Last Name_____First Name_____

Student ID#_____

OCEANOGRAPHY 201
Fall, 2001
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 1: True/False (1 point each = 20 points). Mark (a) for "true" and (b) for "false".

1. Scientific hypotheses are never proved untrue.

2. Outrageous hypotheses require extraordinary evidence.

3. Whereas science may seem to be a search for truth, in practice it is actually a search for error.

4. Latitude can be told from the declination of the Pole Star, whereas longitude requires an accurate clock.

5. Elements heavier than iron are produced only during the explosion of stars in supernovae.

6. Earth is believed to have originated by accretion from planetesimals.

7. The crusts of Venus and Earth are similar.

8. The atmospheres of Earth and its nearest neighbors, Venus and Mars, are similar.

9. The age of the Earth is indistinguishable from that of the Moon and meteorites: about 4.5 billion years.

10. The oldest rocks from the seafloor are much older than the oldest rocks from the continents.

11. The amount of land exposed above sea level has remained about the same for the last 600 million years.

12. 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.

13. Earth is massive enough to retain all of its constituent chemical elements.

14. The lithosphere includes both the crust and part of the upper mantle.

15. Most rivers in North America empty into the Pacific Ocean.

16. The Hawaiian Islands are an example of island arc volcanism.

17. Convection currents in the mantle are the ultimate cause of plate tectonics.

18. Seawalls are usually effective in preventing beach erosion.

19. The deep sea is a promising place to explore for oil and gas.

20. The lithosphere is rigid and brittle, whereas the asthenosphere is plastic and ductile.

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. Red-shifting of light from stars occurs because they are
a) hot b) made up of hydrogen c) moving away from us
d) moving toward us e) none of the above

23. Which of the following statements is true?
a) Magnetic North is always the same as True North.
b) True North is the same as Geographic North: the northern location where Earth's rotational axis intersects the surface of the Earth.
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.

24. 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°

25. The Earth is relatively rich in the volatile elements H, C, N, and O because
a) they were enriched in the inner part of the Solar nebula.
b) they were held by the cold planetesimals as ices.
c) they have outgassed extensively from Earth's interior.
d) the Earth accreted rapidly, gaining nearly its present mass at the same time that it heated up.
e) both b and d.

26. 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.

27. 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.

28. Unlike the other planets, the Earth has oceans of liquid water. This is because
a) Earth formed originally from a water-rich comet.
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).

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 followed by burial of some of the organic carbon produced.
e) nucleosynthesis in stars.

30. A record of Earth’s history going back nearly 4 billion years can be found
a) in deep-sea sediments b) in the ocean basins c) on the continents
d) in subduction zones e) all of the above

31. 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 Bolivia.

32. 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.

33. Evidence supporting Alfred Wegener's 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.

34. 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.

35. Which of the following supports the hypothesis of seafloor spreading?
a) the elevated topography of mid-ocean ridges.
b) absence 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.

36. 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 thermal expansion.
e) none of the above.

37. 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 increases 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.

38. 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.

39. 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).

40. Which of the following terms consistently describe one type of plate boundary?
a) convergent, constructive, mid-ocean ridge.
b) divergent, constructive, subduction zone.
c) divergent, conservative, transform fault.
d) convergent, conservative, mid-ocean ridge.
e) convergent, destructive, subduction zone.

41. 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

42. Which of the following is a “rule” of plate tectonics?
a) Oceanic 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) All of the above.

43. 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.

44. 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.

45. The Hawaiian-Emperor seamount chain is an example of
a) a fracture zone b) a hot-spot trace c) a mid-ocean ridge
d) a volcanic arc e) a subduction zone.

46. 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.

47. Which of the following statements about hot spots 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.

48. 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 and the Andes Mountains.

49. 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.

50. Most of the sediment in the oceans, by volume, is deposited
a) by organisms that have calcareous skeletons.
b) by organisms that have siliceous skeletons.
c) in the deep-sea trenches.
d) along the margins of the continents.
e) by andesitic volcanoes.

51. Which of the following statements are true?
a) Most terrigenous sediment in the deep sea gets there by turbidity currents.
b) Most sediment in the deep sea is cosmogenic in origin.
c) Turbidity currents are essentially deep-sea avalanches.
d) Both a) and c). e) All of the above.

52. 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).

53. The simplified reaction $CO_2 + H_20 = CH_20 + 0_2$ represents:
a) photodissociation b) chemical weathering c) photosynthesis
d) none of the above e) all of the above

54. The simplified reaction $H_20 + CO_2 + CaSiO_3 = CaCO_3 + SiO_2 + H_2O$ represents
a) weathering of silicate rocks by rain water and removal of CO2 from the atmosphere into rocks.
b) photosynthesis followed by burial of some of the organic material produced.
c) the reaction by which the Earth's core formed.
d) The reaction that generates energy within the Sun and similar stars.
e) the formation of evaporite deposits that can form salt domes and trap oil and gas.

55. The process of large-scale chemical differentiation has produced
a) the Earth's core b) continental and oceanic crust c) the oceans
d) the atmosphere e) all of the above

56. The *major* cause of the *largest* worldwide changes in sea level known in the geologic record is
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) storm surges.

57. From outside to inside, the Earth consists of
a) rocky crust, brittle lithosphere, plastic asthenosphere, solid metal outer core, liquid metal inner core.
b) rocky crust, rocky mantle, liquid metal outer core, solid metal inner core.
c) rocky crust, liquid mantle, plastic asthenosphere, solid outer core, solid inner core.
d) rocky crust, liquid asthenosphere, plastic mantle, liquid outer core, solid inner core.
e) none of the above.

58. 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.

59. 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.

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 below each question.

61. **(6 points)** Draw a cross-section of a subduction zone with an oceanic-continental boundary. Include the following features in your diagram:
a) Wadati-Benioff Zone b) trench c) oceanic and continental crust
d) volcanoes e) lithosphere and asthenosphere f) direction of plate motions

62. **(4 points)** List four kinds of observations used for way-finding by ancient Polynesian navigators.

63. **(5 points)** Draw a line connecting each feature with its classification:

Feature:	**Classification:**
East Pacific Rise	Seafloor spreading axis
Ninety-East Ridge	Hot-spot trace (plume tail?)
Ontong-Java Plateau	Large igneous province (plume head?)
Yellowstone	Hot spot
San Andreas Fault	Transform plate boundary