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OCEANOGRAPHY 201

Fall, 2003

Exam #1: Section #2

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. Volatile elements are those that tend to form solids, even at relatively high 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 Earth and only one on Venus.
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 massive enough to retain all of its constituent chemical elements.
13. Free oxygen was abundant in the Earth's early atmosphere.

14. The lithosphere includes both the crust and part of the upper mantle.
15. Sea level changes have been modest throughout Earth's history, never exceeding more than about 10 m up or down.
16. The oceanic crust is much thinner than the continental crust.
17. The Hawaiian Islands are an example of island arc volcanism.
18. Worldwide, sea level is rising 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. Occam's Razor, or the Law of Parsimony, states that
 - a) For a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.
 - b) If things can go wrong, they will.
 - c) If two or more alternative hypotheses explain a set of observations equally well, the simplest hypothesis is to be preferred.
 - d) Stars in the night sky as seen from Earth appear to rotate around Polaris, the North Star.
 - e) None 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 is mainly composed of
 - a) hydrogen
 - b) helium
 - c) carbon
 - d) iron
 - e) calcium carbonate.
24. Processes that caused large-scale chemical differentiation of the Earth include
 - a) a supernova explosion in a distant galaxy.
 - b) bombardment by cosmic rays originating from an unknown source.
 - c) separation of volatile elements and compounds from refractory elements and compounds.
 - d) separation of dense materials from less dense materials by gravity stratification.
 - e) both c) and d).

25. The Earth is relatively rich in the volatile elements H, C, N, and O because
- They were enriched in the inner part of the Solar nebula.
 - They were held by the cold planetesimals as ices.
 - They have outgassed extensively from Earth's interior.
 - The Earth accreted rapidly, gaining nearly its present mass at the same time that it heated up.
 - both b and d.
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. Which of the following theories for origin of Earth's Moon cannot be dismissed on dynamical or chemical grounds?
- gravitational capture of a large planetesimal.
 - fission due to rapid rotation.
 - impact by a large planetesimal, about the size of Mars, which blasted off material that then coalesced to form the Moon.
 - formation in the same manner as Earth, by accretion.
 - condensation from the Solar nebula.
28. The Earth's oceans and atmosphere are considered to be secondary in origin. This means that
- they formed directly by condensation from the Solar nebula.
 - they formed by outgassing of the Earth's interior.
 - they formed by reaction between an earlier atmosphere and crustal rocks.
 - they formed by the interaction of living things with their environment.
 - all of the above.
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. Most of the CO₂ ever outgassed on Earth can be found in:
- seawater
 - the atmosphere
 - rocks
 - living plants and animals
 - none of the above.

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. 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.
33. 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.
34. Which of the following statements is true?
- On Earth, H_2O is in the oceans, CO_2 is in rocks, and N_2 and O_2 are 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. Earth, from the center outward, is composed of the following concentric layers:
- inner core, outer core, mantle, crust
 - inner core, outer core, mesosphere, lithosphere
 - core, mantle, asthenosphere, crust
 - core, mantle, continental crust, oceanic crust
 - 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 ocean water.
 - 25% of the continental crust presently lies below sea level.

37. According to the Geodynamo theory, the Earth's magnetic field originates from
- a bar magnet at the center of the Earth.
 - the Solar wind.
 - cosmic rays bombarding the upper atmosphere.
 - convection currents within the Earth's outer, liquid iron core.
 - outgassing of the planet and formation of the core.
38. We have "dry land" on our planet because of the following physical characteristic or process on Earth:
- The age of the seafloor is much younger than the age of the land.
 - As the age of the ocean increases, the seafloor deepens.
 - Erosional processes on the continents cause the continents to be lighter than the ocean floor.
 - Water carried down into subduction zones causes wet melting of the overlying mantle, creating andesitic volcanic rocks which are lighter than basaltic rocks produced by dry melting of the mantle.
 - Carbon dioxide in the atmosphere is forced into continental rocks creating air pockets which make the continental crust lighter.
39. The major cause of the largest changes in sea level known from the geologic record is
- change in the rate of seafloor spreading, which produces a change in the volume of the ocean basins.
 - change in the volume of ice stored on land.
 - local, tectonically induced vertical motions of the crust.
 - change in the temperature of ocean water.
 - storm surges.
40. Continental margins in the Atlantic Ocean are typically described in the following order:
- shelf, slope, marginal basin, trench.
 - shelf, slope, marginal basin, volcanic island arc, trench.
 - shelf, slope, rise, trench.
 - shelf, slope, rise, abyssal plain.
 - shelf, slope, rise, volcanic island arc.
41. Atlantic-type continental margins are considered to be aseismic, or passive, because
- they lack earthquakes.
 - they lie along a plate boundary.
 - they lie far from a plate boundary.
 - both a) and c).
 - 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
- animals had crossed from Africa to South America via land bridges.
 - the Earth's magnetic poles had apparently wandered through time, but the paths inferred were different for different continents.
 - the Earth's magnetic field had reversed polarity repeatedly in the past.
 - the Earth was rotating on its axis, which corresponds to the geographic and magnetic poles.
 - all of the above.
43. The continents drift because
- they "plow through" the ocean basins in response to "polflucht".
 - of convection in the Earth's outer core.
 - they ride passively on the lithospheric plates, which are moving relative to one another and the mantle.
 - the Earth's magnetic field reverses its polarity.
 - all of the above.
44. A major prediction of the seafloor spreading hypothesis that was made and tested is
- that there are magnetic stripes on the ocean floor.
 - that it could cause sea level change.
 - that the age of the seafloor increases with distance from the ridge on either side.
 - that the Earth's magnetic field originates by convection in the outer core.
 - that the Earth's magnetic field reverses its polarity.
45. The theory of plate tectonics
- is a unifying theory for the Earth sciences.
 - holds that the Earth's surface consists of a dozen or so rigid plates.
 - holds that most mountain-building occurs along plate boundaries.
 - holds that the lithospheric plates ride on the asthenosphere.
 - all of the above.
46. Which of the following is a "rule" of plate tectonics?
- Oceanic crust is too thick and buoyant to be subducted.
 - The volcanic arc always forms on the upper surface of the subducting plate.
 - When continents collide with one another they tend to "stick".
 - The major process driving the plates is convection in the Earth's outer core.
 - All of the above.
47. The three major types of plate boundaries are
- conservative, transform, slipslide
 - continental-continental, oceanic-oceanic, continental-oceanic
 - divergent, convergent, conservative
 - constructive, destructive, conservative
 - both c) and d).

48. Which of the following terms consistently describe a subduction zone?
- 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
- abyssal plains, abyssal hills, and continental margins.
 - Hawaii, Iceland, and the Andes.
 - mid-ocean ridges, subduction zones, and hotspots.
 - convergent, divergent, and conservative plate boundaries.
 - Indonesia, Japan, and eastern Australia.
55. Regarding its origin, most sediment in the oceans, by volume, including the continental margins, is
- terrigenous.
 - biogenic.
 - volcanogenic.
 - cosmogenic.
 - none of the above.
56. Sediment in the deep sea, far from continents, is composed of three main components:
- biogenic, authigenic, and hydrogenous.
 - terrigenous, biogenic, and pelagic.
 - forams, radiolaria, and diatoms.
 - calcareous ooze, abyssal clay, and siliceous ooze.
 - pelagic, hemipelagic, and neritic.
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 state government
 - the public
 - 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.

