

Name (print, last name first): \_\_\_\_\_

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## OCEANOGRAPHY 201

Fall, 1997

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 = 25 points). Mark (a) for "true" and (b) for "false".**

1. Whereas science may seem to be a search for truth, in practice it is actually a search for error.
2. Beaches are normally very stable in shape and width unless disturbed by human activities.
3. Venus has a similar outgassing history to Earth, and similar surface conditions.
4. The Earth is 4.5 million years old.
5. Free oxygen has always been an important component of the Earth's atmosphere.
6. The amount of land exposed above sea level has remained about the same for the last 600 million years.
7. Latitude can be told from the declination of the Pole Star, whereas longitude requires an accurate clock.
8. Magellan's expedition was the first to circumnavigate the Earth.
9. The oldest rocks from the seafloor are much older than the oldest rocks from the continents.

10. Seismic S-waves do not travel through liquids and this indicates that at least part of the Earth's core is molten.
11. The continental crust is much thicker than the oceanic crust.
12. Continental crust is too buoyant to be subducted.
13. The Hawaiian Islands are an example of island arc volcanism.
14. On the island of Oahu, sea level is falling at present.
15. Earth contains elements that were formed in a supernova explosion.
16. The four inner planets are relatively richer in volatile elements and compounds than are the four outer gas-giant planets.
17. The Earth is believed to have originated by accretion from planetesimals.
18. Earth's crust originated by solidification of molten rock that rose up from the mantle.
19. Earth is massive enough to retain all of its constituent chemical elements.
20. The Pacific Ocean has the highest rate of input of terrigenous sediment of any of today's oceans.
21. The seafloor-spreading hypothesis was supported by the Deep Sea Drilling Project, which determined that the age of the oceanic crust increases with distance from the ridge axis.
22. Hotspots can occur both at plate boundaries and in the middle of plates, and both in the oceans and on the continents.
23. Most seamounts are extinct volcanoes.
24. The greatest volume of sediment in the oceans is found in the deep sea, far from the continents.
25. The deep sea is a promising place to explore for oil and gas.

**PART 2: Multiple Choice (1 point each = 35 points).**

The scientific method involves

- a) making observations
- b) asking questions
- c) formulating hypotheses
- d) making predictions
- e) all of the above.

Which of the following statements is true?

- a) Magnetic North is always the same as True North.
- b) True North is always the same as Geographic North.
- c) Magnetic North is always the same as Geographic North.
- d) The Earth's magnetic field is constant and unchanging.
- e) None of the above.

If the Sun is overhead one hour later than at some fixed point to the east of you, how many degrees are you to the west of this position?

- a) 5°
- b) 15°
- c) 20°
- d) 25°
- e) 30°

The leading theory for the origin of Earth's Moon is

- 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 spun off the Moon.
- d) formation in the same manner as Earth, by accretion.
- e) condensation from the Solar nebula.

Earth's core is composed of

- a) solid Fe and Ni
- b) liquid Fe and Ni
- c) silicate rock that flows plastically
- d) basalt
- e) both a and b

The Earth's oceans have originated by

- a) impacts of comets from outer space
- b) outgassing of the Earth's interior
- c) condensation from the Solar nebula
- d) fusion of hydrogen
- e) reaction with surface rocks

The oceanic crust is composed mainly of

- a) deep-sea ooze
- b) andesite
- c) basalt
- d) granite
- e) calcite

The Earth, from the center outward, is composed of the following concentric layers:

- a) inner core, outer core, mantle, crust
- b) inner core, outer core, mesosphere, lithosphere
- c) core, mantle, asthenosphere, crust
- d) core, mantle, continental crust, oceanic crust
- e) none of the above.

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

Isostatic compensation occurs within

- a) the continental crust
- b) the oceanic crust
- c) the lithosphere
- d) the asthenosphere
- e) the liquid outer core

An Atlantic-type continental margin consists, from land to sea, of

- a) shelf, slope, rise, trench
- b) shelf, slope, rise
- c) shelf, slope, trench
- d) shelf, slope, marginal basin, abyssal plain
- e) either b or c

From a structural standpoint, the continents consist of

- a) lithosphere and asthenosphere
- b) cratons and mobile belts
- c) volcanic arcs and subduction zones
- d) andesite and basalt
- e) all of the above

Evidence supporting the theory of continental drift includes

- a) the fit of continental margins on opposite sides of the Atlantic Ocean
- b) the presence of compressional mountain belts mainly along continental margins
- c) the distribution of fossil organisms
- d) the distribution of paleoclimatic indicators such as glacial tills and coal
- e) all of the above

Which of the following evidence supports the hypothesis of seafloor spreading?

- a) elevated topography of mid-ocean ridges
- b) a valley at the mid-ocean ridge axis, formed by normal faulting
- c) absence of sediment along the mid-ocean ridge axis
- d) a and b only
- e) a, b, and c

A major prediction of the seafloor spreading hypothesis was

- a) the magnetic stripes on the ocean floor
- b) that it could cause sea level change
- c) that the age of the seafloor would increase with distance from the ridge
- d) that the Earth's magnetic field originates by convection in the outer core
- e) that the Earth's magnetic field reverses its polarity

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

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).

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

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

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

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

Plate tectonics has important implications for

- a) global patterns of ocean circulation
- b) global sea level
- c) global climate
- d) distribution of living and fossil organisms
- e) all of the above

The main theory that explains hotspots is

- a) the shrinking Earth
- b) seafloor spreading
- c) continental drift
- d) plate tectonics
- e) mantle plumes

The Hawaiian-Emperor seamount chain is an example of

- a) an aseismic ridge
- b) a hot-spot trace
- c) a mid-ocean ridge
- d) a volcanic arc
- e) a subduction zone

Atolls are

- a) formed by coral reefs built on a submarine volcano
- b) ring-shaped islands of coral reefs and reef-derived sediment
- c) submerged seamounts with flat tops, cut off by wave action
- d) both a and b
- e) a, b, and c

Guyots are

- a) formed by coral reefs built on a submarine volcano
- b) ring-shaped islands of coral reefs and reef-derived sediment
- c) submerged seamounts with flat tops, cut off by wave action
- d) both a and b
- e) a, b, and c

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

The Sun is mainly composed of

- a) hydrogen
- b) helium
- c) carbon
- d) iron
- e) calcium carbonate.

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.

\*The most abundant element on Earth is

- a) hydrogen
- b) oxygen
- c) water
- d) iron
- e) silicon.

\*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.

The 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.

Unlike the other planets, the Earth has oceans of liquid water. This is because

- a) Earth was bombarded by water-rich comets early in its history.
- b) Earth inherited a primitive, water-rich atmosphere from the Solar nebula, which condensed into oceans as the Earth's surface cooled.
- c) Earth formed rapidly from cold, water-rich planetesimals, and this water subsequently outgassed from Earth's interior.
- d) Earth is the proper distance from the Sun, such that water can exist in the liquid state.
- e) both c) and d).

The Earth has dry land because

- a) there is not enough water to cover the surface completely.
- b) all planets have dry land.
- c) 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.

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.

Evidence that the Earth has two kinds of crust comes from

- a) seismology.
- b) the hypsometric curve.
- c) the Moon.
- d) both a) and b).
- e) all of the above.

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.

Continental drift theory 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 poles had apparently wandered through time, but the paths inferred were different for different continents.
- c) the Earth's magnetic field had reversed polarity repeatedly in the past.
- d) the Earth was rotating on its axis, which corresponds to the geographic and magnetic poles.
- e) all of the above.

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.

Which of the following supports the hypothesis of seafloor spreading?

- a) the elevated topography of mid-ocean ridges.
- b) absent of sediment along the mid-ocean ridge axis.
- c) evidence for earthquakes and volcanism along the mid-ocean ridge axis.
- d) a valley along the mid-ocean ridge axis, formed by normal faulting and extension.
- e) all of the above.

Which of the following is an example of an active subduction zone?

- a) Mid-Atlantic Ridge.
- b) East Pacific Rise.
- c) San Andreas Fault.
- d) Tibetan Plateau and Himalayan Mountains.
- e) Peru-Chile Trench.

### 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.

\*Regarding its origin, most sediment in the oceans, including the continental margins, is

- a) terrigenous.
- b) biogenic.
- c) volcanogenic.
- d) cosmogenic.
- e) none of the above.

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).

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 involving both waves and currents, that transports sand and other sediment along the coast.
- e) movement of sand by tidal action.

According to the State Constitution of Hawaii, beaches in Hawaii belong to

- a) the state government
- b) the public
- c) private landowners
- d) the Bishop Estate
- e) the Native Hawaiians.

**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.

61. List the four major causes of sea level change. (4 points)

62. Draw a cross-section of a subduction zone and label the following features: lithosphere, asthenosphere, crust, trench, volcanic arc. (5 points)

63. Name the three types of convergent plate boundary. Give an example of each. (6 points)