

mtlin11 and kman1234t's Dynamic Planet Test

Dynamic Planet Division C 2020: Oceanography



KEY

Name(s): _____

School: _____ Team #: _____

Contact kgollam49@gmail.com if you have any questions or corrections.

Score: ____ / 200

Rules and Misc.

1. Turn off all cell phones and smart devices and submit them to the proctor for the duration of the test
2. Each team may bring: one 2 inch binder, and two calculators of any type.
 - a. A binder is measured by the interior of the rings, and all sheets MUST be attached by all three rings of the binder. If the binder is in violation of this, the team may be disqualified, to the proctor's discretion
 - b. No papers may be removed from the binder at any point during this test.
3. This test can be separated at the proctors discretion;
4. ***A bonus point: what is the title of the picture on the front? Write in the space below, under the breakdown. For a secondary point, what is the mountain featured?***
5. Write legibly. Illegible or cryptic answers will be discarded.
6. When time is up, then the time is up.
7. Tiebreakers are identified with a (*) on the exam. They also count towards the overall score.
8. There is no guessing penalty.
9. Moking, inappropriate, and/or nonsensical answers will result in a penalty.
10. Do not worry if you do not finish. The test-maker apologises for any and all wrong answers and bad questions.

GOOD LUCK!

Answer to rule no. 4:

The Great Wave off Kanagawa or The Great Wave or The Wave. Mountain: Mount Fuji.

Multiple Choice Section (35 points)

Some questions have multiple answers. Use your best judgement.

General Knowledge and Oceanography

- What is oceanography?
 - The graphing of oceans
 - A branch of science which studies the physical and biological properties of the oceans.**
 - The study of transport across oceans
 - The worst event in Science Olympiad
- What is a beach?
 - The part of the coast below the low water line, which is constantly submerged
 - a deposition landform in which an island is attached to the mainland by a narrow piece of land
 - Sediment seaward of the coastline through the surf zone**
 - A rocky outcropping detached from the shoreline
- What is coral?
 - A group of anthozoans that exist as individuals or in colonies**
 - A type of rock that is deposited on islands and shipwrecks.
 - A plant that grows in crevices and builds up rings, like a tree
 - a marine mollusk that has an oval flattened body with a shell of overlapping plates.
- What is a guyot?
 - The eroded center of an atoll
 - A flat topped seamount**
 - A tablemount**
 - A seamount which has yet to surface
- What is a neap tide?
 - a tide just after a new or full moon, when there is the greatest difference between high and low water.
 - a tide just after the first or third quarters of the moon when there is least difference between high and low water.**
 - The difference itself between high and low water
 - None of the above
- What are the three main clines?
 - Hadalcline
 - Halocline**
 - Thermocline**
 - Pycnocline**
 - None of the above are one of the main clines.
- What is the correct order, from deepest to shallowest?
 - Bathypelagic, Hadopelagic, Mesopelagic, Epipelagic, Abyssopelagic
 - Abyssopelagic, Hadopelagic, Bathypelagic, Mesopelagic, Epipelagic
 - Hadopelagic, Abyssopelagic, Bathypelagic, Mesopelagic, Epipelagic.**
 - Epipelagic, Bathypelagic, Mesopelagic, Hadopelagic, Abyssopelagic

- e. None of the above are in the correct order.
8. What are the 2 major sources of salt in the ocean?
- Animal Waste
 - Land erosion**
 - Volcanic activity**
 - Cosmogenous sources
9. What type of magma is the seafloor formed from?
- Rhyolitic
 - Basaltic**
 - Andesitic
 - None of the above
10. What kind of environment does coral prefer?
- Dark, turbid seas
 - Highly saline seas
 - Clear, warm seas.**
 - None of the above
11. Compared to continental lithosphere, oceanic lithosphere is:
- Thinner and less dense
 - Thinner and denser**
 - Thicker and denser
 - Thicker and less dense
12. The oldest large scale oceanic crust is how old?
- 400 my
 - 200 my**
 - 100 my
 - 50 my
 - Even younger
13. How did the horse latitudes get their name?
- From the horses that were thrown overboard**
 - It was a misspelling; sailors used to get sick and become *hoarse* in these latitudes
 - Horses were discovered in these latitudes
 - None of the above
14. What is the barycenter?
- The apex of the orbits on the Earth-Moon System
 - The center of rotation in the Earth-Moon system**
 - The center of the tides on Earth
 - The center of a hurricane or another barometric system
15. What is the accumulation rate of red clay?
- 0.1 - 0.5 cm/1000 years**
 - 0.1 - 0.5 cm/100 years
 - 0.1 - 0.5 cm/year

- d. None of the above
16. What are some sources of food or energy in the abyssal depths?
- Whale fall**
 - Marine snow**
 - Hydrothermal vents**
 - Solar energy/light
 - The rock itself
17. Sea walls:
- Have no effect on erosion
 - Decrease erosion
 - Increase erosion**
 - None of the above
18. Marquet's Principle states that:
- The ratio of ions in seawater to each other is nearly the same, no matter what**
 - The residence times of all ions is always the same
 - The overall salinity of the ocean will remain the same, no matter what
 - The carbonate supply is always greater than the amount of dissolution
19. If you wanted to trace oceanic processes, which of the following ions or compounds would be best suited for your task?
- CaCO₃ (Calcium Carbonate)
 - K⁺ (Potassium)
 - F⁻ (Fluorine)**
 - Na⁺ (Sodium)
20. Oceanic to Oceanic convergence causes:
- Shallow focus earthquakes
 - Deep focus earthquakes**
 - Plate suturing
 - High levels of volcanism**
21. Ocean waves are classified as:
- Longitudinal waves
 - Transverse Waves
 - Orbital Waves**
 - Rotational Waves
 - Medial Waves
22. At the poles, the thermocline is
- More or less vertical / nonexistent**
 - Extremely shallow
 - Moderately steep
 - None of the above

Scientists and Important People

23. Who first observed the Gulf Stream?

- a. **Ponce De Leon**
 - b. Benjamin Franklin
 - c. Ferdinand Magellan
 - d. Jacques Costeau
24. Who came up with the idea of Continental Drift?
- a. **Alfred Wegener**
 - b. Harry Hess
 - c. Harold Jeffries
 - d. J. Walter Gregory
25. Who discovered the concept of Seafloor Spreading?
- a. Louis Agassiz
 - b. **Harry Hess**
 - c. **Robert Dietz**
 - d. Alfred Wegener
26. Who has gone to the bottom of the Mariana Trench? (*)
- a. **Don Walsh**
 - b. **James Cameron**
 - c. Jacques Costeau
 - d. **Jacques Piccard**
 - e. Robert Mallard
 - f. None of the above
27. Who first described the concept of atoll formation?
- a. James Hutton
 - b. Nicholas Steno
 - c. Benjamin Franklin
 - d. **Charles Darwin**
28. Who found the Titanic? (*)
- a. James Cameron
 - b. David Mearns
 - c. **Dr Robert Ballard**
 - d. Clive Cussler
29. Who was the first scientist to analyse ocean water?
- a. **Antoine Lavoisier**
 - b. Joseph Gay-Lussac
 - c. Louis Marsilli
 - d. William Dittmar
30. Who is known as the “Father of Modern Oceanography”?
- a. John Dalton
 - b. Aristotle
 - c. **Matthew Maury**
 - d. Andreas Rechnitzer

Tools

31. What is a Nansen Bottle?
- A water sampler for approximate depths in the column. Requires end over end movement.**
 - A water sampler for approximate depths in the column. Does not require end over end movement.
 - A water sampler designed for use in shallow water
 - This instrument does not exist.
32. What is a Niskin Bottle?
- A water sampler for approximate depths in the column. Requires end over end movement.
 - A water sampler for approximate depths in the column. Does not require end over end movement.**
 - A water sampler designed for use in shallow water
 - This instrument does not exist.
33. What is a Niskin Grab?
- A sediment sampler that preserves strata
 - A sediment sampler for hard bottoms
 - A sediment sampler for unstratified sediments
 - This instrument does not exist.**
34. What is an Ekman Grab?
- A sediment sampler for soft bottoms**
 - A sediment sampler for hard bottoms
 - Captures sediment, but with much disturbance
 - This instrument does not exist.
35. What is a gravity - assisted corer?
- A sediment corer that uses gravity to bring it to the bottom and collect sediment**
 - A corer that uses gravity to suck up sediments from the bottom
 - A corer that uses gravity ONLY to bring it to the bottom.
 - This instrument does not exist.

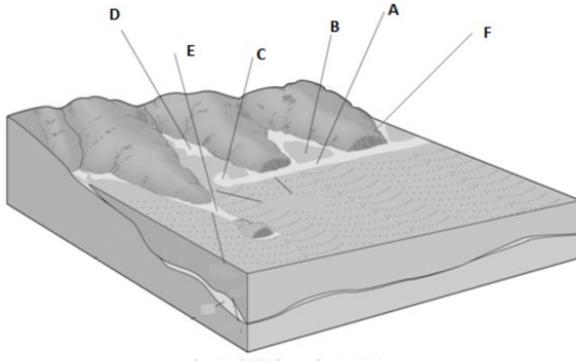
Fill in the Blank Section (58 points)

Each question's answer is only a few words or less, other than abbreviations.

KISS; keep it simple, stupid

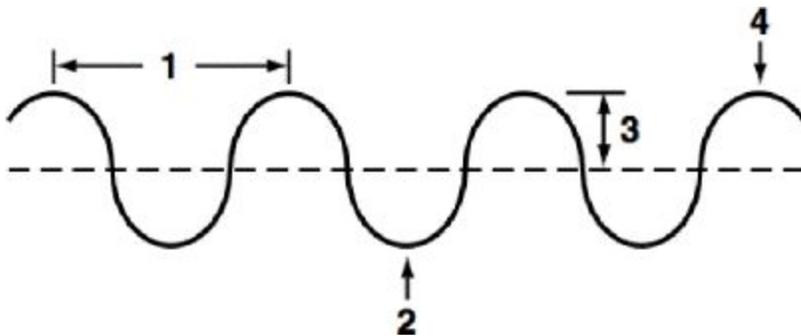
LABELLING (each one of these labels is worth 1 point, cause it's easy) (14 total)

Label the following. Write your answer in the corresponding blank on your answer sheet.



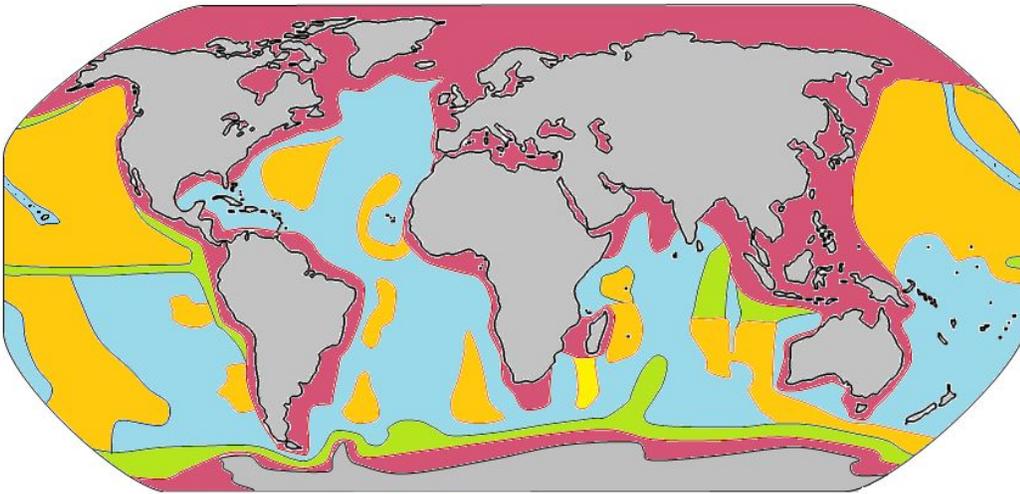
1.

- a. Baymouth bar
- b. Lagoon
- c. Recurved Spit
- d. Estuary
- e. Tombolo
- f. Headland (accept beach, it's a little hard to tell)



2.

- i. Wavelength
- ii. Trough
- iii. Amplitude
- iv. Crest



- 3.
- a. Red is 1, Yellow is 2, Green is 3, Blue is 4
 1. Terrigenous
 2. Clay
 3. Siliceous ooze
 4. Carbonate ooze

Proper Fill in the Blank: (each worth 2 points) (40 tot)

4. What does CTD stand for? **Conductivity, Temperature, Depth**
5. Does upwelling increase or decrease biologic production? **increase**
6. What is the single most common ion in seawater? **Chloride**
7. What is the quantity of those ions dissolved in the ocean by unit mass? Hint, in parts per thousand. **35 parts per thousand (ppt)**
8. Subsidence will cause which, relative sea level RISE or FALL? **Rise**
9. What about uplift? RISE or FALL? **Fall**
10. Is the rock that forms the seafloor felsic, mafic or ultramafic? (*) **mafic**
11. Ocean waves can be depicted in the shape of a _____ wave. **Sine, transverse, or trochoid. Accept any or all.**
12. Below a depth of 1/___ of the wavelength, the wave energy has no effect on water. (Integer 1-20) **2**
(<https://manoa.hawaii.edu/exploringourfluidearth/physical/waves/wave-energy-and-wave-changes-depth>)
13. Which grows faster, mid-ocean ridges or rises? **Rises**
14. A _____ is a standing wave in a lake or enclosed body of water. **Seiche, resonant wave**
15. ENSO stands for _____. **El Nino Southern Oscillation**

For the following questions, name the correct term for the given definition.

16. A narrow, flat area at the base of a sea cliff **Wave Cut Platform**
17. The leading edge of the tide forms a wave of water that travels up a river or narrow body of water. **Tidal Bore**
18. The measurement of the ocean's depth, or the oceanographic equivalent of topography. **Bathymetry**
19. The eastern boundary current of the South Atlantic Tropical Gyre **Benguela Current**
20. Biogenous sediment on the deep ocean floor made up of in part by CaCO_3 **Calcareous Ooze**
21. A type of hydrogenous sediment, they are rock concretions containing concentric layers of iron and manganese around a core. **Manganese Nodule (accept polymetallic)**

22. A partially enclosed body of brackish water with a connection to both open sea and a source of freshwater.

Estuary

23. Geologic deposit of a turbidity current. **Turbidite**

24. Primary reason for man-caused increased salinity in the ocean. **Acid Rain, accept Carbonic Acid (H_2CO_3)**

25. The term for the fact that the increase in salinity of water lowers its freezing point. **Freezing Point Depression**

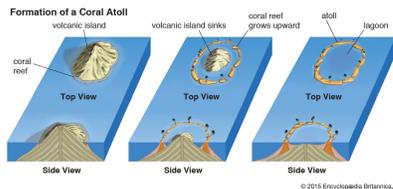
26. The average pH of surface ocean waters. **8.1 (Accept anywhere from 8.0 to 8.3)**

27. List of the top 4 ions in ocean water by weight. **Chloride(Cl^-), Sodium(Na^+), Sulfate(SO_4^{2-}), Magnesium(Mg^{2+})**

Free Response Section (107 points)

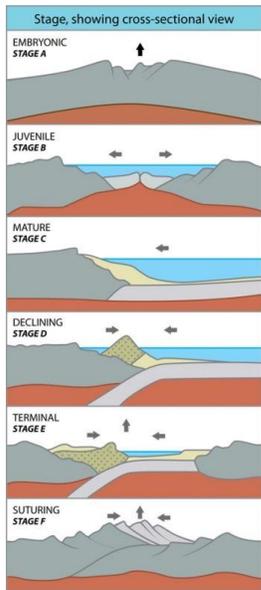
1. Draw the halocline, thermocline, and pycnocline at the equator. Label all parts and graphs. (3)
2. What is a chemocline? Provide an example, and its impact. (2)
 - a. **A strong, vertical chemistry gradient, separating layers of water with different chemical compositions or concentrations. (1 pt)**
 - b. **An oxygen chemocline; where anoxic bottom waters lie. It separates the aerobic and anaerobic zones. (1pt) One exists in the Black Sea.**
3. What was the old definition of chlorinity? What is the current definition? Why did they change it? (3)
 - a. **The old definition was the amount of weight of the seawater that was composed of halogens. Or the weight of chlorine in grams per kg of seawater after the bromides and iodides had been replaced with chlorides. (1 point for either)**
 - b. **The current definition is: chlorinity is 0.3285233 times the weight of silver equivalent to all the halides. Or the mass of silver(g) required to precipitate out all of the halides in .3285233 kg of water. (1 point for either)**
 - c. **This was changed in order to make the definition independent of atomic weights. (1 point)**
4. What is the SOFAR channel? Describe how it works and its importance. (4)
 - a. **The SOFAR channel (Sound Fixing and Ranging Channel), aka DSC (Deep Sound Channel), is a vertical layer in the ocean where the speed of sound is at its minimum. It occurs at approximately 1000 m. (1 pt)**
 - b. **It works through refraction of sound; if a sound wave tries to deflect upward, it is redirected as it accelerates back down towards the center of the channel. The same thing happens for the lower bound; it deflects upwards. (2)**
 - c. **It is important because it allows sound waves to travel extreme distances, helping long range communications, and submarine warfare. (1) if they describe just submarine warfare, and specifics about it, that is acceptable.**
5. The CCD: (10)
 - a. Describe the CCD, and why it exists. What does it stand for? (3)
 - i. **As you get deeper and deeper in the ocean, the dissolution rate and potential increases.**
 - ii. **The CCD is the Carbonate Compensation Depth, and it is at this depth where the supply of calcium carbonate is equal to the rate of dissolution. Below this depth, there is no net accumulation.**
 - b. Why is the CCD deeper in the Atlantic? Be sure to mention the lysocline. (4)

- i. The lysocline (the line where dissolution becomes evident) is far higher or shallower due to increased productivity and organic matter (upwelling) which results in a lower pH and greater dissolution.
 - c. What is the difference between the CCD and the ACD? (1)
 - i. **ACD is the aragonite compensation depth, compared the the carbonate compensation depth (CCD)**
 - d. What ramifications does this have for the fossil record? (2) (*)
 - i. **The ramifications that it has means that less carbonate based life forms are preserved, for example deep sea molluscs, many plankton and the tests of microscopic organisms. (2pts, all or nothing)**
6. How do the controls on silica deposition differ from carbonate deposition? (2)
- a. **Silica is mainly controlled by an influx of siliceous material, whereas carbonate is controlled more by depth. (2)**
7. Describe and illustrate the stages of reef formation. (2)

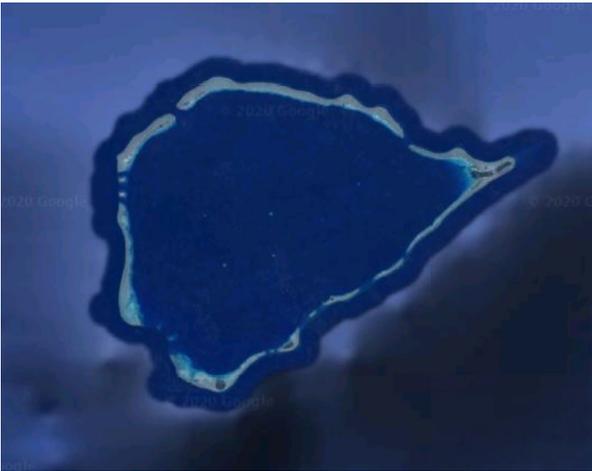


- a.
 - b. **The diagram should look somewhat like above; it's acceptable to include just the side views.**
 - i. **Fringing reef**
 - 1. **A volcanic island rises above sea level and a coral reef forms around it, like a fringe.**
 - ii. **Barrier Reef**
 - 1. **The interior island begins to subside and erode away, leaving a shallow lagoon separating the island and the coral reef**
 - iii. **Atoll**
 - 1. **The island completely subsides, leaving a shallow lagoon surrounded by a reef.**
 - c. **Give ½ per each part: diagrams, and each name paired with a description.**
8. What is the OMZ? What depth does it occur at? What impact might this have on life in the area? (4)
- a. **The Oxygen Minimum Zone, or OMZ, is where oxygen saturation is at its lowest.**
 - b. **They occur usually at depths from 200-1500m.**
 - c. **Bacterial life in these zones play a significant role in regulating productivity; the denitrification helps create the large fisheries off the coast of South America. (2)**
 - d. **Alternate answers:**
 - i. **This forces life to become more efficient at extracting and using the oxygen they have; for example higher efficiency gills and blood. (2)**
9. How can we reconstruct plate movement using marine sediments? (4)
- a. **As we pass through the equatorial area, CaCO₃ and other high productivity sediment will increase.**

- b. When taking cores you can measure the distance from the equator, and compare the distance to their age, and compare the distance to the current position, and the age of the sediments from when it was deposited to now, and use that information to determine the rate of plate movement.
 - c. 4 pts, two for mentioning cores and sediment, two for the comparison
 - d. (It is the test writer's understanding that you do need to know the direction of plate movement, however.)
10. What is geostrophic balance? How does it affect ocean gyres? (2)
- a. Geostrophic balance is when the current and the current direction match the Coriolis force and the pressure gradient force, hence "balanced"
 - b. This forces ocean gyres to be domed; higher in the center and lower on the outsides.
11. What is the Ekman Spiral? At what depth does it have negligible effects? How does it work? (3)
- a. The Ekman Spiral is the structure of currents or winds near a horizontal boundary in which the flow direction rotates as one moves away from the boundary (Wikipedia)
 - b. Essentially depicts the motion of water or currents due to incident wind, and the direction offsets itself deeper and deeper.(1)
 - c. It becomes negligible at a 100m depth. (1)
 - d. The force of wind pushes the uppermost layer of water, which is deflected by the coriolis force. That layer of water pushes lower water through friction, which is further deflected. This process repeats, slowly decreasing in magnitude as it is reliant on turbulent drag, spiraling down until it becomes negligible.
12. What causes upwelling along the equator? How is this important for Peru? (3)
- a. Upwelling is caused by Ekman Suction pulling deep water to the surface. The trade winds cause diverging Ekman Spirals on either side of the equator due to the coriolis effect, and this causes upwelling. (2)
 - b. This is important for Peru as it contributes to the overall productivity of the area, helping the productivity of their very rich fisheries. (1)
13. Describe the concept of residence time. What does this have to do with Marquet's Principle? (3)
- a. Residence time is defined as the average length of time where a substance is held in solution or suspension. (2)
 - b. Residence time of all ions is the same in the entire ocean, so the ratios always stay the same. (½)
 - c. This connects with Marquet's principle in that Marquet states that "the ratios between the amounts of the major ions in the waters of the ocean are constant" (½)
14. Where is one most likely to find downwelling? For what reason? (4)
- a. In the higher latitudes (near the poles), where water is colder (2 for location, 2 for reasoning)
 - b. As well as the Red Sea and Persian Gulf, where there is increased salinity (1 bonus)
 - c. Alternate answers: The middle of geostrophic currents, such as the Atlantic or Pacific Gyres, Coasts where wind flows the correct direction, and boundaries between currents that create downwelling.
 - d. All of the above receive full credit so long as they express location and reasoning. And the bonus, if mentioning a specific location which seems to match.
15. Illustrate and label the Wilson Cycle. (3)



- a.
- b. $\frac{1}{2}$ for each stage.



16. Reefs: (4)

- a. What kind of reef is depicted above? (1)
- i. **Atoll**
- b. How do you know? (1)
- i. **No central island, we're given that it's a reef, so it must be an atoll.**
- c. What are the hallmarks of this kind of reef? (2)
- i. **A large ring-like reef, with no central island or core, as the core has been eroded away.**
 - ii. **The reef surrounds a lagoon.**
 - iii. **Usually fairly circular in form.**
 - iv. **Low total elevation.**
 - v. **Steep drop off at the coast.**
 - vi. **Shallow lagoon inside.**
 - vii. **Can have small plants growing on top of the reef itself, where it breaches sea level.**
 - viii. **Any two of the above count.**

TOOLS

17. What is a secchi disk? What purpose does it serve? (2)
- an opaque disk, typically white, used to gauge the transparency of water by measuring the depth (*Secchi depth*) at which the disk ceases to be visible from the surface.(1 point)
 - Mentioning the secchi depth is +1 bonus.
 - Purpose: measures turbidity (1 point)
18. Name and describe the tools depicted below. What use are they for?
- 1 point for identification, one point for each explanation correct. 10 total.
 - Peterson Grab**
 - Collects bottom samples, and is especially good for hard bottoms
 - Plankton Splitter**
 - Helps divide up plankton for subtesting
 - Dredge**
 - Dredges at the bottom or a certain level for on the bottom/in the bottom/near the bottom objects, substrate, and flora/fauna.
 - Van Veen Grab**
 - Can take large, deep samples for soft bottoms
 - Van Dorn Bottle**
 - For sampling in waters that are stratified or have prevailing currents
 - They sample water, essentially
19. If one had to sample a gravelly bottom, which sampler might one choose, and why? Explain why this, compared to the others, is the best one. (5)
- Choose between a Van Veen grab, Ekman Grab, and a bottom dredge.
 - Bottom dredge (3)**
 - Ekman grab is inefficient and not good for hard bottom with large particle size, only benefit is no disturbance (½ point)**
 - Van Veen grab is not effective for large particle size, as the jaws get stuck, you could lose part or all of your sample because of this (½ point)**
 - We only want to sample the bottom, no need for stratification specified, nor depth, which is why the bottom dredge is the easiest and most effective (1)**

Math:

Give all answers to three significant figures. Give units in each question, otherwise they will be completely wrong. Your work and the general formula are all worth points. DO NOT AWARD POINTS IF UNITS ARE ABSENT

20. A simple math problem. You are using SONAR. Assume that the depth of the water has no effect on speed, and assume the speed is the same as it is in surface waters. If you send a pulse, and it takes 0.433 seconds to return, how far away is the object it reflects off of? (3) Use a speed of sound in water of 1.50×10^3 m/s.
- 325 m away. (1 pt)**
 - Distance = (celerity * time) / 2 (1 pt for formula)**
 - Distance = (1500 m/s * 0.433 s) / 2 = 324.9 m (1 pt for calculation)**
21. What is the celerity of a wave with a wavelength of 20.55 meters, and a depth of 5.651 meters? (4)
- 5.49 m/s (+/- 0.5 m/s is acceptable)**

$$C = \sqrt{\frac{gL}{2\pi} \tanh\left(2\pi \frac{d}{L}\right)}$$

- b. It's an intermediate water wave, so the equation is as shown below.
- c. This form is perfectly acceptable, so long as they find the correct answer.
- d. K is simply radians/second, so, as long as they show the conversion, that is fine.
- e. The relative depth is between .05 and .5, so we see it's intermediate
- f. Filling this in, $c = \sqrt{\left(\frac{9.81 * 20.55}{2\pi}\right) * \tanh\left(2\pi * \left(\frac{5.651}{20.55}\right)\right)}$
- g. Calculation or similar is worth 3 points. Final answer is worth 1. If they calculate for a shallow wave, 2 points only. They must find the correct answer. That work is shown below.
- h. Shallow water wave: $c = \sqrt{g * D} = \sqrt{9.81 * 5.651} = 7.45 \pm 0.1 \text{ m/s}$
22. What is the speed of sound in seawater at 25 degrees C, 35 ppt salinity, and a depth of 1000 meters? (5)
- a. 1550 m/s +/- 1 (1 point for correct answer)
- b. Use the following equation:
- c. $C = a_1 + a_2T + a_3T^2 + a_4T^3 + a_5(S-35) + a_6d + a_7d^2 + a_8T(S-35) + a_9Td^3$
- d. C = celerity = velocity
- e. T = temperature
- f. S = salinity
- g. D = depth
- h. $a_1 = 1448.96, a_2 = 4.591, a_3 = -5.304e-2, a_4 = 2.374e-4, a_5 = 1.340, a_6 = 1.630e-2, a_7 = 1.675e-7, a_8 = -1.025e-2, a_9 = -7.139e-13$
4 points for calculation (2 for equation, 2 for work)
23. A 2.00 km deep ocean basin is filled to sea level by sediments over a long period of time. Assuming isostatic equilibrium is maintained, how deep will the sediments be? Use these densities: water (1.00), sediment (2.40), asthenosphere (3.20). All units are in g/cm³. (5)
- a. 5.50 km thickness(3 points), give 1 point if they say 3.50 km
- b. Weight equation: $t_w \rho_w + h_1 \rho_a = (2 + h_1) \rho_s$ (2 points)
- c. $2.00 * 1.00 + h_1 * 3.2 = (2 + h_1) * 2.40$
- d. Solve for $h_1 = 3.50 \text{ km}$
- e. Add 2 km ocean depth to h_1 (additional thickness of sediment)

Climate:

24. The ocean is the single most important body on this planet in regards to weather and climate. How did the Antarctic Circumpolar Current form and how does it play an important role in regulating the Earth's climate and keeping it at the state it is now? Be as detailed as possible in your answer. (4 points)
- a. Mentions that the Drake passage opened up to form the ACC. (1 point)
- b. Mentions that the ACC keeps Antarctica surrounded by cold waters (1 point)
- c. Mention that the Antarctic Ice Sheet doesn't melt away (1 point)
- d. Mentions that because of the ice sheet, the earth stays cool (1 point)

25. Global warming is pretty depressing. The gulf stream is very important to humans in Europe for one major reason. What is that? What will happen to the gulf stream and Europe if global warming gets worse? (5 points)
- The gulf stream brings warm water to Europe, creating milder climates. (2 points)**
 - If global warming gets worse, the gulf stream will slow down(1 point.)**
 - Europe will not get colder as the warmth from Global warming will vastly overshadow the lack of warmth from the Gulf Stream. (2 points) 1 point only is they say that Europe will get colder because the gulf stream won't transport as much heat.**

25. Explain how sea ice forms. Be as detailed as possible. What is the salinity of sea ice when it is newly formed? Why? After a year or so? Why? (8 points)

- First, at around -1.91 degrees C, salt water starts to freeze.(1 point)**
- As dissolved solids cannot fit into the structure of frozen water, the salts are left dissolved in the seawater, creating a denser water that sinks to the bottom, bringing up fresher water to continue the process. (1 point, mentions anything in this sentence)**
- Then, small needlelike hexagonal crystals form, and become numerous to the point of slush. As the slush forms a sheet, the wind breaks it up. (1 point)**
- The pieces form disk shaped pieces(pancake ice) and eventually coalesce into ice floes (1 point, must mention ice floes)**
- Newly formed sea ice can have a salinity ranging from 4 to 15 ppt.(1 point for anything in that range) This is because brine gets trapped during the freezing process.(1 point)**
- After a year or so, the salinity drops to near 0 ppt, (1 point for anything less than 3ppt) as brine will trickle down through the sea ice. (1 point)**