreases.
 - c) when the salinity increases.
 - d) when the pressure decreases.
 - e) when exposed to extremely high sound levels.
27. Why of the following types of water is the most dense?
- a) Cold and fresh.
 - b) Cold and salty.
 - c) Warm and fresh.
 - d) Warm and salty.
28. A zone where the ocean's density increases rapidly with increasing depth is called
- a) a halocline.
 - b) a thermocline.
 - c) a pycnocline.
 - d) a densocline.
 - e) a patsyline.
29. A zone where the ocean's salinity increases rapidly with increasing depth is called
- a) a halocline.
 - b) a thermocline.
 - c) a pycnocline.
 - d) a densocline.
 - e) a patsyline.
30. A zone where the ocean's temperature decreases rapidly with increasing depth is called
- a) a halocline.
 - b) a thermocline.
 - c) a pycnocline.
 - d) a densocline.
 - e) a calvincline.
31. The most pronounced thermoclines exist in
- a) the temperate regions.
 - b) the polar regions.
 - c) the tropics.
 - d) anywhere the water is very clear.
 - e) anywhere the water is very salty.

32. In the context of oceanography, the concept of a *water mass* refers to
- a body of water having approximately the same temperature throughout.
 - a body of water having approximately the same salinity throughout.
 - a body of water having approximately the same temperature and salinity throughout.
 - a body of water having high temperature near the top and much lower temperature near the bottom.
 - a body of water having low salinity near the top and much higher salinity near the bottom.
33. The upper sunlit layer of the ocean is called _____ and typically extends to a depth of about _____
- the aphotic zone ... 100 meters.
 - the photic zone ... 100 meters.
 - the absorption zone ... 1000 meters.
 - the scattering zone ... 100 meters.
 - the aphotic zone ... 1000 m.
34. The colors of light that penetrate deepest into the ocean are
- red and violet.
 - red and yellow.
 - blue and red.
 - green and blue.
 - all colors (penetration is not a function of color).
35. Sound travels at approximately ____ m/s in seawater.
- 100
 - 334
 - 1000
 - 1500
 - 10000
36. The speed of sound is governed by such variables as
- water temperature
 - sea surface roughness
 - pressure
 - a and b
 - a and c
37. Which of the following is true regarding the effect of frequency on sound traveling in seawater?
- high frequencies are absorbed much more than are low frequencies.
 - low frequencies are absorbed much more than are high frequencies.
 - high frequencies travel faster than low frequencies.
 - low frequencies travel faster than high frequencies.
 - neither sound speed nor absorption are affected by frequency.
38. The sofar channel is the layer of the ocean where
- sound waves tend to stay, because of refraction.
 - sound travels slowest.
 - sound travels very efficiently for long distances.
 - all of the above.
 - none of the above.
39. Since 1993 oceanographers have been transmitting sound throughout the world's oceans as a way to determine if the oceans are warming up as part of an overall pattern of global warming. The idea behind this approach is that
- if the oceans are generally getting warmer, the travel time will decrease by several seconds over 10 years.
 - if the oceans are generally getting warmer, the travel time will increase by several seconds over 10 years.
 - if the oceans are generally getting warmer, many species of fish will die, and less sound will be absorbed.

- d) if the oceans are generally getting warmer, more carbon dioxide will be absorbed, causing more sound to be absorbed.
40. Explain to your grandmother why water is a liquid at room temperature. Tell her why this is a surprising fact.
 41. Explain to your grandmother why water is sprayed onto orange groves on nights when a frost is expected.
 42. Explain the Principle of Constant Proportions.
 43. Explain the difference between conservative and nonconservative seawater constituents.
 44. Explain to your grandmother why the sea is salty. Include in your explanation where the salts come from. Is the ocean simply concentrated river water? Is the ocean getting saltier with time? Why or why not?
 45. Sketch and label a typical profile of temperature as a function of depth.
 46. Sketch and label a typical profile of density as a function of depth.
 47. Explain the two-layer model of the physical ocean. What causes this structure to be stable, and what causes the stability to break down?
 48. Your grandmother has noticed that many underwater photos and video have a blue hue, with little or no red color showing. Explain this to her. What color would a red fish be in deep water?
 49. Explain the SOFAR channel to your grandmother.