

Last Name _____ First Name _____

Student ID# _____

OCEANOGRAPHY 201

Spring, 2005

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

1. In science complex theories are preferred over simple ones.
2. An informal rule in science is that extraordinary hypotheses require extraordinary evidence.
3. Latitude can be told from the declination of the Pole Star, whereas longitude requires an accurate clock.
4. Earth is believed to have originated by accretion from planetesimals.
5. The age of the Earth is indistinguishable from that of the Moon and meteorites: about 4.5 billion years.
6. An hypsometric curve shows two levels on Earth, implying two kinds of crust, and only one on Venus.
7. Free oxygen has always been an important component of the Earth's atmosphere.
8. Oceans of liquid water are common in our Solar System.
9. The oldest rocks from the seafloor are much older than the oldest rocks from the continents.
10. Sea level changes have been modest throughout Earth's history, never exceeding more than about 10 m up or down.
11. Because seismic s-waves do not travel through liquids, the s-wave shadow zone indicates that at least part of the Earth's core is molten.
12. The lithosphere is rigid and brittle, whereas the asthenosphere is plastic and ductile.
13. The lithosphere includes both the crust and part of the upper mantle.

14. Hotspots can occur both at plate boundaries and in the middle of plates, and both in the oceans and on the continents.
15. The Earth's mantle is entirely molten.
16. The Hawaiian Islands are an example of island arc volcanism.
17. On the island of Oahu, sea level is falling at present.
18. Seawalls are usually effective in preventing beach erosion.
19. Beaches are normally very stable in shape and width unless disturbed by human activities.
20. The deep sea is a promising place to explore for oil and gas.

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

21. The scientific method involves
 - a) making observations
 - b) asking questions
 - c) formulating hypotheses
 - d) making and testing predictions
 - e) all of the above.
22. The ancient Polynesians navigated using
 - a) a home-centered reference system
 - b) the rising and setting of stars
 - c) the direction of swells
 - d) homing birds
 - e) all of the above.
23. Four elements make up 93% of Earth's mass. They are
 - a) iron, oxygen, silicon, and magnesium.
 - b) iron, oxygen, magnesium, and hydrogen.
 - c) hydrogen, helium, nitrogen, and oxygen.
 - d) iron, nickel, calcium, and aluminum.
 - e) oxygen, nitrogen, carbon dioxide, and water vapor.
24. Which of the following processes characterizes the interior of the Sun?
 - a) infall of iron under the influence of gravity.
 - b) outgassing of volatile elements and compounds.
 - c) reaction of a rocky mantle with an iron core.
 - d) a runaway greenhouse effect.
 - e) nuclear fusion of two hydrogen atoms to form helium
25. The process of large-scale chemical differentiation of the Earth has produced
 - a) the Earth's core.
 - b) continental and oceanic crust.
 - c) the oceans.
 - d) the atmosphere.
 - e) all of the above.

26. Which of the following theories for origin of Earth's Moon *cannot* be dismissed on dynamical or chemical grounds?
- a) gravitational capture of a large planetesimal.
 - b) fission due to rapid rotation.
 - c) impact by a large planetesimal, about the size of Mars, which blasted off material that then coalesced to form the Moon.
 - d) formation in the same manner as Earth, by accretion.
 - e) condensation from the Solar nebula.
27. The Earth's oceans and atmosphere are considered to be secondary in origin. This means that
- a) they formed directly by condensation from the Solar nebula.
 - b) they formed by outgassing of the Earth's interior.
 - c) they formed by reaction between an earlier atmosphere and crustal rocks.
 - d) they formed by the interaction of living things with their environment.
 - e) all of the above.
28. The Earth would probably have no continents if it did not have
- a) life
 - b) an atmosphere
 - c) oceans and subduction
 - d) both a and b
 - e) all of the above
29. Free oxygen in the Earth's atmosphere has been produced mainly by
- a) photodissociation of water and loss of hydrogen to outer space.
 - b) change in sea level.
 - c) formation of the Earth's core.
 - d) photosynthesis and burial of organic carbon.
 - e) nucleosynthesis in stars.
30. A "runaway greenhouse" refers to
- a) what happened on Mars.
 - b) what happened on Venus.
 - c) a process involving a positive feedback between the amount of carbon dioxide in a planetary atmosphere and the temperature of that atmosphere.
 - d) both b) and c)
 - e) all of the above.
31. Most of the CO₂ ever outgassed on Earth can be found in:
- a) seawater
 - b) the atmosphere
 - c) rocks
 - d) living plants and animals
 - e) none of the above.

32. Sea level can change as a result of
- 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.
 - all of the above.
33. A record of Earth's history going back nearly 4 billion years can be found
- in deep-sea sediments
 - in the ocean basins
 - on the continents
 - in subduction zones
 - all of the above.
34. The simplified 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.
35. 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.
36. 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.
37. Evidence that the Earth has two kinds of crust comes from
- seismology.
 - the hypsometric curve that plots Earth surface area against its elevation.
 - the Moon.
 - both a) and b).
 - all of the above.

38. The principal of isostasy states that
- a) the Earth's surface is dominated by two levels: the continents and the oceans.
 - b) the lithosphere is in gravitational equilibrium through a buoyancy mechanism, with compensation occurring in the asthenosphere.
 - c) crust is produced by differentiation from the mantle, by upwelling and solidification of molten rock.
 - d) if the Earth were perfectly smooth, it would be covered by nearly 3000 m of ocean water.
 - e) 25% of the continental crust presently lies below sea level.
39. 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.
40. 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.
41. Which of the following statements correctly describes crustal formation?
- a) Continental crust is created by wet melting of the mantle in subduction zones to produce andesite, whereas oceanic crust is formed by dry melting at mid-ocean ridges to form basalt.
 - b) Continental crust is created by erosion in mountain belts, whereas oceanic crust is created from deep-sea sediments.
 - c) Continental crust is formed above sea level, whereas oceanic crust is formed below the carbonate compensation depth.
 - d) Continental crust is formed on cratons, whereas oceanic crust is formed in mobile belts
 - e) None of the above.
42. 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.

43. Continental drift theory 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.
44. 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.
45. 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 Bolivia.
46. Which of the following represents the extraordinary evidence that convinced geologists that the outrageous hypothesis of seafloor spreading was correct?
- the elevated topography of mid-ocean ridges.
 - absence of sediment along the mid-ocean ridge axis.
 - evidence for earthquakes and volcanism along the mid-ocean ridge axis.
 - magnetic stripes on the seafloor that were symmetrical on either side of the mid-ocean ridge axis and which could be correlated globally.
 - a valley along the mid-ocean ridge axis, formed by normal faulting and extension.
47. 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.
48. 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.

49. 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).
50. Which of the following terms consistently describe a mid-ocean ridge?
- shallow earthquakes, basaltic volcanism, young crust, sediment absent to thin
 - shallow earthquakes, andesitic volcanism, young crust, thick sediment
 - shallow to deep earthquakes, andesitic volcanism, older crust, thick sediment
 - shallow to deep earthquakes, basaltic volcanism, older crust, thin sediment
 - no earthquakes, no volcanism, older crust, thick sediment
51. 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.
52. Continent-continent collisions
- result when the ocean basin between them is consumed by subduction.
 - cause the crust to thicken locally, as continental crust is too thick and buoyant to subduct.
 - cause the subducting lithospheric slab to break off, after which it continues to descend on its own.
 - can cause a reorganization of plate motions.
 - all of the above.
53. The main theory that explains hotspots is
- the shrinking Earth
 - seafloor spreading
 - continental drift
 - plate tectonics
 - mantle plumes.
54. The Hawaiian-Emperor seamount chain is an example of
- a fracture zone
 - a hot-spot trace
 - a mid-ocean ridge
 - a volcanic arc
 - a subduction zone.
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 carbonate compensation depth, or CCD, is
- a) the depth at which calcium carbonate dissolves in the oceans.
 - b) the depth at which calcium carbonate sediment is replaced by siliceous ooze.
 - c) 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.
 - d) the depth above which calcium carbonate can accumulate, and below which it cannot.
 - e) both c) and d).
57. Longshore drift is
- a) a special case of continental drift theory.
 - b) a current that can carry swimmers offshore.
 - c) a process that results in formation of a delta.
 - d) a process that transports sand and other sediment along the coast.
 - e) movement of sand by tidal action.
58. The major long-term cause of coastal erosion is
- a) failure of politicians to plan ahead.
 - b) sea level rise.
 - c) beach loss.
 - d) building of sea walls and groins.
 - e) continental drift.
59. According to the State Constitution of Hawaii, beaches in Hawaii belong to
- a) the state government.
 - b) the people of Hawaii.
 - c) private landowners.
 - d) the Bishop Estate.
 - e) the Native Hawaiians.
60. The most valuable mineral material recovered from the seafloor today is
- a) gold and silver.
 - b) manganese nodules.
 - c) oil and gas.
 - d) sand and gravel.
 - e) phosphorites for fertilizer.

PART 3: Short-Answer Essay Questions (total of 15 points).
Please write your answers in the space provided below each question.

61. Describe the “tape recorder” model and how it confirmed the hypothesis of seafloor spreading by answering the following questions (**10 points**):

a) What was measured?

b) What global Earth process generated the pattern in the first place?

c) What two unusual properties did the pattern possess?

d) Why did Earth scientists find this evidence so convincing?

e) What major prediction was made by the seafloor spreading hypothesis that was subsequently tested and found to be true?

62. Explain how seawalls cause beach loss. (**5 points**)