This midterm consists of four parts: multiple choice, Definition, Short Answer, and Quantitative. Calculators are permitted, but no other electronic devices. Please leave all bags at the front of the room. You will have until 10:40 am to complete this exam.

Please answer all questions on the page provided, including your name as well as the name of your TA on each page.

For the definitions, please choose any 5 of the words provided, and fill in your definitions (using sketches if desired) in the space provided.

Cheating will not be tolerated. Please sign your name under the statement below:

I understand that cheating on this midterm (including but not limited to, copying from others’ work or referring to pre-prepared notes during the exam) is not acceptable and will be subject to disciplinary action. I understand that I may fail the midterm, and that anyone I knowingly let cheat from my exam may also fail the midterm.

Signed

Printed
Multiple choice. Circle the one best answer for each question. 2 points each.

1. An isotope of an element is defined as an element with an identical number of protons as the parent element but
   A. None of the choices are correct.
   B. a different number of tachyons.
   C. a different number of electrons.
   D. a different number of neutrons.
   E. a different number of orbitals.

2. If a radioactive isotope has a half life of ten years, then how much radioactivity exists after ten years?
   A. 0%
   B. 100%
   C. 50%
   D. 25%
   E. 10%

3. The Principal of Constant Proportions states that
   A. the salinity of the ocean is constant.
   B. the concentration of dissolved elements in the ocean is constant.
   C. all dissolved elements in the ocean have the same concentration.
   D. the relative proportions of major dissolved elements is constant.
   E. the relative proportions of minor dissolved elements is constant.

4. If oceanic crust makes up slightly more than 50% of the Earth's crust, how is it that 70% of Earth's surface is covered by ocean?
   A. one measurement is based on weight while the other is based on area
   B. the world ocean covers the edges of the continents
   C. scientists are uncertain why this happens
   D. there is an error in the measurements
   E. the ocean coverage includes lakes

5. The long-term average of environmental conditions on our planet is called
   A. weather.
   B. decadal scales.
   C. millennial scales.
   D. climate.
   E. Ice Ages.
6. How did sonar lend support to the ideas of continental drift and plate tectonics?
   A. it provided direct evidence of sea-floor spreading
   B. it revealed that mid-ocean ridges exhibited the greatest heat flow through the crust
   C. it revealed vast undersea mountain ranges in the middle of ocean basins
   D. it demonstrated a thinning of sediments from continental margins to mid-ocean ridges
   E. it led to the discovery of the deepest location in the ocean, the Mariana Trench

7. Approximately ________ % of Earth's surface area is covered by world ocean.
   A. 70.8
   B. 96.4
   C. 33.3
   D. 64.8
   E. 50.5

8. Oceanic crust is largely composed of ____ while continental crust is composed of ____.
   A. basalt; serpentine
   B. granite; basalt
   C. granite; serpentine
   D. basalt; granite
   E. serpentine; basalt

9. Some of the first evidence that Earth's interior was not homogeneous came from
   A. studies of the sea floor.
   B. studies of earthquakes.
   C. studies of mountains.
   D. studies of tsunami.
   E. studies of volcanoes.

10. What data supports the possibility of comets as a source of Earth's water?
    A. Both the observation that twenty or so 20-40 ton comets impact Earth's upper atmosphere every minute and the calculation that over billions of years, a sufficient number of comets could account for the volume of Earth's water.
    B. the lack of any other possible source of Earth's water
    C. the deuterium (D) to hydrogen (H) ratio of comets is similar to the D/H ratio of Earth's water

11. A stable isotope is
    A. a radioactive isotope with a long half-life.
    B. a non-radioactive isotope of an element.
    C. an isotope that emits a constant amount of radioactivity.
    D. an isotope that can be reliably used to determine the age of rocks.
    E. All of the choices are correct.
12. The age of oceanic crust gets progressively _____ from oceanic ridges to the continental margins.
   A. younger  
   B. older  

13. Where do you expect to find a greater accumulation of biogenous sediments?
   A. central gyres with low productivity  
   B. coastal waters that are highly productive  
   C. Both coastal waters that are highly productive and highly productive equatorial waters are correct.  
   D. coastal waters with low productivity  
   E. highly productive equatorial waters  

14. The deepest known location in the world ocean is
   A. Puerto Rico Trench.  
   B. Deep Muddy.  
   C. Monterey Bay Submarine Canyon.  
   D. Mariana Trench.  
   E. Java Trench.  

15. Where can the youngest oceanic crust be found?
   A. there is no pattern to its age  
   B. midway between oceanic ridges and continental margins  
   C. at the very edge of the continents  
   D. at oceanic ridges  
   E. deep within subduction zones  

16. Early evidence for continental drift came from
   A. identical fossil species on different continents.  
   B. All of the choices are correct.  
   C. matching rock strata on opposite sides of ocean basins.  
   D. the changing distribution of fossil plants and animals through time.  
   E. the "puzzle-piece" fit on the continents.  

17. The numerous volcanoes that surround the Pacific basin have earned the nickname
   A. the Peaks o' Plenty.  
   B. Hell's Kitchen.  
   C. the Ring of Fire.  
   D. the Circle of Smoke.  
   E. the Mountains of Fire.
18. The age of Earth's formation, based on radioisotopes in meteorites, is taken to be
A. 4.56 million years ago.
B. 10.56 billion years ago.
C. 10.56 million years ago.
D. None of the choices are correct.
E. 4.56 billion years ago.

19. The plastic and deforming portion of the upper mantle is called the
A. lithosphere.
B. mesosphere.
C. asthenosphere.
D. xenosphere.
E. cryosphere.

20. Deposits of diatoms may be classified as
A. hydrogenous oozes.
B. calcareous oozes.
C. siliceous oozes.
D. metalliferous oozes.
E. cellulose oozes.

21. How does sediment thickness provide evidence for or against seafloor spreading?
A. seafloor spreading predicts that thicker sediments will cause the seafloor to spread more rapidly
B. seafloor spreading predicts that sediment thickness should be uniform across the entire ocean basin
C. seafloor spreading predicts that the thickest sediments should be near mid-ocean ridges
D. seafloor spreading predicts that sediments should be thickest on the oldest parts of the seafloor farthest away from mid-ocean ridges
E. seafloor spreading has no bearing on sediment thickness

22. The formation of Earth's atmosphere and ocean possibly occurred through
A. outgassing.
B. ingassing.
C. differentiation.
D. accretion.
E. evaporation.

23. The Hawaiian Islands are thought to have originated from
A. deep subduction.
B. bubbles of magma rising from the mantle.
C. movement of the Pacific plate over a hotspot.
D. seafloor rifting.
E. a swell or superswell.
24. Accumulations of sediments at the base of the continental slope create the
A. abyssal plain.
B. continental slope.
C. continental shelf.
D. continental breakfast.
E. continental rise.

25. The deepest locations of the world ocean are associated with
A. hot spots.
B. mid-ocean ridges.
C. submarine trenches.
D. submarine canyons.
E. submarine valleys.

26. The Monterey Bay submarine canyon
A. is among the largest submarine canyons in the world.
B. boasts an impressive diversity of sea life.
C. equals the size of Arizona's Grand Canyon.
D. is more than 300 miles long, seven miles wide and a mile deep.
E. All of the choices are correct.

27. Atlantic-type margins are largely ____ while Pacific-type margins are ______.
A. seismic; aseismic
B. None of the choices are correct.
C. passive; active
D. active; passive
E. tectonic; sedimentary

28. Plate boundaries where two plates are moving away from each other are called
A. transform boundaries.
B. convergent boundaries.
C. conservative boundaries.
D. divergent boundaries.
E. transitional boundaries.

29. The cyclic movement of water between various reservoirs of Earth is known as
A. the carbon cycle.
B. the hydrologic cycle.
C. the rock cycle.
D. the ocean cycle.
E. the rain cycle.
30. Starting from Earth's surface, the three principal layers of Earth consist of
A. crust, core, mantle.
B. mantle, crust, core.
C. core, crust, mantle.
D. core, mantle, crust.
E. crust, mantle, core.

31. The pH of ocean water is
A. slightly alkaline.
B. neutral.
C. highly acidic.
D. highly alkaline.
E. slightly acidic.

32. An imaginary volume of water from surface to depth is commonly called
A. the water box.
B. the water table.
C. the abyss.
D. the deep.
E. the water column.

Part 2: Definitions (10 pts). Choose any 5 of the following 8 words or terms listed on this page and give a brief but complete definition in the space below. Sketches are OK.

Excess volatile

Lithosphere

Transform fault

Hydrogenous sediment

Pycnocline

Lysocline
Part 3. SHORT ANSWERS
(There’s a list of words to use to fill in the short answers on the last page)

(3 pts) The surface winds are affected by the Coriolis Effect. Draw those winds within the hemisphere below. You should have more than one type of wind!

(3 pts) The surface winds lead to a surface ocean circulation pattern in the North Atlantic Ocean. Draw that pattern with an oval, indicating the direction of flow with arrows.
Now answer the following questions that are based upon the previous material. Fill in the blanks (use words from the box on the last page) 2 pts each.

The ocean circulation pattern is called a ________.

Water in the middle of the circulation pattern creates a “hill” due to ________________.

This hill is shifted towards _____________ (name of continent), due to the oceanographic phenomenon called ________________.

The general type of current (not the name of the current) you drew going past the US East Coast is called a(n) ________________ and is ___________________ and deeper than the currents on the eastern side of the basin.

Finally, imagine that you take a boat from the US East Coast to Spain. Draw a profile of the ocean height relative to a constant sea level (so what would the height be compared to if the ocean were perfectly flat?), from North America to Spain. You should include an approximate height scale. In simple terms, explain why the currents are not the same speed, based on your diagram, on the east and west side of the Atlantic. (4 points).
Part 4. A little bit of math (you’re almost done!). 4 points—show your work.

From the Plate Tectonics assignment, you learned that there is a mathematical relationship between seafloor depth (the top of the oceanic crust) and the age of the crust. The relationship is described as:

\[ D = 2500 + 350 \times T^{1/2} \]

Where \( D \) is depth (meters), \( T \) is age in millions of years, and \( \frac{1}{2} \) means you take the square-root. Based on that information, if the oldest crust in the ocean is about 200 million years, how deep would it be?

Extra Credit—2 points each.

Extra Credit #1: If the average depth of the ocean is 3800 m, how old (on average) is the ocean crust?

Extra Credit #2: Explain, in oceanographic terms, why the Santa Ana winds exist.

Extra Credit #3: List four seas that are named for colors—no partial credit given, and the Coral Sea is named for the animal, not the color.
abyssal plain
back-arc basin
backscatter
bathysphere
clay
cobble
continental
Continental slope
Convergent boundary
Coriolis
CTD
Divergent boundary
Eastern boundary current
Ekman transport
Faster
gravity core
Gulf Stream
gyre
halocline
lysocline
mountain
North America
narrower
nutricline
oceanic
pebble
pycnocline
Reynold's flow
rise
rosette of Niskin bottles
sand
shelf
shelf break
silt
slope
slower
Sverdrup
thermocline
trench
turbidity current
Western boundary current
Westward intensification
wider