Introduction to Oceanography
Prelim Exam No. 1

Your Name ______________________________

- by filling in the appropriate circle with a number 2 pencil.
- Make sure to write and bubble in your name and your student i.d., number on the answer sheet. You do not need to fill in the other information (birthdate, etc.)
- Write down the special code on the answer sheet you are given and take it with you. You will need this number to find out your test score.
- Instructions will be posted on how to retrieve your score on the class web site (http://www.geo.cornell.edu/eas/education/course/descr/EAS154/EAS154home.html) during the next week.

Write your special code in the space provided below. Tear off the corner of this cover sheet and take it with you.

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| | My Special Code __________ |
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1
All questions are Multiple Choice. Indicate the one best answer. Record your answers on the answer sheet provided.

1. The principle of parsimony, which is an important part of the philosophy of science, states that when two theories explain a set of observations equally well, the one which is preferred is always
   a. the most complex one
   b. the one proposed first
   c. the one proposed most recently
   d. the simplest one
   e. none of the above

2. Which of the following is not true about the Messinian Salinity Crisis:
   a. Geologically speaking, it both began and ended abruptly
   b. the reduction in seawater salinity produced a global ecological crisis
   c. the extensive evaporite deposits beneath the Mediterranean produced during this period were first discovered by the Deep Sea Drilling Project
   d. the Messinian evaporite deposits are comprised only of the mineral gypsum, no halite is present
   e. much of the Mediterranean dried by when the Straits of Gibraltar closed.

3. Which of the following is not true about the evolution of life on Earth
   a. the oldest fossils are found in rocks that are 3.5 billion years old
   b. complex, multicellular organisms evolved shortly after the first life appeared
   c. representatives of essentially all animal phyla appear almost simultaneously in the fossil record during the “Cambrian Explosion”, about 520 million years ago
   d. the first land plants and land animals both appeared around 410 to 430 million years ago during the Paleozoic Era.
   e. humans came along only very recently, within the last few hundred thousand or million years (depending on how you define “human”).

4. The Earth’s magnetic field arises from the outer core, which consists of
   a. liquid iron-nickel alloy
   b. rock similar in composition to granite
   c. silicates rich in iron and magnesium
   d. rock similar in composition to basalt
   e. none of the above

5. The average depth of the oceans is about:
   a. 150 meters
   b. 4000 feet
   c. 10 kilometers
   d. 135 feet
   e. 3800 meters

6. The age of the earth is about
   a. 4.5 billion years
   b. 600 million years
   c. 20 thousand years
   d. 13 billion years
   e. 4.5 million years

7. Compared to the rest of the solar system, the Earth is
   a. somewhat older
   b. a lot younger
   c. a lot older
   d. the same age
   e. none of the above
8. Natural radioactive decay is important because
   a. it provides much of the energy that drives plate tectonics
   b. its ionizing effect provides nuclei for water condensation and cloud formation
   c. it occurs at a constant rate and therefore provides a clock to measure geologic time
   d. both a and c are correct
   e. none of the above.

9. The part of the Earth’s mantle that, although solid, is capable of flow is the
   a. asthenosphere
   b. lithosphere
   c. andesite
   d. magma chamber
   e. none of the above

10. The concept of isostacy states the continents are high and the ocean floor low because:
    a. continents are pushed up by convection currents in the mantle
    b. **continental crust is less dense than oceanic crust**
    c. continental crust is more dense than oceanic crust
    d. oceanic crust is thicker than continental crust
    e. none of the above

11. The principal observation that led Alfred Wegener to propose the theory of continental drift early in this century was:
    a. differing polar wander curves for North America and Europe
    b. **fit of the continents on opposite sides of the Atlantic**
    c. magnetic anomaly patterns on the seafloor
    d. fluctuations in the Gulf Stream
    e. none of the above

12. Which of the following was **not** a key discovery leading to the development of plate tectonic theory in the 1960’s.
    a. magnetic anomaly patterns along the Mid-Atlantic Ridge
    b. **radar and laser ranging that enabled measurement of plate movements**
    c. the motion along Fracture Zones when earthquakes occurred was the opposite of that predicted by classical geologic theory
    d. continents on either side of the Atlantic fit together even better when the edge of the continental margin rather than the coast line was used.
    e. heat flow decreased and sediment thickness increased away from mid-ocean ridges.

13. Multibeam echo sounding, and side-scanning sonar are examples of techniques used to:
    a. image rocks beneath the ocean surface
    b. measure wave heights
    c. **map bathymetry and image the ocean floor**
    d. forecast volcanic eruptions
    e. determine tidal currents

14. As new lithosphere moves away from the mid-ocean ridges and rises,
    a. it cools and contracts, so that the ocean floor becomes progressively deeper.
    b. it becomes increasingly prone to magnetic reversals
    c. it is steadily heated by the asthenosphere below, making it more buoyant.
    d. it is subject to hydrothermal activity which increases its density so that it subsides into the underlying mantle. As a result, the ocean floor becomes progressively deeper.
    e. none of the above.
15. The sheeted dike complex in the ocean crust is formed as:
   a. magma freezes while rising from the magma chamber to the surface
   b. magma in the magma chamber freezes in place
   c. iron and manganese minerals precipitate from hydrothermal solutions
   d. the oceanic crust cracks during cooling
   e. none of the above

16. Compared to passive continental margins, active continental margins:
   a. are wider and more likely to have earthquakes and volcanoes
   b. are narrower and more likely to have earthquakes and volcanoes
   c. have more frequent turbidity current events
   d. are narrower and less likely to have earthquakes and volcanoes
   e. are wider and less likely to have earthquakes and volcanoes

17. Melting in the mantle that produces volcanism above subduction zones is caused by:
   a. frictional heating due to upward mantle motion
   b. addition of water, which lowers the melting point
   c. decompression due to upward mantle motion
   d. it is already molten
   e. none of the above

18. Subduction-related volcanoes, such as Mt. St. Helens, tend to erupt explosively because:
   a. their magmas are rich in water
   b. they form and erupt rapidly
   c. they are hotter than other volcanos
   d. the Coriolis force causes magma to spiral out of the vent
   e. both c and d are correct.

19. Atolls, which are more or less circular coral reefs with a central lagoon, form by which of the following mechanisms:
   a. By a major volcanic eruption blasting a crater in the center of an island volcano
   b. By a meteorite impact, with coral eventually growing on the crater rim
   c. As an extinct volcano cools, it contracts and sinks beneath the sea. The fringing reef around it, however, continues to grow upward, with its top just at sealevel
   d. atolls can arise through either a or b.
   e. none of the above.

20. The person who first correctly explained the origin of coral atolls was:
   a. Alfred Wegener
   b. Richard Wagner
   c. Harry Hess
   d. J. Tuzo Wilson
   e. Charles Darwin

21. Hot spots that produce chains of volcanic islands that increase in age in the direction of plate motion are thought to result from:
   a. diverging tectonic plates
   b. subduction
   c. transform faults
   d. meteorite impacts
   e. mantle plumes rising from deep in the mantle.
22. A good example of a chain of volcanoes produced by such a “hot spot” is
   a. The East Pacific Rise  b. The West Coast of South America
   c. The Hawaiian Islands  d. The Aleutians
   e. none of the above.

23. The “K-T” or Cretaceous-Tertiary Boundary asteroid impact that ended at the age of the dinosaurs occurred about
   a. 65 million years ago  b. 60 thousand years ago
   c. 2 million years ago  d. 6 billion years ago
   e. just last week.

24. The marine snow line or “Carbonate Compensation Depth” (CCD) is the depth at which:
   a. more CO\textsubscript{2} is produced by respiration than removed by photosynthesis
   b. calcium carbonate begins to dissolve
   c. the rate of dissolution of calcium carbonate matches the rate at which it is falling, so that carbonate sediment is not found below this depth
   d. the depth below which seawater is undersaturated with calcium carbonate
   e. none of these

25. The property of hydrothermal fluids that allows them to dissolve metals from the oceanic crust is:
   a. they are oxidized  b. they are acidic
   c. they are reduced (no oxygen)  d. they are alkaline
   e. both b and c are correct.

26. Hydrothermal fluids contain H\textsubscript{2}S, which is essential to bacteria of the vents, but toxic to most animals. The tube worm \textit{Riftia pachyptilia} can tolerate the H\textsubscript{2}S because
   a. the hemoglobin in its blood has a special site to fix the sulfide, so it can be delivered to bacteria in its troposome
   b. its gill is coated with bacteria that oxidize the H\textsubscript{2}S
   c. it only colonizes those areas of the vent environment when H\textsubscript{2}S concentrations are below toxic levels
   d. it has a specialized pancreas that neutralizes the H\textsubscript{2}S
   e. it has a specially adapted version of the cytochrome \textit{c oxidize} enzyme, which is immune to sulfide poisoning.

27. The primary evidence supporting the asteroid impact theory to explain the extinction of dinosaurs comes from marine sediments. Which of the following is \textbf{not observed} in marine sediments at the “K-T” Boundary:
   a. anomalously high concentrations of the element iridium (Ir)
   b. grains of shocked quartz
   c. glassy spherules (tektites)
   d. crushed dinosaur bones
   e. both a and d.

28. Carbonate oozes are most often composed of the shells of:
   a. diatoms  b. \textit{foraminifer}
   c. radiolarians  d. copepods
   e. dinoflagellates
29. A deep sea sediment consisting primarily of the shells of diatoms would be called
   a. a siliceous ooze
   b. red clay
   c. a carbonate ooze
   d. neritic sediment
   e. cosgenic sediment

30. Siliceous oozes are most likely to be found
   a. on continental margins
   b. in deep sea trenches
   c. on deep ocean floor underlying areas of low biologic productivity
   d. on areas of the ocean floor shallower than the carbonate compensation depth
   e. on the deep ocean floor underlying areas of high biologic productivity

31. $^{18}$O differs from $^{16}$O in that
   a. $^{18}$O is radioactive whereas $^{16}$O is not
   b. $^{18}$O has 2 more electrons than $^{16}$O
   c. $^{18}$O has 2 extra protons and electrons
   d. $^{18}$O has 2 more protons than $^{16}$O
   e. $^{18}$O has 2 more neutrons than $^{16}$O.

32. Isotopic and other studies of marine carbonate sediments have led to the conclusion that the fundamental cause of the ice ages has been
   a. variations in the Earth's orbit and rotation
   b. changes in the level of atmospheric CO$_2$
   c. changes in ocean circulation
   d. changes in the Sun's radiation output
   e. changes in the configuration of the continents

33. While the Milankovitch hypothesis is accepted as the fundamental cause of the ices ages, there must be feedback mechanisms that amplify this primary signal. Which of the following is not a possible feedback mechanism:
   a. changes in the Earth's reflectivity (albedo) due to build-up of continental ice
   b. changes in the level of atmospheric CO$_2$
   c. changes in ocean circulation
   d. changes in the Sun's radiation output
   e. both c and d.

34. Glacial epochs, although colder, appear also to have been drier, windier, and consequently dustier than interglacial epochs. This might have contributed to climatic feedback because:
   a. Higher wind speeds would have increased wave height, therefore increasing ocean albedo
   b. Higher wind speeds would have increased wave height, therefore slowing ocean currents
   c. Winds would have delivered more iron to the oceans, increasing biological productivity and drawing down atmospheric CO$_2$.
   d. higher amounts of dust in the atmosphere would have absorbed more solar radiation, heating the atmosphere
   e. both a and b are correct.

35. Which of the following is not true of pure water:
   a. It is most dense at 0° C.
   b. It has a very high heat capacity compared to other substances
   c. It's latent heat of vaporization is very high compared to other substances
   d. More carbon dioxide gas dissolves into it as temperature decreases,
   e. It dissolves more substances than any other naturally occurring compound.
36. The energy represented by the latent heat of evaporation of H\textsubscript{2}O is being used mainly to
   a. raise the temperature of the ice
   b. raise the temperature of liquid water
   c. break hydrogen bonds
   d. increase the energy of individual molecules
   e. dissociate hydrogen and oxygen

37. The dissolving power of water is a consequence of
   a. its low viscosity
   b. the polar nature of the H\textsubscript{2}O molecule
   c. its ability to dissociate into H\textsuperscript{+} and OH\textsuperscript{-}
   d. hydrogen bonds between H\textsubscript{2}O molecules
   e. its high latent heat of fusion

38. Water that is acidic has
   a. a low pH and an excess of H\textsuperscript{+} over OH\textsuperscript{-}
   b. a high pH and an excess of H\textsuperscript{+} over OH\textsuperscript{-}
   c. a low pH and an excess of OH\textsuperscript{-} over H\textsuperscript{+}
   d. a high pH and an excess of OH\textsuperscript{-} over H\textsuperscript{+}
   e. a lot of NaCl dissolved in it.

39. The oceans act as a sort of thermostat, moderating temperature on the Earth. The physical property of water most responsible for this effect is:
   a. viscosity
   b. density
   c. electromagnetic absorption spectrum
   d. heat capacity
   e. dielectric constant

40. The average salinity of seawater is about
   a. 3.5‰
   b. 5%
   c. 2.3%
   d. 35‰
   e. 25 ppm

41. Which of the following is not among the major ions in seawater
   a. magnesium
   b. chloride
   c. sulfate
   d. nitrate
   e. sodium

42. The high concentrations of sodium in seawater in spite of its low concentration in rivers can be viewed as a consequence of
   a. its long residence time in seawater
   b. its low solubility in river water
   c. its rarity in continental rocks
   d. its forming an inert molecule in seawater
   e. none of the above

43. Hydrothermal processes at mid-ocean ridges affect both the composition of the oceanic crust and that of seawater. For example, hydrothermal activity is the principal “sink” for the element ______ in seawater.
   a. magnesium
   b. hydrogen
   c. calcium
   d. chlorine
   e. phosphorus

44. Beaches exhibit seasonal changes. Compared to a summer beach, a winter beach typically
   a. has finer sediment
   b. has a gentler slope
   c. has coarser sediment
   d. has a steeper slope
   e. both c and d are correct.
45. The characteristic that most distinguishes sediments deposited by turbidity currents is
   a. they are fine-grained  b. they are coarse grained
   c. they are rich in calcium carbonate tests  d. the grains in the are well-rounded
   e. they grade from coarse-grained at the base to fine grained at the top

46. The average depth of the seaward margin of continental shelves is about:
   a. 50 m  b. 2000 m
   c. 350 m  d. 2000 ft
   e. 135 m

47. If the Earth were to rotate in the opposite direction to its current rotation, so that the sun rose in the
   west and set in the east, the Coriolis Effect would deflect moving objects:
   a. to the left in the Southern Hemisphere,  b. always to the north,
   c. to the right in the Northern Hemisphere,  d. always to the south,
   e. to the right in the Southern Hemisphere

48. An intermediate-water wave, one whose speed depends on both water depth and wave length, is a
   wave whose wavelength is between
   a. 1/2 and 1/10 the water depth  b. 1/2 and 1/20 the water depth
   c. 1/2 and 1/10 its wave height  d. 1/10 and 1/20 the water depth
   e. 1/4 and 1/2 the water depth

49. The height of wind-generated waves is determined by...
   a. wind speed  b. wind duration
   c. fetch  d. all of the above
   e. none of the above

50. Longshore sediment transport is driven by...
   a. river discharge  b. waves hitting the coast obliquely
   c. extreme high tides  d. wave refraction
   e. wave diffraction

51. Tsunamis are generated by...
   a. large hurricanes  b. underwater earthquakes or landslides
   c. constructive addition of two large storm waves  d. the reversal of trade winds in the tropical Pacific
   e. none of the above

52. According to the equilibrium theory of tides, we would expect the tidal wave to move from east to west. The dynamic theory of tides, however, predicts
   a. the tidal wave should move from west to east
   b. a tidal wave that rotates clockwise (in the north hemisphere) around an ocean basin
   c. that there will be two tidal waves, one on the side of the Earth closest the Moon, a second opposite
   d. that the tides should become larger closer to the equator
   e. a tidal wave that rotates counter-clockwise (in the north hemisphere) around an ocean basin
53. Internal waves are...
   a. surface waves that propagate back and forth within semi-enclosed basins or lakes
   b. waves that propagate along abrupt density discontinuities within the ocean
   c. the same as planetary waves
   d. only associated with the deepest regions of the ocean
   e. have little affect on biology

54. In the dynamic theory of tides, tides are considered to be
   a. shallow water waves
   b. freely propagating waves
   c. unaffected by Coriolis Force
   d. unaffected by continental boundaries
   e. all of the above

55. Cotidal lines depict
   a. regions that have co-dependent tides
   b. the wavelength of a tide
   c. places where the tide is in the same stage (e.g., high tide) at a given time
   d. places where the tidal range is the same
   e. constructive addition to two tide waves

Part II True/False  Use answer a to indicate TRUE; b to indicate FALSE

56. There is no evidence that CO₂ concentrations were lower during glacial periods, so the greenhouse effect probably played no role in glacial-interglacial cycles. FALSE

57. A tidal “day” is 24 hours and 40 minutes long. FALSE (TRUE was also accepted).

58. The speed of deep water waves depends only on wave height and wave length. FALSE

59. The speed of shallow water waves depends only on water depth. TRUE

60. In an ideal deep water wave, the motion of water molecules is circular. TRUE

61. On a beach, the summer berm is further back, higher, and steeper than the winter berm. FALSE

62. In the Pacific, Kelvin waves are associated with the phenomenon known as El Niño. TRUE

63. “Salt Wedge” estuaries occur where the tidal flow is much stronger than the river flow. FALSE

64. Barrier Islands, such as Padre Island along the Texas coast, have been moving seaward since the end of the last ice age. FALSE

65. A fjord is a good example of a primary coast. TRUE