C - Dynamic Planet C 2020-2021 - BEARSO - 10-24-2020

Greetings! Welcome to the Dynamic Planet C test!

Questions that invite multiple responses are clearly marked with (*) as well as other indicators, like checkboxes and a small message underneath the question.

Good luck!

1. (2.00 pts) Besides the obvious hydrogen and oxygen, which of the following consist of the next 3 highest mass percentages in seawater? (*)

(Mark **ALL** correct answers)

- [x] A) Chlorine
- [ ] B) Sulfur
- [x] C) Magnesium
- [x] D) Sodium
- [ ] E) Calcium
- [ ] F) Potassium

2. (2.00 pts) Which of the following are qualities of aragonite seas?

(Mark **ALL** correct answers)

- [ ] A) High Mg/Ca ratio due to increased volcanic activity as a magnesium source
- [x] B) Occurs during periods of slow seafloor spreading
- [x] C) Generally higher pH than calcite seas
- [ ] D) Low Mg/Ca ratio due to hydrothermal vents allowing metamorphism of calcium-rich minerals

3. (2.00 pts) Which of the following types of carbonate slopes predominantly consists of turbidites

- (●) A) Rimmed platform slope apron
- ( ) B) Rimmed platform based-of-slope apron
- ( ) C) Open (unrimmed) platform apron
- ( ) D) Submarine Fans

4. (2.00 pts) Why is the thermocline steeper in shallow depths during the Summer rather than the Winter?

- ( ) A) Increased precipitation in the Summer allows for distribution of energy throughout the water column
- ( ) B) Decreased precipitation in the Summer allows for the increased rates of downwelling
- (●) C) Increased wind speeds in the Summer allows for increased mixing throughout the water column
- ( ) D) Decreased wind speeds in the Summer allows for density-differences to dominate the mixing process

5. (2.00 pts) Out of all of the following, which is NOT predominantly and directly controlled by heat transport?

- (●) A) Halocline
- ( ) B) Thermocline
- ( ) C) Thermohaline circulation
- ( ) D) Ocean currents

6. (2.00 pts) In which of the following ocean environments can I find cross-stratification sedimentation? (*)

(Mark **ALL** correct answers)

- [x] A) Carbonate clastic continental shelves
- [x] B) Epicontinental seas
- [ ] C) A beach with no fluvial output
- [x] D) Estuaries

7. (2.00 pts) When analyzing seafloor bathymetry, which of the following is NOT an indicator of a mid-ocean ridge?

- ( ) A) Many parallel ridges on the ocean floor
- ( ) B) A linear region of decreased depth
- (●) C) A broad region of increased depth
- ( ) D) Series of normal faulting originating from a central location

8. (2.00 pts) Which of the following triple junction types can ONLY be unstable? (Hint: R=Ridge, T=Trench, F= Transform fault)

- ( ) A) R-R-R
- ( ) B) R-T-F
- ( ) C) T-T-T
- ( ) D) F-F-T
- (●) E) F-F-F

9. (2.00 pts) Hypoxia is caused by which of the following factors? (*)

(Mark **ALL** correct answers)

- [x] A) Increased fluvial output to a lagoon
- [ ] B) Rapid deposition of fine-grain clastic particles
- [x] C) Eutrophication of a coastal body of water
- [x] D) Extremely high concentration of iron ions and rapid production of iron oxides

10. (2.00 pts) Which of the following is not true about chemicals in the ocean during ice age eras?

- ( ) A) Increased O18 in calcium carbonate shells at lower latitudes
- (•) B) Decreased O18 in calcium carbonate at higher latitudes
- ( ) C) Decreased O18 in glaciers
- ( ) D) Increased O18 in the ocean
- ( ) E) Increased salinity in the ocean
- ( ) F) Decreased salinity in the ocean at lower latitudes

11. (2.00 pts) Which of the following phenomena would prevent the complete formation of an atoll? (*)

(Mark **ALL** correct answers)

- [x] A) Rapid island subsidence compared to coral growth
- [ ] B) Calcite sea conditions
- [ ] C) Aragonite sea conditions
- [x] D) Rapid sea level drop compared to island subsidence

12. (2.00 pts)
Given an ocean wave that was formed with wavelength 120 m and in waters of ocean depth 1.5 km, which of the following characteristics of this wave are correct? (*)

(Mark **ALL** correct answers)

- [ ] A) Wave celerity = 7.3 m/s
- [x] B) Wave celerity = 13.7 m/s
- [ ] C) This wave is a shallow-water wave
- [x] D) This wave is a deep-water wave
- [x] E) This wave is most likely a wind wave
- [ ] F) This wave is most likely a tidal wave

13. (2.00 pts) Which of the following statements concerning wave motion are false? (*)

(Mark **ALL** correct answers)

- [x] A) A wave is energy traveling in circular orbital motion, transporting water from the origin of the wave to shore.
- [x] B) The circular orbital motion of waves only occurs at or near the surface of the ocean.
- [ ] C) The circular orbital motion of waves dies out at half the wavelength below sea level.
- [ ] D) The energy received from winds at a certain speed, over a certain distance and duration, determine the height, wavelength, and period of a wave.

14. (2.00 pts) If you throw a paper airplane from North Dakota to South Dakota, it will most likely land in _____ due to the Coriolis effect.

- (•) A) Wyoming

- ○ B) South Dakota
- ○ C) Minnesota
- ○ D) Nebraska
- ○ E) Canada

15. (2.00 pts) Which of the following are true concerning gyres? (*)

(Mark **ALL** correct answers)
- ☑ A) Gyres spin clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere due to the Coriolis effect.
- ☑ B) Gyres are composed of 4 different currents that contribute to its circular flow.
- ☐ C) Gyres are exclusively found in the subtropics. That is why all gyres are also called subtropical gyres.
- ☐ D) Due to gyres' relatively fast current velocity, the temperature of the waters they carry have little to no variation.

16. (2.00 pts) True or False: Ekman transport only has an effect on shallow waters (sea floor is 100 m below sea level)

- ○ True ◉ False

17. (2.00 pts) The Coriolis effect and gravity balance each other to form geostrophic currents. In reality, these currents are:

- ○ A) Upward, because the Coriolis effect outweighs gravity.
- ○ B) Upward, because friction decreases the effect of gravity.
- ◉ C) Downward, because friction decreases the Coriolis effect.
- ○ D) Downward, because gravity outweighs the Coriolis effect.

18. (2.00 pts) Coastal upwelling/downwelling can be caused by… (*)

(Mark **ALL** correct answers)
- ☑ A) Wind blowing parallel to a shoreline
- ☑ B) Wind blowing non-parallel to a shoreline
- ☐ C) A seafloor obstruction
- ☑ D) A land breeze
- ☑ E) A sea breeze

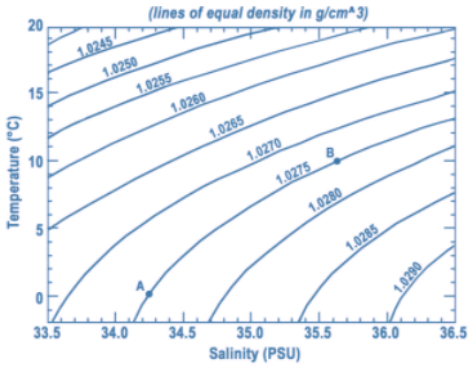
19. (2.00 pts) Which of the following concerning longshore currents are true? (*)

(Mark **ALL** correct answers)
- ☑ A) Longshore currents are caused by the refraction of incoming waves.
- ☐ B) Longshore currents form far offshore.
- ☐ C) Longshore currents cause a net perpendicular movement of sand (toward/away from shore).
- ☐ D) Longshore currents typically flow Northward along the East Coast of the US and Southward along the West Coast of the US.
- ☑ E) Longshore drift, which is caused by longshore currents, causes an downstream build-up of sand.
- ☐ F) Groins and breakwaters are sustainable solutions to the detrimental effects of longshore currents.

20. (2.00 pts) Thermohaline circulation is initiated by the sinking of very dense water. Therefore, one could suspect that thermohaline circulation is initiated:

- A) By glacial melt
- B) At the equator
- C) At the poles
- D) Near continental shelves
- E) In the pelagic zone

21. (2.00 pts) Diagrams like the one below are useful in characterizing:



- A) Deep-water masses
- B) Air over seawater
- C) Shallow ocean inlets
- D) Global warming
- E) Precipitation

22. (2.00 pts) Of the following combinations of tidal and lunar phenomena, which could occur simultaneously?

- A) Neap tide — proxigean
- B) Neap tide — opposition
- C) Spring tide — quadrature
- D) Spring tide — syzygy

23. (2.00 pts) Which of the following concerning tidal currents are true? (*)

(Mark **ALL** correct answers)

- [ ] A) Unlike tides, tidal currents are hard to predict.
- [x] B) Longshore currents reduce the strength of ebb flows.
- [ ] C) The erosion caused by tidal currents decreases when tides enter through a narrow inlet.
- [x] D) Spring currents are stronger than neap currents.

24. (2.00 pts) True or False: Barrier islands are always found along passive plate margins

- True
- False

25. (2.00 pts) Which of the following would promote eustatic sea level rise? (*)

(Mark **ALL** correct answers)

- [x] A) High seafloor spreading rates
- [ ] B) Low continental weathering rates
- [x] C) Low mantle convection rates
- [x] D) Higher seawater temperatures (IGNORING GLACIAL MELTS)

26. (2.00 pts)
You receive a sediment core from the ocean floor and determine it was taken from an ancient, pelagic zone. The presence of which of the following materials could support your hypothesis? (*)

(Mark **ALL** correct answers)

- [x] A) Abyssal clay
- [x] B) Siliceous ooze
- [ ] C) Calcareous ooze
- [ ] D) Fossilized corals
- [x] E) Metal sulfides
- [ ] F) Stromatolites

27. (2.00 pts) Which of the following characterize normal (non-El Niño) conditions? (*)

(Mark **ALL** correct answers)

- [ ] A) Low atmospheric pressure and rains near Peru.
- [x] B) Trade winds converge at the equator and push warm water from Peru to Australia.
- [x] C) Upwelling of nutrient rich cold water near Peru.
- [x] D) Low atmospheric pressure and rains near Australia.
- [x] E) Cooler and drier air blows across the Pacific towards Peru.
- [ ] F) Jets bring wetter winters across USA

28. (5.00 pts) Why would hypopycnal flow prevent estuary formation as compared to hyperpycnal flow (which may promote estuary formation) in a deltaic setting?

Expected Answer: Hypopycnal flow consists of lower river water density entering a higher density standing water [1] which would deposit suspended particles over a wide region [2], preventing the coastal build up of sediments [2] for estuaries

29. (4.00 pts) Describe the characteristics of a micro-tidal barrier island.

Expected Answer: Tidal range is 0-2 m [1], the islands are long and thin [1], few inlet channels [1], wave-dominated [1] sediment control

30. (4.00 pts) Explain briefly how radar altimetry can be used to obtain the topography of the seafloor.

Expected Answer: The surface of the ocean mimics the topography of the ocean floor [3], so we can use radar altimetry to obtain measure sea surface height [1] to indirectly obtain topography

31. (6.00 pts) Explain the relationship between Greenland's glaciers and the Atlantic meridional overturning circulation (AMOC). Be sure to define the AMOC.

Expected Answer: The AMOC is a portion of oceanic circulation in the N Atlantic [1 pt] that includes both surface and deep-ocean currents [1 pt]. As Greenland's glaciers are melting [1 pt], less dense water is being generated [1 pt], possibly redirecting the Gulf Stream [1 pt] and shutting down the AMOC [1 pt].

32. (3.00 pts) Scientists attribute the extreme tidal range of the Bay of Fundy to three fundamental characteristics unique to the bay. Identify these three characteristics.

Expected Answer: Tidal period is the same as the oscillation period of water between two antinodes [1 pt], the inlet is narrow [1 pt], the bay curves to the right, so the Coriolis effect of the Northern Hemisphere adds to the tidal range [1 pt].

33. (2.00 pts) Identify one cause of relative sea level change, and identify one case of eustatic change.

Expected Answer: Tectonic changes cause relative sea level changes [1 pt]. Eustatic changes are worldwide and require a change in water volume [1 pt].

34. (3.00 pts) Explain how an air mass moving across a continent and onto ocean waters would develop a halocline.

Expected Answer: Air moves across continent → loses moisture [1 pt]→ enters ocean and evaporates ocean water [1 pt] → salinity increases [1 pt] → halocline develops

35. (3.00 pts) Identify at least three effects that global warming has on ocean hydrology and/or ocean life.

Expected Answer: Accelerates hydrologic cycle [1 pt] - more melting also dilutes seawater [1 pt], making deep-sea circulation less effective [1 pt]. Increases frequency and intensity of hurricanes [1 pt]. Ocean warming = less dissolved oxygen present [1 pt]. Ocean warming also = faster metabolic rates for ocean species [1 pt]. (UP TO 3 POINTS)

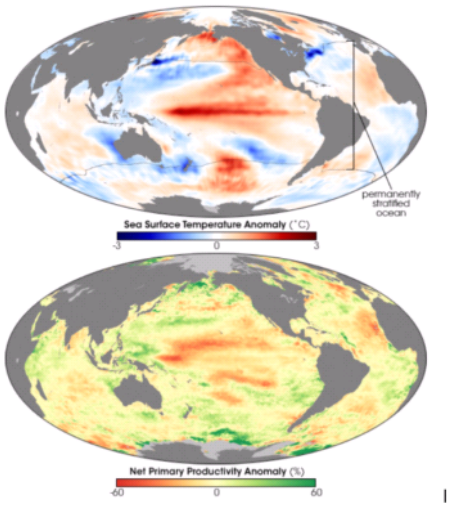
36. (8.00 pts)
Explain the effect that temperature, pressure, and salinity have on the density of seawater. Then rank them in terms of influence from least influence on the density of seawater to the most influence on the density of seawater. Finally, justify your ranking.

Expected Answer: Increase in T = decrease in density [1 pt]; increase in salinity = increase in density [1 pt]; increase in P = increase in density [1 pt]. Ranking: [ressure, salinity, temperature [1 pt]. Pressure has almost no real effect on salinity because water is nearly incompressible [1 pt]; effects of P are only noticeable at extreme depths [1 pt]. T has more influence than salinity - greater range of T for seawater [1 pt] compared to range of salinity. Salinity only affects seawater at poles where T is constant [1 pt].

37. (3.00 pts) Describe on possible climate-related positive feedback loop that in any way involves the ocean

Expected Answer: Just read their answer to see if it makes any sense. Main point is the logical reasoning.

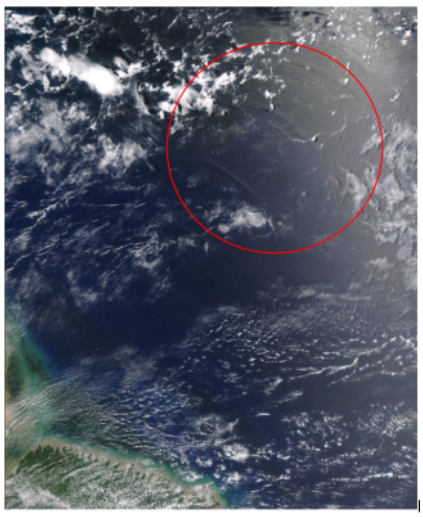
38. (7.00 pts)



The provided data was taken by the SeaWiFS between 2000 and 2004. Identify the primary relation between SST and Net Primary Production Anomaly, explain why this relation occurs, and describe the effect it has on climate.

Expected Answer: Warmer temperatures lead to lower net primary productivity (2). Warmer surface water leads to less mixing between surface waters and nutrient rich deeper waters (3). Reduced net primary productivity means that phytoplankton absorb less CO2, leading to increased CO2 and global warming. (2)

39. (6.00 pts)

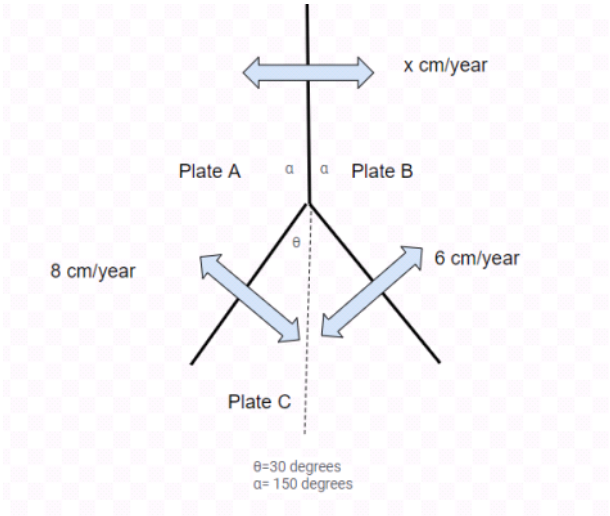


The provided image was taken by MODIS on August 13, 2003 off the northeast coast of Brazil. What ocean phenomenon is seen in the top right of the picture (region indicated by red outline), what are they caused by, and why is the top right end of the phenomenon brighter than the bottom left beginning of the phenomenon?

Expected Answer: Internal Waves [2] Lower, more dense water layer hits a shallow obstacle by tidal action [2] Internal waves converging causes more turbulent waters that reflect more sunlight [2]

40. (5.00 pts)

Given the diagram of a R-R-R triple junction which we assume is stable, calculate the spreading rate of plate B relative to plate A. **READ THE FOLLOWING ASSUMPTIONS:** The diagram is not to scale, however you may assume that the spreading rates between A-C and B-C are exactly perpendicular to the ridge. (Provide your answer in cm/year)



Expected Answer: vectors must sum to 0: x-dir: 4sqrt3 +3sqrt3 y-dir: 4-3 magnitude: 12.1655 cm/yr. -1 if no work shown. 12.1 NOT ACCEPTED, since that indicates that the y-component was not taken into account.

41. (4.00 pts) Other than directly contributing to water volume, how else does the melting of land glaciers contribute to sea level rise?

Expected Answer: Melting land glaciers result in isostatic rebound [2] (also accept anything related to uplifting), which decreases the volume of ocean basins [2]

42. (4.00 pts) Describe the two primary methods of obtaining sea surface temperature (SST) data.

Expected Answer: The first method is to directly measure SST data through radiation measurements such as microwave/IR. The second is to measure sea surface height [2] through radar altimetry[1], as sea surface height is directly correlated to SST [1]

43. (5.00 pts)

The provided image is a perfect example of what geologic event/phenomena cycle? (Hint: the darker layers are shale and the lighter layers are limestone). Provide 3 causes for the transition from the dark to lighter layers. Photo cred: Vivek

Expected Answer: Marine transgression/regression (also accept sea level rise/fall) [2] Causes: land subsidence, increased water volume in ocean basins, decreased ocean basin capacity, also accept specific examples (i.e. glaciers melting). [1] each

44. (5.00 pts)

Identify the given coastal feature. This structure is essentially a raised-above-shore version of a beach and what other coastal structure? How does this “other coastal structure” form?

Expected Answer: (All equivalent: Raised beach, coastal terrace, perched coastline) [2]. The “other coastal structure” is a wave-cut platform [2], which is formed by waves undercutting a cliff face, which then collapses. [1]

45. (4.00 pts)
In paleontology, prehistoric closed lagoons are a treasure trove of fossils today (e.g. the Solnhofen limestone!) due to a practically guaranteed anoxic bottom. Why does the structure of a closed lagoon promote such conditions (assume freshwater inflow exists)?

Expected Answer: Closed lagoons have a stratified water column due to density differences between freshwater and saltwater [2]. This prevents nutrients mixing and traps the salt water at the bottom [2]