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OCEANOGRAPHY 201

Fall, 2003

Exam #1: Section #1

Answer 1-60 on the computer-scan sheet (1 point each). Use a dark (#2) pencil only, and make marks neatly within the circles. If you change an answer, erase completely. Also, be sure your ID number is coded correctly.

PART I: True/False (1 point each = 20 points). Mark (a) for "true" and (b) for "false".

1. Science is a powerful way to find out about the natural world, but it has its limitations.
2. Latitude can be told from the declination of the Pole Star, whereas longitude requires an accurate clock.
3. Current scientific theories suggest that the universe is 10-15 billion years old.
4. Refractory elements are those that tend to form gases, even at relatively low temperature.
5. The four inner planets are relatively richer in volatile elements and compounds than are the four outer gas-giant planets.
6. Oceans of liquid water are common in our Solar System.
7. An hypsometric curve shows two levels on Venus and only one on Earth.
8. The atmospheres of Earth and its nearest neighbors, Venus and Mars, are similar.
9. Earth is believed to have originated by accretion from planetesimals.
10. The age of the Earth is indistinguishable from that of the Moon and meteorites: about 4.5 billion years.
11. Seismic S-waves do not travel through liquids and this indicates that at least part of the Earth's core is molten.
12. Earth is not massive enough to retain all of its constituent chemical elements.
13. Free oxygen has always been an important component of the Earth's atmosphere.

14. The oldest rocks from the seafloor are much younger than the oldest rocks from the continents.
15. The amount of land exposed above sea level has remained about the same for the last 600 million years.
16. The oceanic crust is much thicker than the continental crust.
17. The Hawaiian Islands are an example of island arc volcanism.
18. Worldwide, sea level is falling today.
19. The deep sea is a promising place to explore for oil and gas.
20. Seawalls are usually effective in preventing beach erosion.

PART 2: Multiple Choice (1 point each = 40 points).

21. Which of the following is true about the scientific method?
 - a) The scientific method is a systematic way of asking and answering questions about the natural world.
 - b) In science simple theories are preferred over complex ones.
 - c) Scientific theories are always subject to challenge and may be overturned.
 - d) Scientific theories are continuously updated as new information becomes available.
 - e) All of the above.
22. Which of the following statements most accurately reflects current scientific thinking?
 - a) The size of the universe is static; it has always been and will always remain so.
 - b) The Universe is expanding but will eventually reverse and begin to contract.
 - c) The Universe is contracting and will end in the Big Crunch.
 - d) The Universe is expanding and will end in the Big Chill.
 - e) None of the above.
23. The Sun's energy comes from
 - a) gravity
 - b) nuclear fusion
 - c) red-shifting
 - d) parallax
 - e) chemical differentiation.
24. Chemical differentiation refers to
 - a) the sum of large-scale chemical and physical processes that separate material based on its chemistry.
 - b) the processes that formed Earth's core, mantle, and crust.
 - c) the processes that separated material that became the inner rocky vs. the outer gaseous planets.
 - d) The processes that formed Earth's oceans and atmosphere.
 - e) all of the above.

25. The Earth is relatively depleted in noble gases because
- its present mass is too small to hold them.
 - they have been removed by reaction with surface rocks.
 - they were vaporized and lost when the Earth melted.
 - they were lost early on from the planetesimals that eventually accreted to form the Earth.
 - they have never outgassed from the Earth's interior.
26. The following are examples or characteristics of great circles:
- the equator.
 - all lines of constant latitude.
 - all lines of constant longitude
 - The plane of the circle passes through the center of the Earth.
 - a, c, and d.
27. The leading theory for the origin of Earth's Moon is
- gravitational capture of a large planetesimal.
 - fission due to rapid rotation.
 - impact by a large planetesimal, about the size of Mars, which spun off the Moon.
 - formation in the same manner as Earth, by accretion.
 - condensation from the Solar nebula.
28. Unlike the other planets, the Earth has oceans of liquid water. This is because
- Earth was bombarded by water-rich comets early in its history.
 - Earth inherited a primitive, water-rich atmosphere from the Solar nebula, which condensed into oceans as the Earth's surface cooled.
 - Earth formed rapidly from cold, water-rich planetesimals, and this water subsequently outgassed from Earth's interior.
 - Earth is the proper distance from the Sun, such that water can exist in the liquid state.
 - both c) and d).
29. A "runaway greenhouse" refers to
- what happened on Mars
 - what happened on Venus
 - a process involving a positive feedback between the amount of carbon dioxide in a planetary atmosphere and the temperature of that atmosphere.
 - both b) and c)
 - all of the above.
30. Carbon dioxide that has outgassed from Venus resides mainly in Venus's atmosphere. On Earth, carbon dioxide that has outgassed is mainly
- in rocks, as CaCO_3 in limestone.
 - dissolved in the oceans.
 - tied up as organic matter in soils.
 - stored in coral reefs.
 - stored in deep-sea sediments.

31. The simplified reaction $\text{H}_2\text{O} + \text{CO}_2 + \text{CaSiO}_3 = \text{CaCO}_3 + \text{SiO}_2 + \text{H}_2\text{O}$ represents
- weathering of silicate rocks by rain water and removal of CO_2 from the atmosphere into rocks.
 - photosynthesis followed by burial of some of the organic material produced.
 - the reaction by which the Earth's core formed.
 - The reaction that generates energy within the Sun and similar stars.
 - the formation of evaporite deposits that can form salt domes and trap oil and gas.
32. The reaction $\text{CO}_2 + \text{H}_2\text{O} = \text{CH}_2\text{O} + \text{O}_2$ represents:
- photodissociation
 - chemical weathering
 - photosynthesis
 - none of the above.
 - all of the above.
33. Free oxygen in the Earth's atmosphere has been produced mainly by
- photodissociation of water and loss of hydrogen to outer space.
 - change in sea level.
 - formation of the Earth's core.
 - photosynthesis followed by burial of organic carbon.
 - nucleosynthesis in stars.
34. Which of the following statements is true?
- On Earth, H_2O is in the oceans, CO_2 in rocks, and N_2 and O_2 in the atmosphere.
 - On Venus, H_2O was lost to outer space as H_2 , CO_2 and N_2 are in the atmosphere, and O_2 was never present.
 - On Mars, H_2O and CO_2 are frozen out as ice, N_2 was lost to space, and O_2 was never present.
 - On Venus the atmosphere is very thick whereas on Mars it is very thin. Both atmospheres are mainly CO_2 .
 - All of the above.
35. From outside to inside, the Earth consists of
- rocky crust, brittle lithosphere, plastic asthenosphere, solid metal outer core, liquid metal inner core.
 - rocky crust, rocky mantle, liquid metal outer core, solid metal inner core.
 - rocky crust, liquid mantle, plastic asthenosphere, solid outer core, solid inner core.
 - rocky crust, liquid asthenosphere, plastic mantle, liquid outer core, solid inner core.
 - none of the above.
36. The principle of isostasy states that
- the Earth's surface is dominated by two levels: the continents and the oceans.
 - the lithosphere is in gravitational equilibrium through a buoyancy mechanism, with compensation occurring in the asthenosphere.
 - crust is produced by differentiation from the mantle, by upwelling and solidification of molten rock.
 - if the Earth were perfectly smooth, it would be covered by nearly 3000 m of seawater.
 - 25% of the continental crust presently lies below sea level.

37. Earth's magnetic field originates from convection currents within
a) the mantle b) the liquid outer core c) the liquid inner core
d) the solid inner core e) the asthenosphere.
38. The Earth has dry land because
a) there is not enough water to cover the surface completely.
b) all planets have dry land.
c) it has continental crust, which rides isostatically higher than oceanic crust because it is relatively thick and less dense.
d) sea level has dropped throughout Earth history.
e) the mid-ocean ridges push up the bottom of the seafloor, as if it were a large plastic bowl.
39. Sea level can change as a result of
a) change in the rate of seafloor spreading, which produces a change in the volume of the ocean basins.
b) change in the volume of ice stored on land.
c) local, tectonically induced vertical motions of the crust.
d) change in the temperature of ocean water.
e) all of the above.
40. An Atlantic-type continental margin and its offshore region consists, from land to sea, of
a) shelf, slope, rise, trench b) shelf, slope, rise, abyssal plain
c) shelf, slope, trench d) shelf, slope, marginal basin, abyssal plain
e) either b or c
41. Atlantic-type continental margins are considered to be aseismic, or passive, because
a) they lack earthquakes.
b) they lie along a plate boundary.
c) they lie far from a plate boundary.
d) both a) and c).
e) none of the above.
42. Continental drift theory was initially rejected but experienced a revival in the 1950's as a result of new evidence that
a) animals had crossed from Africa to South America via land bridges.
b) the Earth's magnetic field had reversed polarity repeatedly in the past.
c) the Earth's magnetic poles had apparently wandered through time, but the paths inferred were different for different continents.
d) the Earth was rotating on its axis, which corresponds to the geographic and magnetic poles.
e) all of the above.

43. The continents drift because
- a) they "plow through" the ocean basins in response to "polflucht".
 - b) of convection in the Earth's outer core.
 - c) they ride passively on the lithospheric plates, which are moving relative to one another and the mantle.
 - d) the Earth's magnetic field reverses its polarity.
 - e) all of the above.
44. A major prediction of the seafloor spreading hypothesis that was made and tested is
- a) that there are magnetic stripes on the ocean floor.
 - b) that it could cause sea level change.
 - c) that the Earth's magnetic field originates by convection in the outer core.
 - d) that the age of the seafloor increases with distance from the ridge on either side.
 - e) that the Earth's magnetic field reverses its polarity.
45. The theory of plate tectonics
- a) is a unifying theory for the Earth sciences.
 - b) holds that the Earth's surface consists of a dozen or so rigid plates.
 - c) holds that most mountain-building occurs along plate boundaries.
 - d) holds that the lithospheric plates ride on the asthenosphere.
 - e) all of the above.
46. Which of the following is a "rule" of plate tectonics?
- a) Continental crust is too thick and buoyant to be subducted.
 - b) The volcanic arc always forms on the upper surface of the subducting plate.
 - c) When continents collide with one another they tend to "stick".
 - d) The major process driving the plates is convection in the Earth's outer core.
 - e) Both a) and c).
47. The three major types of plate boundaries are
- a) conservative, transform, slipslide
 - b) continental-continental, oceanic-oceanic, continental-oceanic
 - c) divergent, convergent, conservative
 - d) constructive, destructive, conservative
 - e) both c) and d).
48. Which of the following terms consistently describe a mid-ocean ridge?
- a) shallow earthquakes, basaltic volcanism, young crust, sediment absent to thin
 - b) shallow earthquakes, andesitic volcanism, young crust, thick sediment
 - c) shallow to deep earthquakes, andesitic volcanism, older crust, thick sediment
 - d) shallow to deep earthquakes, basaltic volcanism, older crust, thin sediment
 - e) no earthquakes, no volcanism, older crust, thick sediment

49. The mid-ocean ridge is a ridge because
- a) a Mars-sized body collided with Earth early in its history.
 - b) deep ocean water is cold, just above freezing.
 - c) the ridges balance off the trenches, which are deep.
 - d) the young, newly formed lithosphere is hot, and the ridge is produced by its thermally expanded state.
 - e) none of the above.
50. Continents are built by
- a) andesitic volcanism at subduction zones.
 - b) basaltic volcanism at mid-ocean ridges.
 - c) accretion of exotic terranes onto their margins.
 - d) outgassing of volatiles from the Earth's interior.
 - e) both a and c.
51. Continent-continent collisions
- a) result when the ocean basin between them is consumed by subduction.
 - b) cause the crust to thicken locally, as continental crust is too thick and buoyant to subduct.
 - c) cause the subducting lithospheric slab to break off, after which it continues to descend on its own.
 - d) can cause a reorganization of plate motions.
 - e) all of the above.
52. Recent studies have shown that the main driving force for the Pacific Plate is
- a) ridge push.
 - b) slab pull.
 - c) gravity sliding.
 - d) drag at the base.
 - e) push by mantle plumes.
53. Which of the following statements about hot spots is/are true?
- a) They originate from plumes of unusually hot mantle that remain fixed as the plates move over them.
 - b) They provide a means to estimate the direction of plate motion relative to the mantle.
 - c) They represent a third geologic setting for volcanism on Earth, along with mid-ocean ridges and subduction zones.
 - d) They can occur on land or on sea, at or away from axes of seafloor spreading.
 - e) All of the above.
54. The three main geologic settings on Earth where active volcanoes occur are
- a) abyssal plains, abyssal hills, and continental margins.
 - b) Hawaii, Iceland, and the Andes.
 - c) mid-ocean ridges, subduction zones, and hotspots.
 - d) convergent, divergent, and conservative plate boundaries.
 - e) Indonesia, Japan, and eastern Australia.

55. Most of the sediment in the oceans, by volume, is deposited
- by organisms that have calcareous skeletons.
 - by organisms that have siliceous skeletons.
 - in the deep-sea trenches.
 - along the margins of the continents.
 - by andesitic volcanoes.
56. The main components of sediment on the deep-sea floor are
- biogenic, volcanogenic, and cosmogenic
 - pelagic, hemipelagic, and neritic
 - authigenic, hydrogenous, and hydrothermal
 - calcareous ooze, abyssal clay, and siliceous ooze
 - ooze, chalk, limestone, and sand
57. The carbonate compensation depth, or CCD, is
- the depth at which calcium carbonate dissolves in the oceans.
 - the depth at which calcium carbonate sediment is replaced by siliceous ooze.
 - the depth at any point in the oceans where the rate of delivery of calcium carbonate is equal to the rate at which it dissolves.
 - the depth above which calcium carbonate can accumulate, and below which it cannot.
 - both c) and d).
58. According to the State Constitution of Hawaii, beaches in Hawaii belong to
- the public
 - the state government
 - private landowners
 - the Bishop Estate
 - the Native Hawaiians.
59. The major long-term cause of coastal erosion is
- failure of politicians to plan ahead.
 - sea level rise.
 - beach loss.
 - building of sea walls and groins.
 - continental drift.
60. The most valuable mineral material recovered from the seafloor today is
- gold and silver.
 - manganese nodules.
 - oil and gas.
 - sand and gravel.
 - phosphorites for fertilizer.

PART 3: Short Essay (15 points). Answer the following three questions entirely within the space provided. Think your answer through before starting to write. Write legibly--print if your handwriting is poor, because if the grader can't read it, it will be marked wrong.

1. List five kinds of observations used for way-finding by ancient Polynesian navigators (5 points)

2. Name the three types of convergent plate boundary. Give a (geographic) example of each. (6 points)

3. What is the difference between coastal (land) erosion and beach erosion? (4 points)