

Chapter 1 - Introduction

1. What is the branch of Earth Science concerned with understanding the composition of the Earth and the physical changes occurring in it, based on the study of rocks, minerals, and sediments, their structures and formations, and their processes of origin and alteration.
- Physical geology
 - Meteorology
 - Hydrology
 - Historical geology

The overall goal of science is:

- to create better technology.
- to develop hypotheses and theories.
- to discover the origins of humans.
- to find the origin of the universe.
- to discover underlying patterns in the natural world.

2. Which of the following is a well-tested and widely accepted view that best explains certain observable facts?
- theory
 - scientific method
 - rule
 - hypothesis
 - observation

3. The tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation is called a:
- fact.
 - theory.
 - hypothesis.
 - observation.
 - scientific law.

4. A pure chemical substance consisting of one type of atom distinguished by its atomic number is called:
- an atom.
 - an element.
 - a nucleus.
 - a proton.

5. Chemical substances classified as **salts** are held together by:
- covalent bonds.
 - ionic bonds.
 - metallic bonds.
 - Van der Waals bonds.

6. Isotopes of an element have:
- the same number of protons and neutrons.
 - the same number of neutrons, but different number of protons.
 - equal number of protons, but different number of neutrons.
 - different numbers of electrons, neutrons and protons.

7. Density is usually defined as a measure of mass (in grams) divided by the volume in in cubic centimeters (cm³) or milliliters (ml). What is the average density of seawater?
- 1.027 gm/ml
 - 0.917 gm/ml
 - 1.0 gm/ml
 - 0.986 gm/ml

9. What part of the electromagnetic spectrum listed below has the "greatest energy" (based on highest frequency or shortest wavelength)?

- a. UV (ultraviolet rays)
- b. visible light
- c. thermal infrared rays
- d. microwaves
- e. radio waves

10. Who was first to provide evidence that explained Heliocentrism Theory that the Sun, not the Earth, was the center of our Solar System?

- a. Aristotle
- b. Nicolaus Copernicus
- c. Galileo Galilei
- d. Johannes Kepler
- e. Isaac Newton

11. Which scientist used observational information from earlier scientists to resolve the **Law of Universal Gravitation**?

- a. Aristotle
- b. Galileo Galilei
- c. Copernicus
- d. Johannes Kepler
- e. Isaac Newton

12. What is the name of the theory that generally states that "the physical, chemical, and biological laws that operate today have also operated in the geologic past," or more simply, "the present is key to the past."

- a. hypothesis
- b. superposition
- c. uniformitarianism
- d. historical geology
- e. catastrophism

13. The geologic time scale is used to name periods of geologic time in Earth's history. Segments of time periods are given names like Paleozoic Era, Jurassic Period, or Pleistocene Epoch. The current age of the Earth accepted by the majority of the scientific community is that Earth formed in early Precambrian time. The current estimated age of the Earth is approximately:

- a. 13.8 billion years.
- b. 11,000 thousand years.
- c. 7,000 years.
- d. 4.55 million years.
- e. 4.56 billion years.

14. Who discovered that there are other galaxies outside of the Milky Way galaxy (greatly expanding our knowledge of the size of the Universe)?

- a. Aristotle
- b. Galileo Galilei
- c. Isaac Newton
- d. Edwin Hubble

15. A **light year** is the astronomical measure of:

- a. the distance that light can travel in a year
- b. approximately 9.4607×10^{12} kilometers
- c. about 6 trillion miles.
- d. all of the above.

16. The Milky Way is thought to be:

- a. spiral galaxy.
- b. an elliptical galaxy.
- c. an irregular galaxy.
- d. the Observable Universe.

17. According to the Big Bang Theory, the current estimates put the age of the Observable Universe is about:

- a. 13.8 billion years
- b. 11,000 thousand years
- c. 6,000 years
- d. 4.56 million years
- e. 4.56 billion years

18. An interstellar cloud within a galaxy consisting of gas and dust, typically glowing from radiant energy from stars nearby or within them, and are considered the birth place of stars and solar systems, is called:

- a. a bolide.
- b. a nebula.
- c. a constellation.
- d. a nova.

19. What is the outermost layer of the Sun that includes its thin atmosphere that extends as streaming glowing, hot plasma out into space, and is visible during a solar eclipse?:

- a. the chromosphere and corona.
- b. The convection zone.
- c. The photosphere.
- d. the radiative zone.

20. What causes the solar wind and solar storms?

- a. large solar flares.
- b. large solar prominences.
- c. coronal mass ejections.
- d. All choices are correct.

21. Which planets do not have moons?

- a. Mercury and Venus
- b. Mercury, Venus and Mars
- c. Mercury, Venus, Jupiter, and Saturn
- d. Mercury, Venus, Neptune, Uranus, and Neptune.

22. The Asteroid Belt is located between:

- a. Venus and Earth.
- b. Earth and Mars.
- c. Mars and Jupiter.
- d. Jupiter and Saturn.
- e. Uranus and Neptune.

23. An object that enters the atmosphere and explodes with great force is called a:

- a. galaxy.
- b. comet.
- c. asteroid.
- d. bolide.
- e. meteorite.

24. The tilt in Earth's axis is theorized to have been caused by the collision of a Mars-sized object with the Proto Earth early in the formation of the Solar System. As a result, the Earth has 4 seasons. The day of the year when the north pole axis points closest to the Sun on the longest day of the year in the northern hemisphere is the:

- a. winter solstice.
- b. spring equinox.
- c. summer solstice.
- d. fall equinox.
- e. summer equinox.

25. Which of the moons orbiting a planet in the outer solar system is thought to have twice as much water (volume of oceans) than planet Earth?

- a. The Moon
- b. Europa
- c. Ganymede
- d. Enceladus

Chapter 2 - Rocks and Minerals

1. A substance that is considered a **mineral** must have which of the following characteristics:

- a. It must be naturally occurring in the environment.
- b. It must be an inorganic (never living) solid.
- c. It must have a chemical formula that only varies over a limited range that does not alter the crystal structure that has a definite internal arrangement of atoms.
- d. all of the above.

2. A **rock** is a:

- a. a mixture or an aggregate of mineral matter.
- b. composed of one or more minerals.
- c. may include non-mineral substances, such as water, gases, or organic matter.
- d. All of the above.

3. What two elements are most abundant in the Earth's crust?

- a. hydrogen and oxygen.
- b. oxygen and silicon.
- c. carbon and silicon.
- d. iron and aluminum.

4. What are the three types of rocks?

- a. igneous, sedimentary, and metamorphic.
- b. minerals, soils, and rocks.
- c. weathering, transportation, and deposition.
- d. igneous, sedimentary, and molten.

5. Very few things that are solid are not **crystalline**. Most naturally occurring, inorganic materials are crystalline substances, having the structure and form of a crystal or is composed of crystals. What is an example of a material that is not a crystalline substance?

- a. glass.
- b. halite.
- c. fluorite.
- d) none of the above.

6. A crystal structure describes a highly ordered, repeatable arrangement of atoms. Only when molecules are

arranged in an orderly, repeatable symmetric pattern will it be considered a mineral. The smallest and simplest possible representation of molecules arranged to form a repeating crystal structure is called:

- a. a mineral.
- b. a unit cell.
- c. an octagon.
- d. a chemical formula.

7. Roughly, about how many atoms are in a single crystal grain of salt?

- a. 1.2×10^6 (or 1,200,000)
- b. 4.5×10^9 (or 4,500,000,000)
- c. 13.8×10^9 (or 13,800,000,000)
- d. 1.2×10^{18} (or 1,200,000,000,000,000,000)

8. A mineral with the chemical formula of CaCO_3 and has hexagonal crystal shapes and rhombohedral cleavage is:

- a. dolomite.
- b. calcite.
- c. quartz.
- d. gypsum.

9. Which crystal system has crystal shapes that have symmetry axes in equal lengths in 3 directions (at 90° angles to each other) are part of the:

- a. trigonal crystal system.
- b. isometric crystal system.
- c. tetragonal crystal system.
- d. triclinic crystal system.

10. The tendency of a crystallized substance (including minerals) to split along definite crystalline planes, yielding smooth surfaces is called:

- a. non crystalline.
- b. chatoyancy.
- c. luster.
- d. cleavage.

11. The description of the quality and intensity (sheen or shine) of light reflected off of a mineral, particularly a reflective appearance of the exterior of crystal surfaces is called:

- a. luster.
- b. fluorescence.
- c. specific gravity.
- d. double refraction.

12. A mineral that can transmit light, but it is dispersed or cloudy is called:

- a. opaque.
- b. transparent.
- c. translucent.
- d). All of the above.

13. **Iceland spar** is a mineral that can demonstrate double refraction—that is, light passing through clear Iceland spar will transmit a double image, or split a laser beam into two separate beams. Iceland spar is a variety of what mineral?

- a. quartz
- b. calcite
- c. feldspar
- d. mica

14. According to the Mohs Hardness Scale, which is the hardest mineral?

- a. quartz
- b. topaz
- c. diamond
- d. feldspar

15. Many rocks contain minerals that are rich in iron and are partly magnetic and display measurable magnetic susceptibility -- making them useful for geophysical exploration, such as finding hidden faults or mineral ore bodies. A mineral with high magnetic susceptibility includes:

- a. magnetite.
- b. calcite.
- c. diamond.
- d. labradorite.

16. The property of a mineral to glow in often bright colors when exposed to invisible ultraviolet radiation (glow under a blacklight) is called:

- a. schiller.
- b. fluorescence.
- c. phosphorescence.
- d. thermoluminescence.

17. A geiger counter is used to:

- a. count the potential facets on a crystal.
- b. count the number of elements in a mineral.
- c. measure levels of radioactivity.
- d. measure the amount of electricity to move through a rock or mineral.

18. Mafic silicate minerals and the rocks they form are rich in magnesium and iron. The word mafic is used to describe rocks containing a group of dark-colored, mainly ferromagnesian minerals (rich in iron and magnesium). Mafic rocks are common in the Earth's crust under the ocean basins and are exposed in the volcanoes of Hawaii and Iceland. Two examples of mafic minerals include:

- a. calcite and dolomite.
- b. quartz and feldspar.
- c. biotite and muscovite.
- d. olivine and pyroxene.

19. The minerals orthoclase and plagioclase are examples of what common group of minerals?

- a. quartz.
- b. feldspars.
- c. micas.
- d. mafic silicate minerals.

20. Examples of sheet silicate minerals include:

- a. biotite.
- b. muscovite.
- c. clay minerals.
- d. All of the above.

Chapter 3 - Basic Geologic Principles & Maps

1. **Geochronology** is the study of the age of rocks. According to the **geologic time scale**, if it was determined that a rock containing fossils was precisely 180 million years old, what geologic time period would that be from?

- a. Late Permian
- b. Early Triassic
- c. Early Jurassic
- d. Late Cretaceous

2. The **rock cycle** conceptually includes aspects of which of the following:

- a. Earth materials may change from one form to another over the passage of geologic time.
- b. Igneous, sedimentary, and metamorphic rocks all form from different processes and under unique conditions.
- c. Tectonic forces are responsible for the gradual uplift of mountains, both on land and the seafloor.
- d. all of the above.

3. What would explain why beach sand is dominated by the mineral quartz?

- a. Quartz is composed of silicon and oxygen, the two most abundant elements in the Earth's crust.
- b. Quartz is a very hard and durable mineral, and is more resistant to weathering and erosion than other minerals.
- c. Minerals other than quartz tend to break down into tiny particles or dissolve and be carried away by wave action, whereas grains of quartz stay behind.
- d. all of the above.

4. A **rock formation** is a rock unit that is distinctive enough in appearance that a geologist can distinguish it from other surrounding rock layers. A named rock formation must also be thick enough and extensive enough to plot on a geologic map. Large bodies of rocks that display characteristic layers are called:

- a. unstratified.
- b. strata.
- c. metamorphic.
- d. all of the above.

5. The relative age of a volcanic intrusion might best be determined by:

- a. the Law of Original Horizontality.
- b. the Law of Superposition.
- c. the Law of Cross-Cutting Relationships.
- d. the Law of Angular Unconformities.

6. The arrow in this view of the Grand Canyon points toward:



- a. a disconformity.
- b. an angular unconformity.
- c. a nonconformity.
- d. a conformable contact.
- e. all of the above.

7. Unconformities are caused by relative changes in sea level over time. When sea level falls, erosion tends to strip away sediments exposed on land. When sea level rises, sediments tend to be deposited and preserved on the seafloor. When sea level falls it is called:

- a. a transgression.
- b. a regression.
- c. angular unconformity.
- d. nonconformity.

8. Which of the following is NOT a form of relative dating?

- a. Using the Laws of Original Horizontality, Superposition, Cross-Cutting Relationships to compare the ages of rock layers.
- b. Placing geologic layers or events in their proper sequence or order without knowing their exact age in years.
- c. Comparing fossils found in sedimentary rock layers to rock layers found in different locations.
- d. Using radioactivity to find the age of a rock.

9. A graphic representation of the intersection of the geological features in the subsurface with a vertical plane is called a:

- a. geologic map.
- b. cross section.
- c. geophysical survey.
- d. legend.

10. Geophysical exploration methods involve the use of:

- a. sound (shock waves produced by explosives or machines making sounds to penetrate the ground).
- b. measurements using electricity and radar to penetrate the ground.
- c. measurements of variations in gravity and magnetism.
- d. all of the above.

11. **Absolute dating** is a general term applied to a range of techniques that provide estimates of the age of objects, materials, or sites in real calendar years either directly or through a process of calibration with material of known age. One method uses the radioactive decay of Uranium isotope ^{238}U (the unstable parent isotope). Slowly over billions of years, this radioactive parent isotope decays to form what daughter isotope?

- a. ^{206}Pb (stable lead isotope)
- b. ^{87}Sr (stable strontium isotope)
- c. ^{235}U (stable uranium isotope)
- d. ^{40}K and ^{40}Ar (potassium and argon stable isotopes)

12. What is the half-life of radioactive ^{14}C (radioactive carbon-14 isotope)?

- a. 1.3 billion years
- b. 47 billion years
- c. 710 million years
- d. 5,730 years.

13. **Topography** is the arrangement of the natural and artificial physical features of an area. A **topographic map** is a graphical representation of a landscape showing selected natural and artificial landscape feature. The amount of change in elevation on the surface of the Earth is called:

- a. contours.
- b. relief.
- c. height.
- d. ceiling.

14. The angular distance of a place north or south of the earth's equator, usually expressed in degrees and minutes, and is called:

- a. latitude.
- b. parallels.
- c. longitude.
- d. meridians.

15. One degree of latitude anywhere on Earth is equivalent to:

- a. zero miles.
- b. 53 miles (85 kilometers).
- c. 69 miles (111 kilometers) or 60 nautical miles.
- d. 100 miles (161 kilometers).

16. In order to make an accurate map of the stars for use in ship navigation, in 1884, a point indicating the precise location of 0° East and West was designated in the cross hairs of a telescope in the Royal Observatory (located on the grounds of the National Maritime Museum in Greenwich England). This line marks the reference location of the Prime Meridian now used in all global mapping (including GPS location systems). The line on the opposite side of the globe at 180° from the Prime Meridian is called:

- a. the Equator.
- b. the Baseline.
- c. the International Date Line.
- d. all of the above.

17. It is difficult to make a flat map of the spherical globe. A commonly used type of map of the Earth that projects lines of longitude and latitude as a perpendicular grid of squares (and does not show lines converging at the north and south poles) is called a:

- a. Lambert conical projection map.
- b. Mercator projection map.
- c. quadrangle projection map.
- d. all of the above.

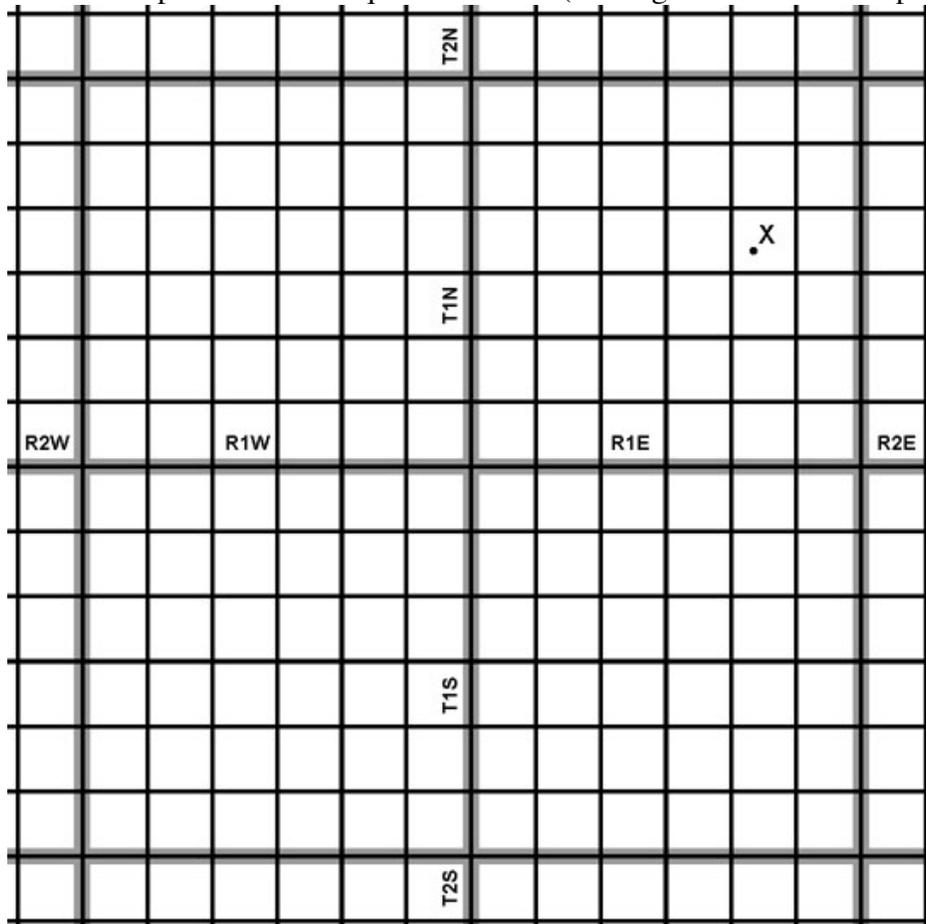
18. Public Land Survey System was used to subdivide land in most of the United States (excluding the 13 Colonies and Texas). The surveying involved measuring a grid of lines east-to-west and north-to-south starting with a designated initial point (such as a mountain peak like Mt. Diablo in central California between San Francisco and Sacramento). From an established initial point, a line running east-to-west was surveyed before lines north-to-south were mapped. This first survey line running east-to-west is called:

- a. the Equator.
- b. the Baseline.
- c. the Prime Meridian.
- d. the Range line.

19. A township is an area that has been mapped using the Public Land Survey System (PLSS). The name of the township usually includes the name of a town, ranch, or landscape feature in the area when it was first surveyed. Today is still commonly used for political boundary designations. In the PLSS most townships encompass an area of:

- a. 12 square miles.
- b. 24 square miles.
- c. 36 square miles.
- d. 48 square miles.

Use this map to answer the question below (See Figure 3-80 for an explanation).



20. In your new CSI investigative reporting job, you received a call from a desperate Nebraska farmer that says an unusual flying object came out a cloud and crash landed in one of his corn fields. He sends you a fax with part of a topographic map with a dot (next to an "X") showing where "the thing" has landed. You now have to report to the proper authorities how to find this location. It is located at:

- a. NE, SW, Section 17, T1N, R1E.
- b. SW, NE, Section 17, T1N, R1E.
- c. NE, SW, Section 14, T1N, R1E.
- d. SW, NE, Section 14, T1S, R1E.
- e. none of the above.

21. Map scale refers to the relationship (or ratio) between distance on a map and the corresponding distance on the ground (relative to both miles and kilometers). On a standard USGS 7.5 minute quadrangle map, the scale is:

- a. 1:24,000.
- b. 1 inch = 2000 feet.
- c. 1:100,000.
- d. answers a and b.

22. A **GIS (geographic information system)** is a computer application used for capturing, storing, editing, and displaying data related to locations or areas on Earth's surface. Both **raw data** and **interpretation data** can be imported into a GIS. What is an example of interpretation data?

- a. an aerial photographic image
- b. satellite imagery
- c. radar images
- d. U.S. Census data.

23. A printed map or a GIS map image that uses sunshading to express topographic relief on a landscape is called:

- a. a digital elevation model.
- b. a shaded relief map.
- c. a digital orthoquad.
- d. none of the above.

24. A region that has distinct landforms and subregions with shared physical characteristics, such as topography (relief), geologic history, ecology, and climate is called:

- a. a physiographic province.
- b. a state.
- c. a political district.
- d. a country.

25. **Colors** on a geologic map are linked to:

- a. boundaries between rock formations.
- b. features such as faults.
- c. areas where the bedrock in a region consist rock formations of similar geologic age and composition.
- d. symbology associated with geologic structure features.

Chapter 4 - Evolution of Earth & Life Through Time

1. The **Theory of Natural Selection** explains the processes whereby organisms that are better adapted to their environment tend to survive and produce more offspring. Who was the first scientist to publish the basic concepts of this theory?

- a. Carl Linnaeus
- b. Charles Darwin

- c. Gregor Johann Mendel
- d. James Watson and Francis Crick

2. Populations of organisms can develop similar features based upon a utilizing a similar environment and living habits. This process is called:

- a. natural selection.
- b. divergent evolution.
- c. convergent evolution.
- d. competition.

3. The science of evolution involves which of these concepts?

- a. The life mission of individuals in any species is to eat, survive, and reproduce.
- b. While living, individuals must deal with competition (within a population of their own species, or with other species).
- c. Individuals within a species must adapt to environmental changes or they face die offs or extinction.
- d. all of the above.

4. The term used by the scientific community to refer to *the total number of fossils that have been discovered, as well as to the information derived from them* is called:

- a. paleontology.
- b. the fossil record.
- c. a sedimentary sequence.
- d. evolution.

5. When sea levels rise and shallow seas *advance* onto the margins of a continent is called a:

- a. regression.
- b. transgression.
- c. sequence.
- d. unconformity.

6. The process of changes in species structure of an ecological community over time is called:

- a. extinction.
- b. mass extinction.
- c. ecological succession.
- d. climate change.

7. Single-celled organisms (both prokaryotes and eukaryotes) appear in what geologic era?

- a. Precambrian
- b. Cambrian
- c. Paleozoic
- d. Mesozoic

8. A mound of calcareous sediment built up of layers of lime-secreting **cyanobacteria** (blue-green bacteria, algae and other *more primitive* eukaryotic life forms) that trap sediment, creating layers accumulations is called a:

- a. stromatolite.
- b. metazoan.
- c. banded iron formation.
- d. Endosymbiosis.

9. Multicellular animals that have cells that differentiated into tissues and organs and usually have a digestive cavity and nervous system are called:

- a. prokaryotes.
- b. eukaryotes.

- c. stromatolites.
- d. metazoans.

10. The earliest period of the Paleozoic Era when *shelled organisms* first appear in the fossil record:

- a. Precambrian.
- b. Cambrian.
- c. Ordovician.
- d. Devonian.

11. The period when ray-fined and lobe-fined bony fishes and sharks first flourished in the Paleozoic Era:

- a. Precambrian.
- b. Cambrian.
- c. Ordovician.
- d. Devonian.
- e. Cretaceous.

12. The period when fossil forests produced extensive coal deposit through eastern North America:

- a. Devonian.
- b. Carboniferous.
- c. Permian.
- d. Triassic.
- e. Cretaceous.

13. The period that amphibians first appear in abundance?

- a. Ordovician
- b. Devonian
- c. Mississippian
- d. Permian
- e. Jurassic

14. The greatest mass extinction occurred at the *end* of this period, wiping out about 96% of marine species and 70% of terrestrial vertebrates that had existed previously.

- a. Ordovician
- b. Devonian
- c. Mississippian
- d. Permian
- e. Jurassic

15. The name *Age of Reptiles* best applies to which time range?

- a. Mesozoic Era
- b. Devonian
- c. Cenozoic Era
- d. Tertiary Period

16. The dinosaurs first appear in what geologic period?

- a. Pennsylvanian
- b. Permian
- c. Triassic
- d. Cretaceous
- e. Tertiary

17. Small mammals and flowering plant first appear in abundance in which geologic period?

- a. Jurassic
- b. Permian

- c. Triassic
- d. Cretaceous
- e. Tertiary

18. A great mass extinction, believed to have been associated with a massive asteroid impact in the Yucatan region of Mexico occurred at the end of which period?

- a. Jurassic
- b. Permian
- c. Triassic
- d. Cretaceous
- e. Tertiary

19. The Ice Ages are associated with which geologic period?

- a. Jurassic
- b. Quaternary
- c. Triassic
- d. Cretaceous
- e. Tertiary

20. The name of the geologic epoch we currently live in is:

- a. Tertiary.
- b. Cenozoic.
- c. Quaternary.
- d. Holocene.
- e. Weshouldhavecene.

Chapter 5 - Atmospheric Processes and Climate

1. Nearly 80 percent of the air's mass and 99 percent of the water vapor in the air occurs within:

- a. the stratosphere.
- b. the troposphere.
- c. the upper atmosphere.
- d. outer space.

2. Incoming solar radiation involves all wavelengths of the electromagnetic spectrum. The atmosphere is transparent to most wavelengths, but part of the solar spectrum are absorbed by certain **greenhouse gases** in the atmosphere. Which of the following is NOT considered a **greenhouse gas**?

- a. water vapor (H₂O)
- b. oxygen (O₂)
- c. carbon dioxide (CO₂)
- d. methane (CH₄)

3. The amount of water vapor in the air can range from trace amounts up to about 4% by volume. Which of the following statements is NOT true?

- a. Warm air can hold more moisture than cold air.
- b. The amount water moisture that air can hold depends on factors including temperature, air pressure, and the amount and kinds of particulate matter dispersed in the air.
- c. When air has reached the maximum amount or water it can hold it is called saturated.
- d. Moist air is heavier than dry air.

4. At sea level, the pressure of the atmosphere:

- a. averages 1013.25 millibars.
- b. increases in pressure when stormy weather is taking place.
- c. decreases in pressure when cold, clear air masses moves into an area.

d. never changes.

5. Of the 4 types of air listed below, which would be less dense and likely to rise the fastest?

- a. Warm, dry air
- b. Cool, dry air
- c. Warm, moist air
- d. Cool, moist air

6. Regarding atmospheric pressure systems moving into a region:

- a. surface winds blow from high to low pressure.
- b. high pressure systems have dry conditions with sinking air masses.
- c. low pressure systems have wetter conditions with rising air masses.
- d. all the choices are correct.

7. Hurricanes can form in association with which type of air mass?

- a. polar-maritime air mass
- b. temperate-continental air mass
- c. tropical-maritime air mass
- d. warm air sinks, forming clouds, resulting in rain

8. Tiny (very microscopic) dust particles and aerosols can become cloud condensation nuclei (CCNs). CCNs come from many sources: dust storms, fires, volcanoes, sea spray, plants, and pollution. If there are too many CCNs in the air, what happens?

- a. It rains more intensely.
- b. Smog turns to fog.
- c. Rain droplets (or ice crystals) don't get big enough to fall as rain (or snow).
- d. All choices are correct.

9. The fog often called the **marine layer** in coastal California is generally most often what kind of cloud?

- a. Cirro-form
- b. Cumulo-form
- c. Nimbo-form
- d. Strato-form

10. Sound travels at about 1,088 feet per second in the air. You just saw a flash of sky-to-ground lightning and you counted seven seconds before you heard the thunder. About how far away was the lightning strike?

- a. 0.6 miles.
- b. 1.0 miles.
- c. 1.4 miles.
- d. 2.2 miles.

11. The Coriolis effect is caused by the rotation of the Earth. As a result:

- a. low pressure systems (like hurricanes) turn counter-clockwise in the Northern Hemisphere.
- b. high pressure systems turn clockwise in the Southern Hemisphere.
- c. maximum Coriolis effect is at the equator and does not occur at the poles.
- d. all of choices are correct.

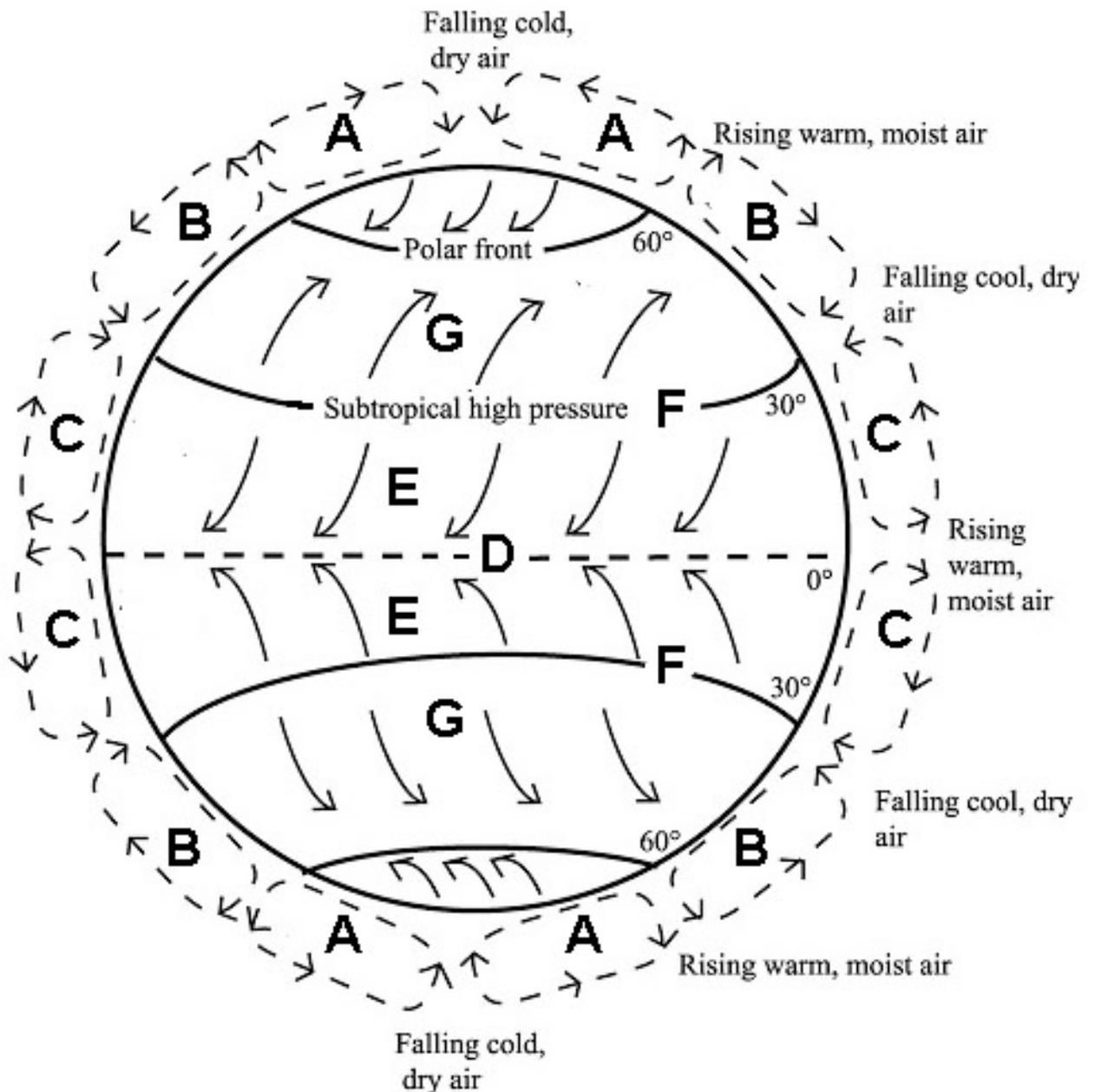
12. Gray sky weather is far too common in parts of the Midwest and Northeastern United States. Sometimes it can last for days. What is the likely cause?

- a. a fast-moving cold front
- b. a cold air mass moving over a warm air mass
- c. a slow-moving or stalled warm front
- d. a slow-moving or stalled cold front

13. The amount of energy Earth receives from the Sun is not evenly distributed. Which of the following statements is most correct?
- The equatorial regions are warmer than the poles because direct sunlight is concentrated and little is reflected.
 - In polar regions, light strikes the earth at an angle; it is diffuse and much of it is reflected back into space.
 - The seasonal variations (winter and summer) also affect the distribution of heating of the planet.
 - all the choices are correct.

14. **The Coriolis effect** influences all moving objects, especially ones moving over large distances (such as intercontinental ballistic missiles). How does the Coriolis effect causes objects or moving masses of air or ocean currents?
- It causes them to change direction—not speed.
 - The maximum Coriolis effect occurs at poles.
 - No Coriolis effect occurs at the equator.
 - All choices are correct.

Questions 15-18 refer to the Global Atmospheric Circulation diagram below.



The **polar circulation cells** (60° to 90° N and S) are shown as letters “A.” The **Ferrel circulation cells** (30° to 60° N and S of equator) are letters “B,” and the **Hadley circulation cells** (0° to 30° N and S of equator) are letters “C.”

15. Which letter represents the **Inter-tropical convergence zone (ITCZ)**?

16. **Doldrums**, where sailing ships can be trapped without winds for extended periods of time, are most common in the zone represented by which letter?

17. The **NE and SE Trade Winds** are represented by which letter?

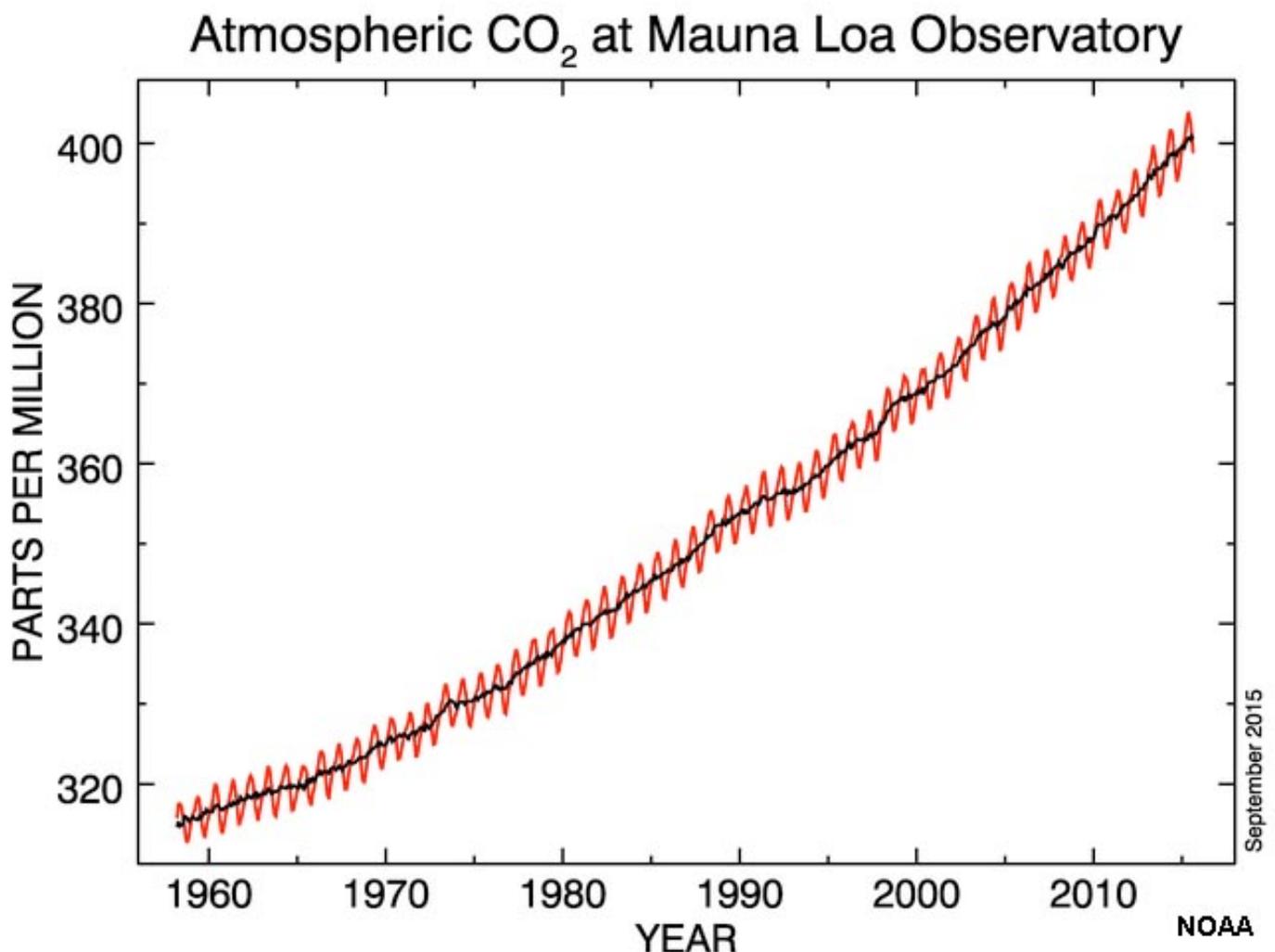
18. The zone of potentially dangerous winds of the **horse latitudes** are represented by which letter?

19. A **tropical cyclone** is caused by *spinning air currents associated with a low pressure system*.

A **tropical storm** becomes a **cyclone** (or a hurricane or a typhoon) when:

- tropical depressions move north across the equator.
- average wind speeds in the heart of the storm rise above 38 mph.
- average wind speeds in the heart of the storm rise above 74 mph.
- average wind speeds in the heart of the storm rise above 155 mph.

20. **The figure below** shows the record of changing carbon-dioxide concentrations in the atmosphere as recorded by NOAA at it’s atmospheric research lab on Mauna Loa in Hawaii.



The graph shows that:

- carbon-dioxide concentrations have been steadily increasing for the last 50 years.
- seasonal growth and decay of plant leaves in the northern hemisphere cause minor but measurable

fluctuations in carbon-dioxide concentrations.

c. carbon-dioxide created by the burning of fossil fuels and other sources is being produced faster than the oceans can absorb and consume the gases.

d. all the choices are correct.

Chapter 6 - Earth's Structure and Plate Tectonics

1. The rigid outer part of the Earth, consisting of the crust and upper mantle, is a relatively cool, rigid shell and averages about 100 km in thickness and called the:

a. asthenosphere.

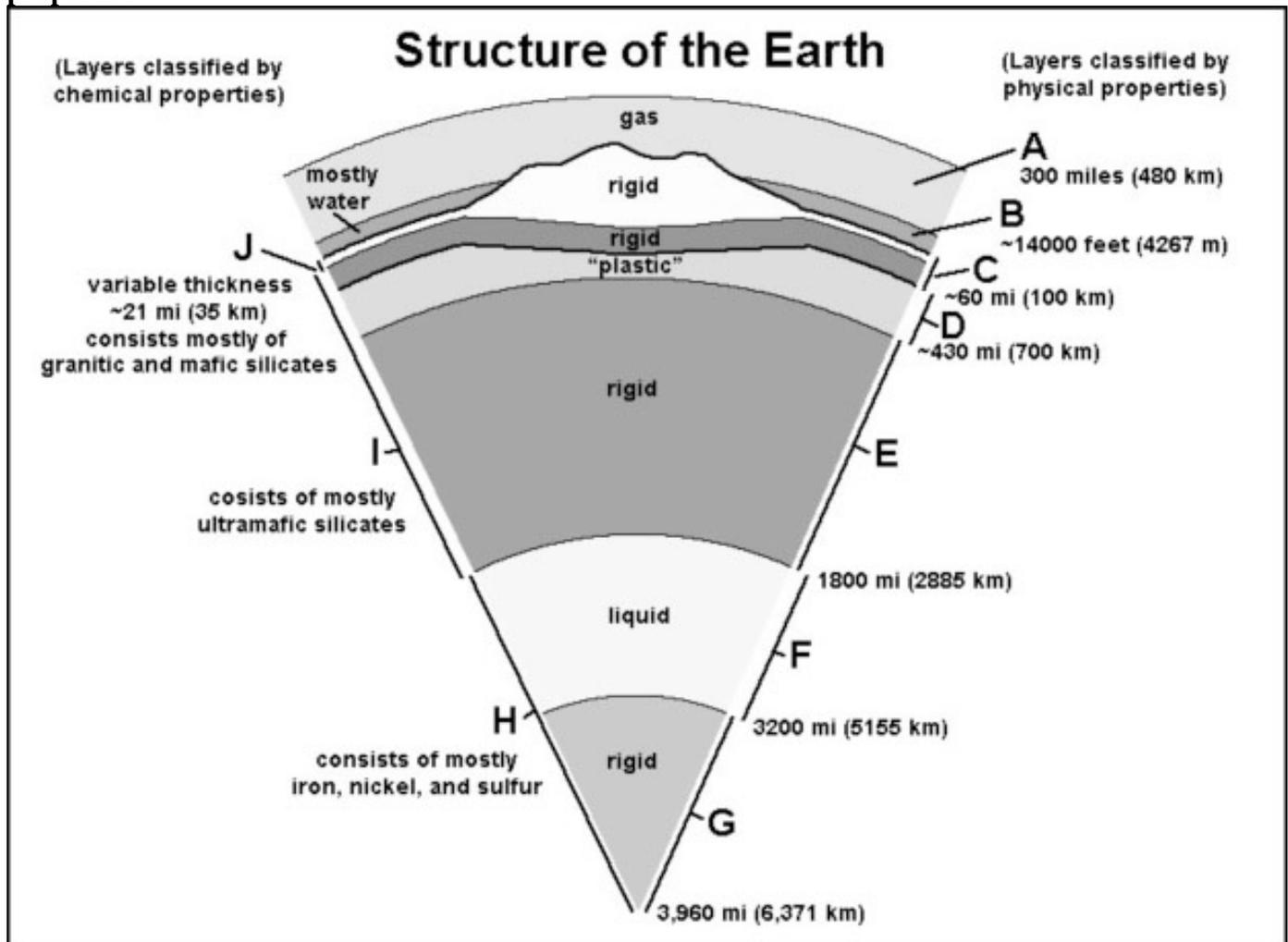
b. lithosphere.

c. stratosphere.

d. cryosphere.

Questions 2-10 apply to the Structure of the Earth Diagram below.

Note: the layers on **left** are classified by **composition**, layers on the **right** are classified by **physical properties**.



Match letters (A to J) to features on the Structure of the Earth diagram.

2. Which letter is the asthenosphere?

3. Which letter is the atmosphere?

4. Which letter is the inner core?

5. Which letter is the crust?

6. Which letter is the lithosphere?

7. Which letter is the mantle?

8. Which letter is the mesosphere?

9. Which letter is the oceans?

10) Which letter is the outer core?

11. What is a magnetic field reversal?

- a. when Earth's magnetic field suddenly disappears for short periods of time
- b. when Earth's magnetic field suddenly runs east/west instead of south/north
- c. when the Earth's north and south magnetic poles switch orientation
- d. when Earth's magnetic north pole moves out of alignment with the Earth's axis of rotation.

12. The alignment of iron-rich minerals in old volcanic lava flows show that:

- a. the Earth's magnetic poles may have moved.
- b. the Earth's magnetic poles have switched alignment many times in the past.
- c. the continents have moved over time.
- d. all of the above.

13. What has seismic research revealed about the internal structure of the Earth?

- a. There are seismic shadow zones between about 105° to 140° on the opposite side of the globe from a seismic shock.
- b. Parts of the Earth are not solid, including the outer core.
- c. Earthquakes only occur in the outer rigid lithosphere.
- d. All choices are correct.

14. The Mohorovicic discontinuity (or Moho) is:

- a. the boundary between granitic continental crust and basaltic oceanic crust.
- b. the physical boundary between the Earth's crust and the mantle, existing at depths of about 6–7 miles (10–12 km) under the ocean basins and about 24–30 miles (40–50 km) under the continents.
- c. the boundary between earth's rigid mantle and the liquid core.
- d. a fault boundary between two plates in a subduction zone.

15. Isostasy allows continental crust to rise above sea level because it is:

- a. denser than ocean crust.
- b. is mostly basalt in composition compared with ocean crust.
- c. contains more less-dense granitic rocks than ocean crust.
- d. all of the above.

16. This extensive region that surrounds the Pacific Ocean basin is both a major earthquake zone and volcano zone.

- a. Ring of Volcanoes
- b. Ring of Fire
- c. Pacific Island Arc
- d. The Pacific Trench

17. The theory of continental drift (proposed by Alfred Wegener in 1912) was supported by what kind of evidence?

- a. matching fossils on different continents
- b. shapes of continents appear to fit like a jigsaw puzzle
- c. matching rocks and mountain ranges on different continents
- d. all of the above

18. The most conclusive proof for continental drift was provided by:

- a. matching coastlines of continents on a world map.
- b. volcanoes erupting around the Pacific Ocean basin.
- c. identical fossils, rocks, and geologic features found on separate continents on opposite side of ocean basins.
- d. changes in climatic patterns.

19. The supercontinent in the continental drift hypothesis was called:

- a. Panthalassa.
- b. Pangaea.
- c. Africana.
- d. Pandora.

20. Mid-ocean ridges are sites with active volcanism, mild earthquakes, and:

- a. consist of rocks of basaltic composition.
- b. have thin sediment cover because ocean floor is being newly formed.
- c. are locations of hot water vents on the seafloor.
- d. all of the above.

21. Geologic mapping shows that bedrock on all continental landmasses around the world range in ages that are exceeding old. However, the oldest rocks found in the world's ocean basins are:

- a. about 2 million years.
- b. about 20 million years.
- c. about 200 million years.
- d. about 2 billion years.
- e. none of the above.

22. The theory of plate tectonics helps explain the location of volcanoes and earthquakes. Which of these also describes the current theory of plate tectonics?

- a. It combines elements of continental drift and seafloor spreading.
- b. It suggests that the lithosphere is divided into pieces, called plates.
- c. Denser ocean crust sinks below less-dense continental crust along subduction zones.
- d. All choices are correct.

23. In plate tectonics theory, a **plate** can be made up of:

- a. continental lithosphere only.
- b. oceanic lithosphere only.
- c. both continental and oceanic lithosphere.
- d. both continental and oceanic asthenosphere.

24. A mid-ocean ridge is an example of what type of plate boundary?

- a. convergent zone
- b. divergent zone
- c. transform zone
- d. subduction zone

25. The youngest rocks on the ocean floor are mostly located near what feature?

- a. a mid-ocean ridge
- b. a subduction zone
- c. a subduction zone
- d. a deep-sea trench

26. A continental rift valley is evidence of which kind of plate boundary?

- a. convergent
- b. transform
- c. divergent
- d. uniform

27. At what type of plate boundary are most continental mountains formed?

- a. convergent
- b. hotspots

- c. divergent
- d. transform
- e. mid-ocean ridges

28. Deep ocean trenches are associated with:

- a. mid-ocean ridge systems.
- b. transform fault boundaries.
- c. subduction zones.
- d. rift zones.

29. Almost all deep-focus earthquake occur along or near what type of plate boundary?

- a. convergent
- b. passive
- c. transform
- d. divergent

30. What happens when an oceanic plate converges with a continental plate?

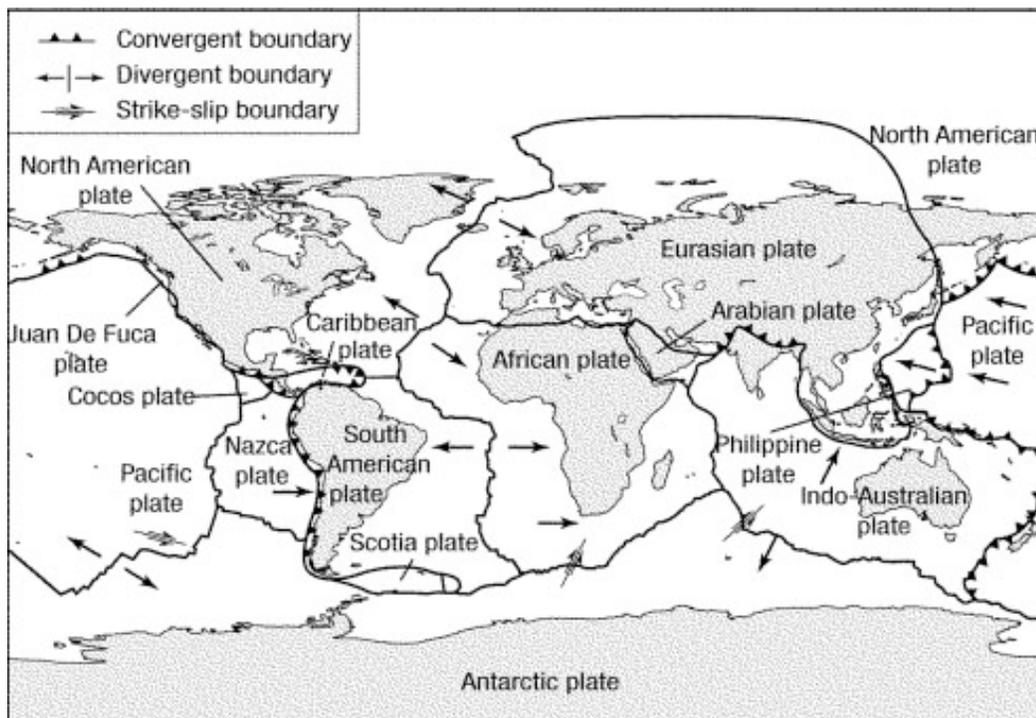
- a. The denser oceanic plate slides on top of the less dense continental plate.
- b. The denser oceanic plate slides under the less dense continental plate.
- c. The less dense oceanic plate slides past the denser continental plate.
- d. The less dense oceanic plate slides under the denser continental plate.

31. What kind of movement created the Himalayan Mountains?

- a. convergence of oceanic crust with continental crust.
- b. divergence between two continental crustal plates.
- c. transform movement between oceanic and continental crustal plates.
- d. convergence of two plates composed of continental crust.

32. Which type of plate boundary is in the southern California region?

- a. passive plate boundary
- b. divergent plate boundary
- c. convergent plate boundary
- d. transform plate boundary



Questions 33 to 35 are related to the Plate Boundary Map above.

33. According to the Plate Boundary Map, what type of plate boundary occurs between the North American Plate and the Eurasian Plate?
- transform boundary
 - divergent boundary
 - convergent oceanic-continental plate boundary
 - convergent oceanic-oceanic plate boundary
34. According to the Plate Boundary Map, what type of boundary occurs between the South American Plate and the Nazca Plate?
- transform boundary
 - convergent continental-continental plate boundary
 - a convergent oceanic-continental plate boundary
 - convergent oceanic-oceanic plate boundary.
35. According to the Plate Boundary Map, Which of the seven major lithospheric plates consists mostly of oceanic lithosphere?
- Pacific Plate
 - Antarctic Plate
 - Indy-Australian Plate
 - South American Plate
36. The active volcanoes on Hawaiian Islands and Yellowstone are associated with what type of volcanism?
- intra-plate volcanism at a hot spot
 - subduction zone volcanism
 - volcanism at a divergent plate boundary
 - volcanism at a convergent plate boundary
37. Gravitational heat convection is the primary mechanism of plate tectonic activity. However plate motion is also influenced by the formation of the lithosphere. What forces drive plate motion?
- slab-pull** as the mantle flows beneath the rigid lithosphere.
 - slab-suction** as old, cold ocean crust sinks into the mantle, pulling crustal rocks and seafloor sediments along with it.
 - ridge-push** from the weight of new crust rising above the seafloor along mid ocean ridges, pushing older, cooler crust away.
 - all choices are correct.
38. What is the process by which material is added to a tectonic plate or a landmass over time?
- accretion
 - terrane motion
 - craton motion
 - shield motion
39. The great supercontinent Pangaea first assembled by plate convergence as the proto-Atlantic (the ancient Iapetus Ocean) closed around 300 million years ago. What was the name of the ancient global ocean that existed when all the ancient continents were assembled together?
- Panthalassa
 - Gondwanaland
 - Laurasia
 - Tethys Seaway
40. California's newest national park is Pinnacles National Park near Monterey, CA. The park encompasses of the Pinnacles Formation, a volcanic rock formation comprising half of the ancient Pinnacles Volcano on

the western side of the San Andreas Fault. The volcano originally formed along the San Andreas Fault in the vicinity of Los Angeles as it started forming about 23 million years ago. Where is the other half of the original volcano?

- a. It is now taking a vacation in northern California.
- b. It got subducted along with the Farallon Plate.
- c. It migrated down to Baja California.
- d. It still exists as the Neenach Formation near where it formed near Los Angeles, but on the eastern side of the San Andreas Fault.

Chapter 7 - Faults, Earthquakes, and Landscapes

1. Continental crust isostatically rises above sea level because:

- a. continental crust is denser than ocean crust.
- b. ocean crust is thicker than continental crust.
- c. continental crust contains more granitic rocks than ocean crust, and granitic rocks are less dense than ocean crustal rocks.
- d. All of the above.

2. A fold in layers of rock (strata) where the concave side faces down, with strata sloping downward on both sides from a common crest [axis] is called:

- a. a syncline
- b. an anticline.
- c. a dome.
- d. A plunging fold.

3. The term **strike and dip** refers to:

- a. a method to describe the orientation of geologic features such as joints, faults, or layers exposed on the earth surface.
- b. a method of measuring the thickness and age of rock layers.
- c. a method of measuring movement along a fault zone.
- d. a method to help resolve a scientific dispute.

4. On a reverse fault:

- a. the hanging wall moves down relative to the foot wall.
- b. the foot wall moves up relative to the hanging wall.
- c. the foot wall moves horizontally relative to the hanging wall.
- d. the hanging wall moves up relative to the foot wall.
- e. none of the above.

5. Where a well-defined fault plane intersects the land's surface is called a:

- a. joint.
- b. fault line.
- c. fault zone.
- d. fault system.
- e. earthquake fault.

6. When rocks are exposed to great pressure they will deform (change shape) or fracture. The amount of deformation on object experiences compared to its original size and shape is called:

- a. stress.
- b. strain.
- c. compression.
- d. extension.

7. Horizontal compression in the Earth's crust is more likely to form:

- a. normal faults.
- b. thrust faults and reverse faults.
- c. strike-slip and transform faults.
- d. oblique slip and normal faults.

8. The location underground where the rocks first start to fracture, generating an earthquake is called:

- a. the epicenter.
- b. the rupture zone.
- c. the focus.
- d. a seismograph.

9. The gradual *aseismic* movement (displacement) displayed by a fault over time is called:

- a. an earthquake fault.
- b. an earthquake.
- c. fault rupture.
- d. creep.

10. The first to arrive at a distant location from an earthquake is:

- a. a shear (S) wave.
- b. a compression (P) wave.
- c. a sound (S) wave.
- d. a rupture.
- e. none of the above.

11. An earthquake may be described as a single shock wave or a complex pattern of shock waves taking place over a period of time. What is the most powerful in a series of earthquakes?

- a. creep
- b. a foreshock
- c. a main shock event
- d. an aftershock

12. A measure of ground shaking describing the local severity of an earthquake in terms of its effects on the Earth's surface and on humans and their structures is called:

- a. earthquake magnitude.
- b. a Richter scale.
- c. earthquake intensity.
- d. all of the above.

13. A landscape feature associated with a raised elongated block of the earth's crust lying (or rising) between two faults is called:

- a. a graben.
- b. a horst.
- c. a rift valley.
- d. an anticline.

14. Landscape features associated with strike-slip faults include:

- a. offset streams.
- b. linear valleys.
- c. shutter ridges.
- d. sag ponds.
- e. all of the above.

15. A polished and striated rock surface produced by friction along a fault; they appear a scratches on a rock surface are called:

- a. mylonite.
- b. fault gouge.
- c. slickensides.
- d. fault breccia.

Chapter 8 - Igneous Rocks & Volcanic Activity

1. The geothermal gradient is:
 - a. the changes in temperature that increases with depth.
 - b. averages 20 to 30 degrees C per kilometer in the upper crust.
 - c. can vary significantly from one location to another.
 - d. all of the above.
2. What process (or processes) can generate magma?
 - a. increased rate of heat flow
 - b. decreases in pressure (such as caused by an earthquake)
 - c. introduction of volatiles (water, gases) under high pressure
 - d. all of the above
3. When molten material crystallizes deep underground, the geologic feature is called:
 - a. an extrusive igneous rock.
 - b. volcanism.
 - c. a pluton.
 - d. all of the above.
4. What are the 2 dominant gases released by a volcanic eruption?
 - a. SO₂ and H₂S
 - b. CO₂ and SO₂
 - c. H₂O and SO₂
 - d. H₂O and CO₂
5. The hottest lava observed on the Earth surface are associated with:
 - a. composite volcanoes, like Mount St. Helens in the Cascades volcanic arc.
 - b. oceanic hotspots, like Kilauea volcano on Hawaii.
 - c. island arc volcanoes, like Mount Pelee on the Caribbean island of Martinique.
 - d. continental rift zones, like the East African Rift volcanoes like Erta Ale, Ethiopia.
6. Which factors help produce the texture and appearance of igneous rocks?
 - a. the amount of dissolved gases in magma.
 - b. the amount of silica present.
 - c. the rate at which magma cools.
 - d. all choices are correct.
7. Igneous rocks are classified based on:
 - a. mineral composition.
 - b. crystal sizes.
 - c. general color and textural characteristics.
 - d. all choices are correct.
8. The igneous process called magmatic differentiation allows different kinds of rocks to form from an original single source of magma. What is main reason this occurs?
 - a. high-temperature minerals crystallize first.
 - b. low-temperature minerals crystallize first.
 - c. high temperature minerals crystallize last.

d. all choices are correct.

9. According to Bowen's reaction series, which of the following minerals has the highest crystallization temperature?

- a. biotite
- b. quartz
- c. olivine
- d. potassium feldspar

10. Which of these rock types contain the most quartz?

- a. granite
- b. andesite
- c. gabbro
- d. basalt

11. Which of these rock types has a fine-grained texture?

- a. diorite
- b. granite
- c. gabbro
- d. basalt

12. Which of these is an ultramafic rock?

- a. diorite
- b. rhyolite
- c. andesite
- d. peridotite

13. A dark, glass-like volcanic rock formed by the rapid solidification of lava without crystallization is:

- a. tuff.
- b. obsidian.
- c. pahoehoe.
- d. a'a.

14. A hard igneous rock containing visible crystals (phenocrysts), usually of feldspar, in a fine-grained (microcrystalline) mineral matrix—typically a dark gray, reddish, or purplish ground mass—is called.

- a. a porphyry.
- b. a xenolith.
- c. a pegmatite.
- d. an inclusion.

15. The large volcanoes on Hawaii including *Kilauea*, *Mauna Loa*, and *Hualalai* volcanoes are what kind of volcano?

- a. cinder cones.
- b. shield cones.
- c. composite cones.
- d. fissure eruptions.

16. A great mass of igneous rock, extending to great depths, formed from extensive magmatic intrusions (plutons) over a long period of time and may extend throughout a region, typically associated with volcanic arcs, is called:

- a. a batholith.
- b. a hotspot.
- c. a volcanic field.
- d. a laccolith.

17. Devils Tower, Wyoming (used in the movies *Close Encounters of a Third Kind* and *Paul*) is an example of a:

- a. sill
- b. stock
- c. dike
- d. palisade

18. An opening or vent on or near a volcano that releases hot sulfurous gases, steam and other gases is called:

- a. a hot spring.
- b. a geyser.
- c. a fumerole.
- d. a black smoker.

19. The general term used to describe rock fragments and particles ejected by a volcanic eruptions is called:

- a. tephra.
- b. lapilli.
- c. cinders.
- d. tuff.

20. A coarsely-grained crystalline igneous rocks with interlocking crystals typically several centimeters in length (or larger, including the world's largest crystals, some larger than 10 meters in length) is called:

- a. a diatrema.
- b. a kimberlite.
- c. a pegmatite.
- d. an aureole.

Chapter 9 - Weathering, Erosion, and Mass Wasting

1. Which of these **best** describe weathering?

- a. the transfer of rock material by gravity
- b. the mechanical and chemical disintegration of rock on the surface of the Earth
- c. the chemical breakdown of a rock
- d. the removal of material by water or air

2. Mechanical weathering includes:

- a. biological activity.
- b. unloading.
- c. frost wedging.
- d. thermal expansion.
- e. all of the above.

3. What is the most important agent of chemical weathering on Earth?

- a. oxygen
- b. carbon dioxide
- c. carbonic acid
- d. water

4. What process involves combining elements with oxygen ions? A mineral that is exposed to air may undergo this process:

- a. hydrolysis
- b. hydration
- c. oxidation

d. carbonation

5. Which common minerals when they weather tend to break down and convert to clays?

- a. quartz and gypsum
- b. gypsum and calcite
- c. calcite and quartz
- d. feldspar and mafic minerals

6. Which of these common minerals is most weathering resistant on the Earth's surface?

- a. quartz
- b. olivine
- c. biotite mica
- d. potassium feldspar
- e. calcite

7. When granite is weathered, what happens to most quartz?

- a. It is broken down to form clay minerals.
- b. It is broken down to form oxide minerals.
- c. It remain virtually unchanged, becoming mostly gravel, sand, and silt.
- d. It dissolves and becomes part of seawater.

8. When granite is weathered, what happens to most feldspar?

- a. It is mostly broken down to form clay minerals.
- b. It is broken down to form oxide minerals.
- c. It completely dissolves and becomes part of seawater.
- d. It remain virtually unchanged, becoming gravel, sand, and silt.

9. What is the origin of the abundance of rounded boulders of granite in arid regions such as in mountainous landscapes in southern California?

- a. Groundwater seeps into fractures in the granite, causing chemical weathering along the margins sharp edges and corners along the fractures.
- b. Durable granite cores of blocks of unfractured granite tend to escape weathering longer.
- c. As erosion strips away the saprolite (weathered granite), the hard rounded cores of blocks of granite accumulate on the surface.
- d. All the choices are correct.

10. What is the layer of weathered rock and mineral fragments located between the bedrock and the surface in most places?

- a. humus
- b. gravel
- c. alluvium
- d. regolith

11. Loose and incoherent surficial deposits usually found on or along the base of a slope and brought their chiefly by gravity is called:

- a. colluvium.
- b. alluvium.
- c. laterite.
- d. loam.

12. Which of the following is included as a component of soil?

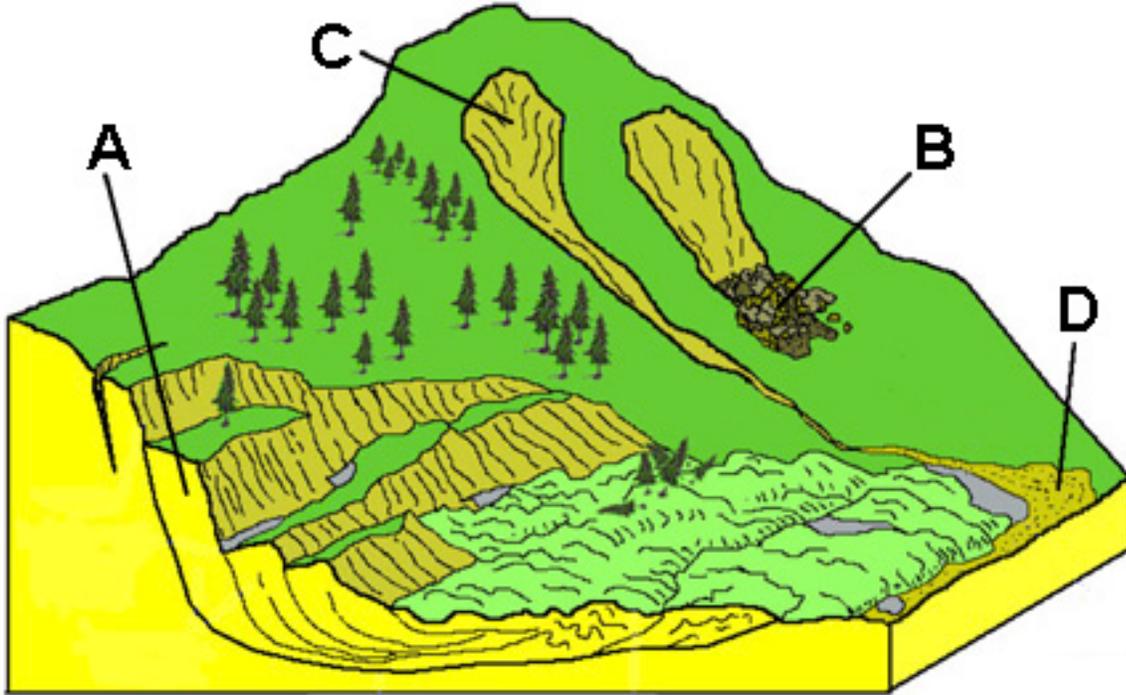
- a. mineral matter
- b. organic matter
- c. water and gases

d. All choices are correct.

13. Which of these are the zone of accumulation in a typical soil profile?

- a. the O horizon
- b. the A horizon
- c. the B horizon
- d. the C horizon

Question 14 applies to the diagram below.



14. What forces and processes are responsible for the features illustrated on the diagram?

- a. landsliding
- b. mass wasting
- c. gravity
- d. All choices are correct.

15. What is the name of a landslide that occurs in volcanic regions that can result in a debris flow or debris flood containing volcanic material that can travel long distances downstream?

- a. a slump
- b. an avalanche
- c. an earth flow
- d. a lahar

Chapter 10 - Sedimentary Rocks & Processes

1. Sediments or sedimentary rocks composed of fragments derived from older rocks are called:

- a. metamorphic.
- b. clastic.
- c. non-clastic.
- d. shale.
- e. None of the choices are correct.

2. A sedimentary rock that formed from sediments that contains gravel-sized particles is called?

- a. shale.
- b. conglomerate.

- c. sandstone.
- d. mudstone.

3. What type of rock consists of angular rock fragments (cemented together) that may be sedimentary, volcanic, or tectonic fracturing origin?

- a. breccia
- b. conglomerate
- c. sandstone
- d. limestone
- e. All choices are correct

4. A coarse-grained sandstone that contains at least 25 percent feldspar fragments is called:

- a. mudstone.
- b. conglomerate.
- c. arkose.
- d. graywacke.
- e. None of the choices are correct.

5. What is the name for a type of limestone composed almost entirely of compacted and cemented **shell fragments**, commonly associated with deposits that accumulate in an upper-beach setting in warm, humid climates?

- a. chalk.
- b. coquina.
- c. oolitic limestone
- d. travertine

6. A rock formed by the replacement of calcite [CaCO_3] with the mineral dolomite [$\text{Ca}_2\text{Mg}(\text{CO}_3)_2$] is called:

- a. limestone.
- b. mudstone.
- c. shale.
- d. dolostone.
- e. None of the choices is correct.

7. Organic matter, mostly plant material, that accumulates as sediment in boggy or swampy environmental settings is called:

- a. peat.
- b. shale.
- c. lime mud.
- d. ooze.
- e. None of the choices is correct.

8. Which of the following rocks would be considered an evaporite?

- a. rock salt
- b. gypsum and anhydrite
- c. sylvite
- d. All choices are correct.

9. Which of the following depositional environments would not likely be considered a **high energy** environment?

- a. a river channel
- b. a beach
- c. a coral reef
- d. a swamp

10. When comparing samples of river sand, beach and dune sand. Which of the following is true?

- a. River sand tends to be more rounded and less angular than beach sand.
- b. Dune sand tends to be less rounded and more angular than beach sand.
- c. Beach sand tends to be more rounded and less angular than river sand.
- d. Dune sand tends to be less rounded and more angular than beach sand.

11. Layers of sediment or sedimentary rock layers that are only a small fraction of an inch (less than a centimeter) in thickness are called:

- a. bedding.
- b. lamination.
- c. sedimentary facies.
- d. a rock formation.

12. Common sedimentary features found in sandstone that are associated with migrating sand dunes includes:

- a. fossils.
- b. cross bedding.
- c. desiccation cracks.
- d. graded bedding.
- e. All choices are correct.

13. An irregular surface fracture pattern formed by shrinkage of clay, silt, or mud under the drying effects of atmospheric conditions at the surface is called.

- a. graded bedding.
- b. cross bedding.
- c. desiccation cracks.
- d. lamination.
- e. All choices are correct.

14. Sediments settling out in a lake or ocean basin after an underwater landslide and associated turbidity current results in:

- a. graded bedding.
- b. cross bedding.
- c. desiccation cracks.
- d. lamination.
- e. None of the choices are correct.

15. Stirring or mixing of sediment or soil by organisms, especially by burrowing, boring, crawling, feeding or other traces left by biological activity is called:

- a. fossils.
- b. bioturbation.
- c. lithification.
- d. deposition.
- e. All choices are correct.

Chapter 11 - Metamorphic Rocks & Processes

1. Where does metamorphism take place?

- a. Metamorphism only at depth below the surface.
- b. Metamorphism occurs where a per-existing rock is subjected to conditions unlike those in which it formed.
- c. Metamorphism occurs only at the surface.
- d. All choices are correct.

2. Listed in order of increasing metamorphic grade, a **shale** could be metamorphosed into:
- gneiss-phyllite-slate-schist
 - slate-schist-gneiss-phyllite
 - slate-phyllite-schist-gneiss
 - schist-phyllite-slate-gneiss
3. Marble forms from what *protolith* (the rock from which it formed)?
- granite
 - limestone
 - slate
 - sandstone
 - shale
4. Which of these is an agent of metamorphism?
- pressure
 - mountain building
 - heat
 - chemically active fluids
 - All choices are correct.
5. The force exerted on a buried rock by the weight of material above it is called:
- recrystallization.
 - a geothermal gradient.
 - confining pressure.
 - directed pressure.
6. Where does most regional metamorphism occur?
- in areas of active mountain building
 - on the seafloor
 - around volcanoes
 - around magmatic intrusions
7. When subject to **directed pressure**, metamorphosed rocks show a layered or banded texture is called:
- slate.
 - mylonite.
 - a non-foliated texture.
 - foliation.
8. When a granite is subjected to direct pressure, its minerals align themselves to adjust to the pressure, forming:
- slate
 - granite gneiss
 - amphibolite
 - quartzite
9. What is a migmatite?
- a metamorphic rock that forms from sandstone.
 - a type of meteorite that has undergone metamorphism.
 - a rock that has been metamorphosed to such high degrees that it has partially melted.
 - a low-grade metamorphic rock containing garnet.
10. Organic matter, mostly plant remains, that escape bacterial decay become an organic sediment called peat. With increasing pressure and temperature with burial over time, peat becomes:

- a. lignite, then bituminous coal, then anthracite coal.
- b. lignite, then oil, then gas and tar.
- c. bituminous coal, then anthracite coal, then natural gas.
- d. bituminous coal, then anthracite coal, then lignite.

Chapter 12 - Streams, Rivers, and Water Underground

1. The circulation of water among the hydrosphere, atmosphere, solid Earth, and biosphere is called:
 - a. the hydrologic cycle.
 - c. hydrology.
 - d. geohydrology.
 - e. transpiration.

2. What two processes add water moisture to the air?
 - a. condensation and precipitation
 - b. evaporation and transpiration
 - b. transpiration and condensation
 - d. precipitation and evaporation

3. Which river has the largest discharge?
 - a. Nile
 - b. Amazon
 - c. Yangtze
 - d. Mississippi

4. A measure of the volume of water to pass a given point on a stream bank per unit of time (usually expressed in *cubic meters of water per second*) is called:
 - a. watershed.
 - b. runoff.
 - c. stream gradient.
 - d. stream discharge.

5. Which of these factors contributes to stream velocity?
 - a. stream gradient
 - b. stream channel size
 - c. stream channel shape
 - d. All choices are correct.

6. The rolling and hopping motion of sediment particles on the stream bed caused by stream flow is called:
 - a. suspension.
 - b. saltation.
 - c. bedload.
 - d. gravel.

7. Rivers tend to constantly change their course over a floodplain over time. This process is called:
 - a. change in gradient.
 - b. change in base level.
 - c. meandering.
 - d. levee formation.
 - e. all of the above.

8. When floodwaters spread out onto a floodplain, they slow down, depositing sediments along the outer margins of a stream channel, resulting in the build up of:
 - a. meanders.

- b. cutbanks.
- c. natural levees.
- d. splays.

9. A feature on a river delta where a stream **distributary channel** branches off and flows away from a main stream channel is called:

- a. a tributary.
- b. a wetland.
- c. a mouth.
- d. a distributary.

10. What kind of erosional drainage patterns are common in fractured and faulted hard bedrock (such as in granite or other igneous and metamorphic rocks)?

- a. dendritic drainage patterns
- b. trellis drainage patterns
- c. rectangular drainage patterns
- d. radial drainage patterns

11. What is the downward limit of stream erosion called?

- a. head
- b. water table
- c. gradient
- d. discharge
- e. base level

12. The ability for rocks or sediment to allow the movement of groundwater is called:

- a. porosity.
- b. permeability.
- c. discharge.
- d. artesian.
- e. drawdown.

13. A **porous** and **permeable** rock or sediment layer, such as a sand or sandstone, containing groundwater that can be used to supply wells is called:

- a. an aquifer.
- b. an aquitard.
- c. an aquiclude.
- d. All choices are correct.

14. The interval between the water table and the land surface is called:

- a. phreatic zone.
- b. vadose zone.
- c. capillary fringe.
- d. All choices are correct.

15. When natural water pressure of a well tapped into a confined aquifer rises to the surface or above it is called:

- a. a spring.
- b. an artesian well.
- c. a water table.
- d. a cone of depression.

16. A stream that contributes water to the zone of saturation of groundwater is called:

- a. an influent stream.

- b. an effluent stream.
- c. bank storage.
- d. All choices are correct.

17. Over pumping of groundwater can result in:

- a. subsidence of the land surface.
- b. harm to wild life by cutting of water supply to springs and streams.
- c. salt water intrusion into coastal areas.
- d. All choices are correct.

18. Which of the following would be considered a non-point source of pollution?

- a. a smoke stack at an oil refinery
- b. an unintended release of sewage from a poorly designed sewage treatment facility
- c. pesticides and herbicides released by poorly managed agriculture activity
- d. a poorly designed landfill.

19. A region underlain by limestone that has subterranean erosion is called:

- a. a cavern.
- b. a cave.
- c. a sinkhole.
- d. karst.

20. Natural features formed by the accumulation of freshwater limestone (travertine) on the roof, walls, and floors of a cavern are called:

- a. speleothems.
- b. stalagmites.
- c. stalactites.
- d. troglodytes.

Chapter 13 - Glaciers & Glaciation

1. What is an extensive dome-shaped or plate-like perennial cover of ice and snow that spreads out from a center and covers a large area, especially of land?

- a. ice cap
- b. piedmont glacier
- c. continental ice sheet
- d. ice shelf

2. What is the name of the most recent glaciation period of North America?

- a. Illinoisan
- b. Nebraskan
- c. Kansan
- d. Wisconsin

3. Early in the 20th century an geophysicist/astronomer named Milutin Milankovitch studied orbital forcing cycles including axial precession, precession of equinoxes, and orbital eccentricity. Which of the orbital forcing cycles is related to the wobble in tilt of Earth's axis?

- a. axial precession.
- b. eccentricity in Earth's orbit.
- c. precession of the equinoxes.
- d. All choices are correct.

4. The area of a glacier in which new ice is forming is called the:

- a. snow line.

- b. zone of wastage.
- c. zone of ablation.
- d. zone of calving.
- e. zone of accumulation.

5. If ablation is equal to accumulation, then:

- a. calving occurs.
- b. the glacier stops flowing.
- c. the glacial front stops moving.
- d. surging occurs.
- e. avalanches occur.

6. The boundary between forests and unforested or barren ground on a mountainside is called:

- a. snow line.
- b. permafrost line.
- c. timberline.
- d. tundra.

7. A bowl-shaped, steep sided hollow at the head of a valley or on a mountainside, formed by glacial erosion is called:

- a. an arete.
- b. a col.
- c. a cirque.
- d. a tarn.

8. A U-shaped canyon (carved by a mountain glacier) that intersects with a larger, deeper U-shaped valley and is a typical location where large waterfalls occur is called:

- a. a horn.
- b. a cirque.
- c. a hanging valley.
- d. a roche moutonnee.

9. Submerged, steep-walled troughs along coastlines that formerly held glaciers are called:

- a. cirques.
- b. cols.
- c. tarns.
- d. fjords.

10. Unusual large boulders that were deposited by glaciers are called:

- a. erratics.
- b. moraines.
- c. drifts.
- d. tills.
- e. drumlins.

11. During the previous interglacial warm period (during the **Sangamonian interglacial period**, about 125,000 years ago):

- a. sea level was lower than it is today.
- b. sea level was the same as it is today.
- c. sea level rose about 18 feet (about 6 meters) higher than the current level.
- d. sea level rose about 165 feet (about 50 meters) higher than the current level.

12. The 400 foot rise in sea level cause by the melting of the last continental glaciers is called:

- a. The Spokane Flood.

- b. The Great Flood.
- c. The Flandrian Transgression.
- d. The Holocene Epoch.
- e. Laurentide Glaciation.

13. At the peak of the last ice age, California did NOT have:

- a. shorelines located as much of 10 to 70 miles west (offshore) of its present location.
- b. alpine glaciers and ice caps covering most of the Sierra Nevada and southern Cascade volcanoes.
- c. great lakes filling large portions of Death Valley and lower Mojave Desert regions.
- d. glaciers covering much of San Francisco Bay.

14. The breakout of an ancient glacial ice-dammed lake (called Lake Missoula) in north-central Washington, resulted the Spokane Floods and in the formation of:

- a. the Channeled Scablands.
- b. the Great Lakes.
- c. the Missouri River.
- d. the Mississippi River.

15. According to a 2009 report released by the *United Nations Intergovernmental Panel on Climate Change* (IPCC), how much is sea level estimated to rise by the year 2100 due to the ongoing effects of climate change?

- a. sea level is not rising
- b. an estimated 0.5 to 1 meters
- c. an estimated 2.6 meters
- d. an estimated 4 meters.

Chapter 14 - Deserts

1. Dry regions comprise approximate what percent of Earth's land area?

- a. 5%
- b. 15%
- c. 30%
- d. 45%

2. Why are most middle-latitude deserts located where they are?

- a. They coincide with zones of subtropical highs.
- b. No rivers run through them.
- c. They are far removed from oceans.
- d. They receive too much sunlight.
- e. All of the above.

3. What is the name for a dry region that occurs on the downwind side of a mountain range (or high volcano) that partially blocks the flow of moist air, forcing precipitation on the prevailing windward side, and creates more arid conditions on the downwind side:

- a. rainshadow.
- b. alluvial fan.
- c. playa.
- d. tundra.

4. Semiarid, grass-covered regions that often surround deserts are called:

- a. tundra.
- b. plains.
- c. plateaus.
- d. steppe.

e. piedmont.

5. What is responsible for most erosion in deserts?

- a. wind.
- b. running water.
- c. glaciers.
- d. plants and animals.
- e. groundwater.

6. Erosional features in desert regions formed from running water include all of the following except:

- a. badlands.
- b. canyons and arroyos.
- c. pediments.
- d. dunes.

7. Streams that are usually dry are called:

- a. effluent.
- b. alluvial.
- c. ephemeral.
- d. base level.

8. A gently inclined ancient erosional surface carved into **bedrock** that has typically developed at the foot of mountains, and may locally covered with thin deposits of stream gravel, and and soil, is called:

- a. an arroyo.
- b. a pediment.
- c. an inselberg.
- d. a desert pavement.

9. Where are you most likely to find the most coarse-grained sediments on a bajada?

- a. upper alluvial fan deposits
- b. mid alluvial fan deposits
- c. lower alluvial fan deposits
- d. a trunk stream or playa

10. What is the name for a hardened zone in soils and surficial deposits found in semiarid regions where of calcium carbonate and possibly other carbonates, clay minerals, or crystalline salts such as gypsum (CaSO_4), halite (sodium chloride), sodium nitrate, and other salts impregnated the pore spaces in the sediment or soil?

- a. caliche
- b. hard pan
- c. salt pan
- d. playa

11. What is the name of the ancient lake that filled Death Valley by as much as 800 feet deep during the last ice age?

- a. Mono Lake
- b. Lake Panamint
- c. Lake Bonneville
- d. Lake Manly

12. Which of the following constitutes most of the bed load carried by wind in desert regions?

- a. boulders
- b. sand
- c. fine dust particles

d. pebbles

13. Which type of desert erosion consists of the lifting and removal of loose material?

- a. ventifact
- b. deflation
- c. abrasion
- d. Desert pavement

14. Loess is:

- a. found in areas downwind of deserts and glacial outwash plain regions.
- b. an extensive blanket of silt.
- c. sediment that was carried in suspension by wind.
- d. all of the above.

15. The largest arid region in North America is:

- a. the Sonoran Desert.
- b. the Chihuahuan Desert.
- c. the Colorado Desert.
- d. the Mojave Desert.
- e. the Colorado Plateau.

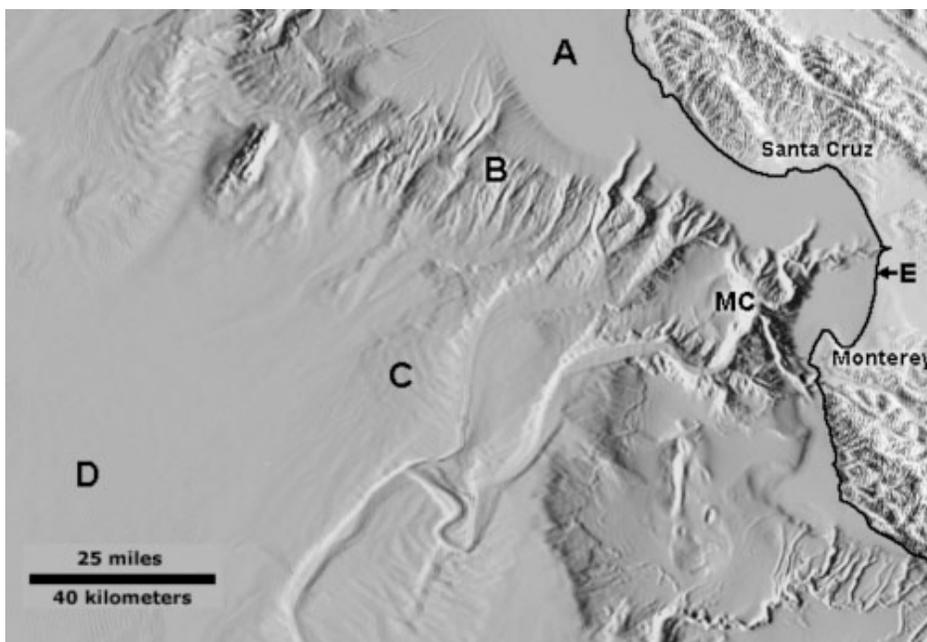
Chapter 15 - Ocean Basins

1. Approximately how old is the oldest oceanic crust on the Earth today?

- a. 6000 years
- b. 200 thousand years
- c. 2 million years
- d. 180 million years
- e. 2 billion years

2. An example of a **passive margin** is:

- a. the coast of California.
- b. the coast of southern Alaska.
- c. the East Coast of the United States.
- d. Hawaii.



Questions 3 to 9 refer to the image below that shows a map of the coastline and the seafloor in a region including Monterey Bay (between the coastal cities of Monterey and Santa Cruz) and Monterey Canyon (shown as MC). On the image, the arrow for letter E points to the coastline along Monterey Bay.

3. On the seafloor, Letter A is located on:

- a. a continental rise.
- b. a continental shelf.
- c. a continental slope.
- d. an abyssal plain.

4. The *shelf break* is located:

- a. between letters A and B.
- b. between letters B and C.
- c. between letters C and D.
- d. at letter E.

5. On the seafloor, Letter B is located on:

- a. a continental rise.
- b. a continental shelf.
- c. a continental slope.
- d. an abyssal plain.

6. On the seafloor, Letter C is located on:

- a. a continental rise.
- b. a continental shelf.
- c. a continental slope.
- d. an abyssal plain.

7. What part of a continental margin consists of deep-sea fans created by turbidity currents?

- a. continental shelf
- b. continental rise
- c. continental slope
- d. abyssal plain

8. Monterey Canyon (shown as letters **MC**) is about twice the size and depth of the Grand Canyon in Arizona. Submarine landslides and turbidity currents move sediments down submarine canyons to be deposited mostly on the:

- a. continental rise
- b. continental shelf
- c. continental slope
- d. abyssal plain

9. An extensive flat section of the seafloor, Letter D is located on:

- a. a continental rise.
- b. a continental shelf.
- c. a continental slope.
- d. an abyssal plain.

10. Trenches are:

- a. long, relatively narrow canyon-like features that run parallel to continental margins.
- b. the deepest parts of ocean basins.
- c. usually occur in the ocean along volcanic island chains.
- d. All choices are correct.

11. An ancient submarine volcano that has a flat top (beveled by wave action before sinking into ocean depths and sea-level rising) and may lack fringing reefs is called:
- an atoll.
 - a seamount.
 - a guyot.
 - a mid-ocean ridge.
12. As new ocean crust forms along mid-ocean ridges, what happens to the older ocean crust?
- Older crust moves away from spreading centers.
 - The older ocean crust cools and isostatically sinks deeper into the ocean basins.
 - The ocean crust is blanketed with layers of ocean sediments.
 - All choices are correct.
13. Black smokers and white smokers are features are:
- hydrothermal vents associated with volcanic activity on the seafloor.
 - most common along the rift zones associated with mid-ocean ridges.
 - host to biological communities that are supported by chemotrophic bacteria.
 - All choices are correct.
14. Pillow basalts occur where:
- sediments accumulate in beds on the seafloor.
 - lava erupts and cools quickly on the seafloor on submarine volcanoes along mid-ocean ridges.
 - lava erupts from a volcano on an island arc chain.
 - fringing reefs form around an ancient volcano.
15. Where are the thinnest sediments generally found in deep ocean basins?
- the mid-oceanic ridges.
 - trenches.
 - abyssal plains.
 - the continental rise.
16. Serpentinite is the State Rock of California. It occurs in abundance throughout the coast ranges of central and northern California. Serpentinite is a rock formed from:
- the accumulation of the remains of ancient sea snakes.
 - a rock formed by the metamorphic alteration of ocean crustal rocks (basalt and gabbro) by exposure to seawater seeping into the ocean crust over time.
 - a rock formed from the accumulation of undersea landslide deposits.
 - All choices are correct.
17. As old ocean crust is destroyed in subduction zones, new continental crust forms as a result of:
- water and gases released by increasing heat and pressure helps to melt some of the old ocean crust.
 - low-temperature *felsic* minerals melt first and migrate upward, forming volcanoes and new continental crust.
 - high-temperature *mafic* minerals are concentrated in the old ocean crust that sinks back into the mantle.
 - All choices are correct.
18. Iron-manganese nodules are considered to be:
- hydrogenous sediments.
 - lithogenous sediments.
 - biogenous sediments.
 - cosmogenous sediment.
19. A *turbidite* is a kind of rock formed from:
- sediments deposited by an underwater landslide on a deep-sea fan.

- b. sediment deposited around a shallow water coral reef.
- c. sediment deposited along a beach near a river delta.
- d. sediment that accumulates from the underwater *rain* of pelagic biogenous sediments.

20. Which is NOT a biogenous sediment?

- a. calcareous oozes
- b. siliceous oozes
- c. coral reef deposits
- d. quartz beach sand

21. If you find a rock that was part of an ancient coral reef, you know that the rock must have formed in:

- a. cold, deep water.
- b. turbid waters, such as near a river delta.
- c. cool, clear, shallow polar water.
- d. warm, clear, shallow tropical water.

22. Which type of seafloor sediment (typically *soft and mushy*) consists mostly of the shells and skeletal remains of small (microscopic) organisms?

- a. coquina
- b. ooze
- c. shelf mud
- d. reef sediments

23. Coccolithopores are single-cell plants that grow in the warmer upper layers of the ocean. Their remains accumulate on the seabed forming:

- a. siliceous ooze.
- b. calcareous ooze.
- c. turbidites.
- d. mudstone.

24. Diatoms are the most abundant form of plankton in the world oceans. Their remains accumulate on the seabed forming:

- a. siliceous ooze.
- b. calcareous ooze.
- c. turbidites.
- d. limestone.

25. A siliceous sedimentary rock that forms from the accumulation of the remains diatoms and radiolarian on the seafloor is called:

- a. chalk.
- b. chert.
- c. graywacke.
- d. quartz sandstone.

Chapter 16 - Ocean Processes & Shorelines

1. It is currently estimated that 97.2% of water resources on Earth is in the world ocean. Most of the remainder is:

- a. frozen in glaciers and ice caps.
- b. trapped as groundwater and soil moisture.
- c. stored in lakes, streams and reservoirs.
- d. trapped as water vapor in the atmosphere.

2. Where does salt in seawater come from?

- a. Salts are released the mechanical and chemical breakdown of rocks on land.
- b. Salts in seawater comes from salts dissolved in streams and groundwater draining off of the continents.
- c. Salts are released by hydrothermal vents on the seafloor.
- d. Salts are concentrated in seawater through evaporation.
- d. All choices are correct.

3. Seawater is composed of water, dissolved matter (including solids and gas [as ions], and suspended matter (dust and organic residues). Of the ions in seawater (besides hydrogen and oxygen), the two most abundant elements are:

- a. sodium and calcium
- b. chlorine and sodium
- c. calcium and sulphate (SO₄)
- d. magnesium and potassium

4. The salinity of seawater varies slightly from one part of the ocean to another, however, the **average salinity** of the oceans is about:

- a. 4% (ppt).
- b. 17‰ (ppt).
- c. 35‰ (ppt).
- d. 40‰ (ppt).

5. Which of the relationships of temperature, salinity, and density of seawater is NOT true?

- a. as temperature increases, density decreases.
- b. as salinity increases, density increases.
- c. as temperature changes, salinity remains the same.
- d. as density increases, temperature increases.

6. A **thermocline** is a layer of water at the ocean surface that prevents the upwelling and mixing of cool nutrient-rich water to ocean surface waters, reducing the production of primary plankton (food) for marine life. What is the best description of thermoclines based on latitude?

- a. Polar regions have well-developed thermoclines in winter months.
- b. Temperate regions have strong thermoclines in the winter months.
- c. Tropical region have no thermocline in winter months.
- d. Temperate regions have weak thermoclines (moderate in summer, less in winter).

7. Because the Earth is rotating, this rotation causes an observable deflection in both the fluid atmosphere and oceans:

- a. moving water is deflected to the right in the Northern Hemisphere.
- b. moving water is deflected to the left in the Southern Hemisphere.
- c. there is no Coriolis effect at the equator.
- d. All choices are correct.

8. The Coriolis effect has an effect on surface water movement in the oceans called Ekman transport, causing seawater to be deflected and rotate with increasing depth (a process called the **Ekman spiral**). In most regions around the world where **Ekman transport** is observed, about at what is the depth that surface movement ceases?

- a. 30 feet (10 meters)
- b. 100 feet (33 meters)
- c. 100 meters (330 feet)
- d. 1,000 feet (330 meters)

9. In large ocean basins, the Coriolis effect helps creates 5 large, circular ocean currents called:

- a. gyres.
- b. cyclones.

- c. typhoons.
- d. anticyclones.

10. The current that flows along the East Coast of North America until it is deflected to the right by westerly winds is called the:

- a. Gulf Stream.
- b. North Atlantic Drift.
- c. North Equatorial Current.
- d. Florida Current.

11. Under what conditions does coastal upwelling commonly occur in coastal California?

- a. Coastal upwelling only occurs where biotic productivity is high enough to sustain it.
- b. Coastal upwelling only occurs on the eastern coasts of continents.
- c. When a *north wind* blows south along the west-facing coastline and Ekman flow carries surface water away from shore.
- d. When a *south wind* blows north along the west-facing coastline and Ekman flow carries surface water away from shore.

12. Based on historical data, how does El Niño conditions generally impact Southern California?

- a. ocean water temperatures are higher (impacting sea life), and there is typically increased rainfall in the rainy season.
- b. ocean water temperatures are lower (impacting sea life), and there is typically increased rainfall in the rainy season.
- c. ocean water temperatures are higher (impacting sea life), and there is typically less rainfall in the rainy season.
- d. ocean water temperatures are lower (impacting sea life), and there is typically less rainfall in the rainy season.

13. The time it takes for one full wave to pass a fixed position is called:

- a. wave period.
- b. wave height.
- c. wave fetch.
- d. wavelength.

14. The vertical distance between the trough of a wave and the crest of a wave is called:

- a. wave height.
- b. wave period.
- c. fetch.
- d. wavelength.

15. What determines **wave speed** in the open oceans?

- a. wave period
- b. wavelength
- c. wind velocity
- d. All of the choices are correct.

16. The region where storm winds blowing over the ocean surface generating waves is called a:

- a. swell.
- b. sea.
- c. cyclone.
- d. tsunami.

17. Groups of waves that move out of area where waves are generated by strong storm winds and travel long distances across ocean basins are called:

- a. seas.
- b. cyclones.
- c. swells.
- d. tsunamis.

18. As waves move along the surface of the water, what do water particles do?

- a. They move back and forth in a direction parallel to wave motion.
- b. They move back and forth in a direction perpendicular to wave motion.
- c. They move along the crests of waves and can travel thousands of miles.
- d. They oscillate in circles parallel to wave motion and whose diameters decrease with depth.

19. In deep water in the open ocean, how deep in water do surface waves cause particle motion?

- a. about 1/2 of the wavelength of passing water waves
- b. exactly twice the wave height
- c. about twice the wavelength
- d. about twice the wave period

20. What happens to waves when they reach shallow water?

- a. They become waves of oscillation.
- b. They slow down and become waves of transition.
- c. They speed up.
- d. They veer to the left.

21. Waves break when:

- a. when the water depth (d) is about the same as the wave height (h).
- b. where the water depth is about one half of its wavelength
- c. the slope of the wave reaches a ratio of about 7:1 (7 long to 1 high).
- d. all of the above.

22. What is **surf**?

- a. Fully-developed waves generated by strong winds.
- b. Waves moving out of the generating sea area.
- c. Where waves steepen and build up near shore.
- d. Waves moving into shallow water as turbulent front that moves onto the beach after they break.

23. The bending of waves so that they are more parallel to the shore is called:

- a. diffraction.
- b. reflection.
- c. refraction.
- d. translation.

24. How are longshore currents best described?

- a. They involve movement of water perpendicular to the shoreline.
- b. They involve movement of water toward the shoreline.
- c. They involve movement of water parallel to the shoreline.
- d. They involve movement of water away from the shoreline.

25. What is significant about longshore currents?

- a. Longshore currents are agents of erosion along shorelines.
- b. Longshore currents are agents of deposition along shorelines.
- c. Longshore currents move in directions dependent on the direction of the dominant incoming swell.
- d. All choices are correct.

26. A strong current associated with the swift movement of water through *inlets* and the *mouths* of estuaries, embayments, and harbors is called a:

- a. longshore drift.
- b. longshore current.
- c. rip current.
- d. rip tide.

27. The force primarily responsible for tides is:

- a. gravity.
- b. friction.
- c. the Coriolis effect.
- d. wind pressure.

28. What is the relative tidal force of the Sun and Moon?

- a. The Sun and Moon exert equal tidal forces on the Earth.
- b. The Sun exerts about twice the tidal force of the Moon.
- c. The Sun exerts three times the tidal force of the Moon.
- d. The Moon exerts about twice the tidal force of the Sun.

29. When do Spring tides occur?

- a. during new moon & full moon phases.
- b. during first quarter & third quarter phases.
- c. In March and April in the northern hemisphere.
- d. All choices are correct.

30. When the Moon is closest to the earth is called:

- a. apogee.
- b. perigee.
- c. aphelion.
- d. perihelion.

31. How many high tides occur almost every day in most coastal areas (including San Diego)?

- a. 1.
- b. 2.
- c. 3.
- d. 4.

32. When a tidal current flows out to sea as tide levels fall is called a:

- a. ebb tide.
- b. spring tide.
- c. flood tide.
- d. neap tide.

33. The **intertidal zone** is:

- a. the area between the high tide mark and dunes, a sea cliff, or permanent vegetation.
- b. the area between the low and high tide marks.
- c. a platform formed by depositional processes along the beach.
- d. the area between the beach and a barrier island.

34. The zone that is the typically vegetation-free splash or spray zone above the high water line where back-beach dunes accumulate is called:

- a. the subtidal zone.
- b. the intertidal zone.

- c. the supratidal zone.
- d. a wrackline.

35. The region on the East Coast (including the Delmarva Peninsula, Chesapeake Bay, and Delaware Bay) is what kind of Coast?

- a. Ria coast
- b. Deltaic coast
- c. Glacial coast
- d. Fault/tectonic coast
- e. Volcanic coast

36. Which of the following is NOT a depositional coastal landform?

- a. spit
- b. baymouth bar
- c. beach
- d. sea arch

37. Barrier island beaches generally develop where:

- a. The coast is composed of hard rock.
- b. The nearby land has a rugged topography of hills and mountains.
- c. The sea floor deepens rapidly offshore.
- d. The sea floor remains shallow for a long distance offshore.

38. When observing a beach through yearly seasonal cycles, during stormy periods in winter with high wave energy:

- a. there is a higher percentage of fine-grained sand on beaches.
- b. more erosion occurs in bays than on headlands.
- c. beaches are eroded and the sand moves to offshore bars.
- d. offshore sand bars are eroded and beaches are built up.

39. An artificial barrier built at a right angle to the beach to trap sand that is moving parallel to the shore is known as a:

- a. groin.
- b. stack.
- c. seawall.
- d. breakwater.

40. Construction of dams upstream on rivers flowing to the coast may lead to:

- a. narrower beaches.
- b. wider beaches.
- c. the filling in of bays.
- d. the building of a barrier island.