

Name: \_\_\_\_\_

TIME: 55 min.

POINTS: 70

For Grading Only

I:	/24	IV:	/25
II:	/10	Total:	/70
III:	/11		

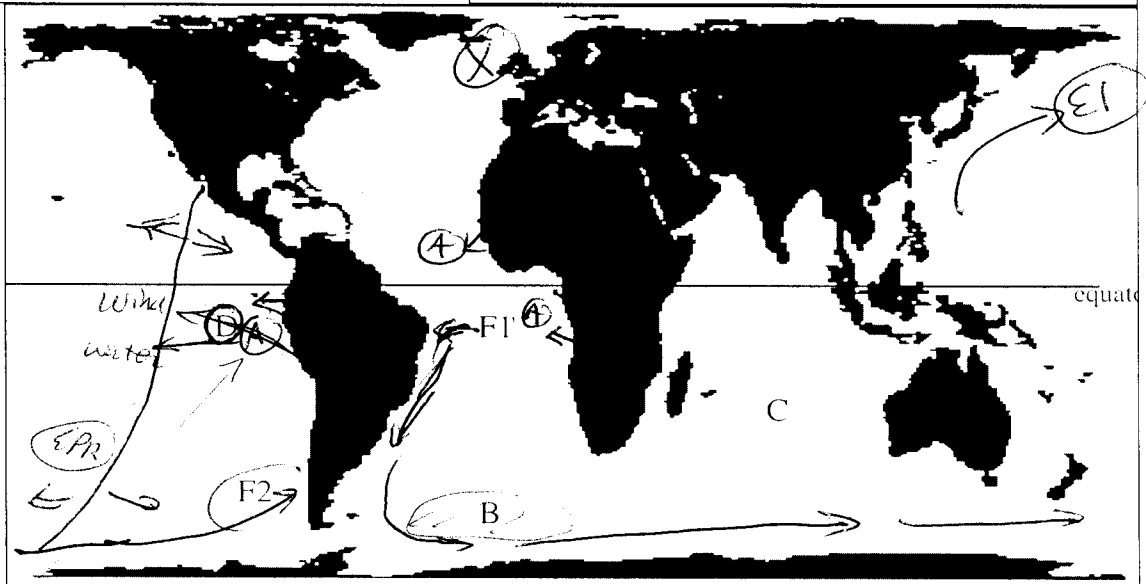
**I. WINDS, CURRENTS**

**LIFE**

(24 pts)

On the screen is the Jan. 2012 satellite map of chlorophyll in the seas.

Note that purple=very low; dark blue=low; light blue=medium; green=med-high; yellow=high



A. (6 pts) Pick a spot on the map where TRADE WINDS are causing UPWELLING, and 1) LABEL it **A**. Now 2) explain how this wind arises from a "wind cell" (note briefly Coriolis effect), and 3) how this causes upwelling:

Trade winds arise from air heating & rising at equator, traveling south, cooling & sinking at ~30°S. Then air travels back to equator, curving leftwards (in S. hemisphere). Due to Ekman effect, seawater is pushed straight off shore, drawing up deeper water.

B. (4 pts) The area at **B** is green/yellow. This is not due to winds! Explain why chlorophyll is high here (don't just name the phenomenon, but explain how it arises):

Thermohaline! Cold water sank near Iceland (X on map) as it got denser, traveled south, and got deflected up as it encounters even denser water sinking next to Antarctica. The upwelled water contains nutrients from the deep Atlantic.

C. (4 pts) Note blue-purple point **C**, where a key nutrient is very low. A German expedition chose this site for a **geoengineering** experiment in 2009! 1) What is the missing nutrient? **IRON** 2) Why is that nutrient low at this point? 3) why is it important for living processes? 4) What was the outcome of the German experiment?

Low due to distance from land sources Fe needed for electron transport chains 4) Algae bloomed but were then eaten by krill so CO<sub>2</sub> ↓ then back ↑

I. D. (5 pts) Suppose there is a crab living at Point **D** on the map

1. What happens to its habitat **temperature** during an **El Niño** period? CO<sub>2</sub> warms up
2. The El Niño temperature change at **D** may impact the crab's body functions. Explain **two** ways -- temperature's basic direct effects on living processes, and effect on dissolved gas:

- metabolic processes may speed up, or exceed the crab's maximum and decline as proteins, membranes denature  
- less O<sub>2</sub> will dissolve so respiration may be impaired

E. (3 pts) 1. **SKETCH** on the MAP the **KUROSHIO Current**--label it **E1**

2. **SKETCH** on the MAP **EAST PACIFIC RISE (Ridge)**.

3. Also draw **arrows** showing which way the **seafloor** is moving from this ridge.

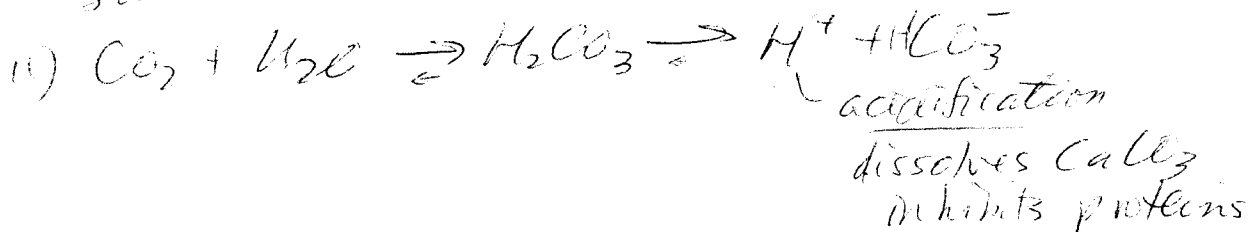
F. (2 pts) Pretend some **ship cargo falls** into the ocean at POINT **F1** on the map. Months later it comes ashore at Point **F2**. Assuming the cargo floats, sketch with **arrows** the most likely route it takes.

## II. CARBON

(10 pts)

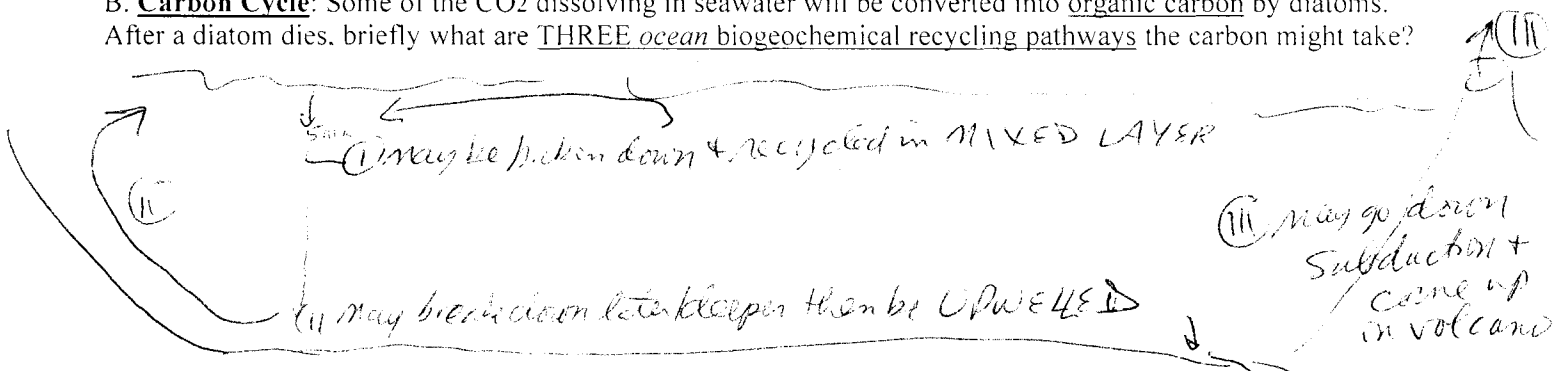
A. Excess CO<sub>2</sub> is having **2 effects** on the oceans: i) indirectly by being in the upper atmosphere: ii) directly by dissolving in seawater. Explain how these effects arise with appropriate *equation* and/or atmospheric *processes*

i) CO<sub>2</sub> in atmosphere traps heat (infrared) radiation leaving the earth. It does not block on coming sunlight which is UV-Visible, NOT infrared.



B. **Carbon Cycle**: Some of the CO<sub>2</sub> dissolving in seawater will be converted into organic carbon by diatoms.

After a diatom dies, briefly what are THREE ocean biogeochemical recycling pathways the carbon might take?



III. **TRUE/FALSE** -- Mark each statement with a "T" if true or "F" if false

(11 pts)

- A. The **Census of Marine Life** focused mainly on counting **fish** because of their importance to fisheries.
- B. **Hydrothermal vents** are typically found at **subduction trenches**.
- C. **Methane (gas) Hydrates** contain lots of energy but are too remote for oil/gas companies to consider using.
- D. **Sediments** on most of the deep-sea floor are made of fine particles--**mud** and **ooze** (mud >30% **biogenous**).
- E. "Hot spots" are isolated areas of magma that are responsible for **island chains** in the oceans.
- F. **Waves** begin to rise and "crash" at 1/2 depth near shore because the traveling energy gets deflected upwards.
- G. In a typical **semidiurnal lunar tidal cycle**, high tides are **12 hrs 25 mins** apart.

True (then 2nd high is 24hr 50min)  
for next

- F** **H. Commensalism** is defined as a symbiotic relationship between 2 species which benefits both partners.
- I** **I.** In general, all else being equal, communities with higher input/flow of **energy** or **nutrients** would be expected to have more **productivity** and more **diversity**.
- F** **J.** A typical **terrestrial** food chain would be "plant---->herbivore---->carnivore": almost all **marine** food chains follow a similar 3-level pattern.
- I** **K.** Recent studies on Antarctic **penguins** show that some groups are **suffering** from climate change but others are actually **benefiting**.

**IV. FILL-INS:** fill in blanks with words to make each sentence correct and that add **specific** information (25 pts)

- A.** In the early 1800s, Jeanne **Villepreux-Powers** invented the aquarium, while **E. Forbes** did the first deep-sea dredging and led him to propose that the deep sea was lifeless. several correct possibilities
- B.** One major result of the 1870s *Challenger* expedition was massive database still in use.
- C.** **SOSUS** is a global network of **hydrophones** that biologists can use to listen to animals like whales; but it was originally designed by the Navy to listen for Soviet subs.
- D.** In 1977 the *Alvin* was used in the discovery of hydrothermal vents, which revolutionized marine science.
- E.** The **Juan de Fuca** Ridge off of Washington State is a place where two tectonic plates are spreading.
- F.** While big **storms** such as hurricanes can be very destructive, they can benefit the oceans by stirring up nutrients.
- G.** There are two moon-related **tidal bulges** on earth: one from **lunar** gravity, the other on the opposite side of the Earth from the centrifugal effect of the earth spinning around a common earth-moon center of mass.
- H.** A **neap tide** occurs when the moon and sun are at 90°.
- I.** Organisms with **CaCO<sub>3</sub>** structures can turn into hard **rock** called limestone and softer rock called chalk.
- J.** Blue color travels the farthest/deepest in water; most fishes have lost their retinal cones for seeing red color.
- K.** **High UV** radiation causes thymidine dimers or mutations to form in DNA; studies show that Antarctic food chains have been affected by high UV entering through the ozone "hole".
- L.** **Na<sup>+</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Mg<sup>2+</sup>, K<sup>+</sup>, Ca<sup>2+</sup> & HCO<sub>3</sub><sup>-</sup>** are major ions of seawater, found in constant proportions around the globe. As a negative ion, **Cl<sup>-</sup>** has been found to enter the oceans from volcanoes and vents.
- M.** A huge floating **garbage patch** has been found in the east-central N. Pacific; the major component of the trash is plastic. Trash collects here because it is within the massive N Pacific gyre.
- N.** The current pattern of **global warming** is different from warming periods of the last 400,000 years in that the rise is unnaturally fast.
- O.** **Energy** for life has to be **renewed** because 90% is lost at each step of a food chain due to **entropy**.
- P.** In the **deepest** seawater, **oxygen** is reasonably high because of thermohaline downwelling.
- Q.** The **average salinity** of the oceans is about 35‰ giving an **osmotic pressure** of about 1000 mOsm. An **osmoconformer** in this water would have an internal osmotic pressure of 1000 mOsm, while an **osmoregulator's** would be about 350 mOsm.
- R.** **Rocky** shorelines generally are more **diverse** than are **sandy** beaches, as predicted by the spatial Heterogeneity Hypothesis.
- S.** In **Competition** for mates, two males might be scored as  indicating that both lose in a fight.
- T.** In the **Nitrogen Cycle**, **N<sub>2</sub>** gas needs to undergo fixation before organisms can use it. The **Phosphorus Cycle** has no gaseous form, but seabirds that eat fish can move **P** from the sea to land where it is deposited as guano.
- U.** In **ARTICLE I** to the right, scientists were able to track the seal by using satellite "tags".
- V.** In **ARTICLE II** on the next page, fertilizers and animal waste caused dead zones as follows: fertilizer causes bloom in plankton, which die once nutrients used up. Dead plankton are decomposed by bacteria which use up O<sub>2</sub>.

**ARTICLE I -- Dec. 2011**

**Elephant Seal Travels 18,000 Miles**

San Diego Daily News, Dec. 13, 2011 — A team of WCS conservationists has reported that a young male elephant seal tracked for the past year swam an astonishing 18,000 miles -- the equivalent of New York to Sydney, Australia -- and back again.

NAME \_\_\_\_\_

# Chesapeake Bay

*Coming back to life*

Biology News 2011

A service of Macroevolution.net

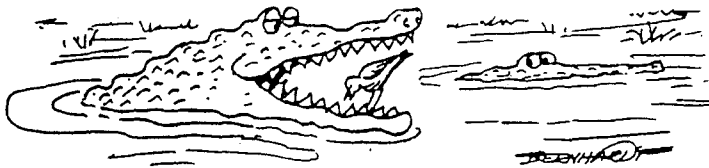
160

A new study that analyzed 60 years of water quality says efforts to reduce the flow of fertilizers, animal and other pollutants into Chesapeake Bay seem to be improving the bay's health. The study, published in November 2011 issue of *Estuaries and Coasts*, was conducted by researchers from Johns Hopkins Univ and the University of Maryland Center for Environmental

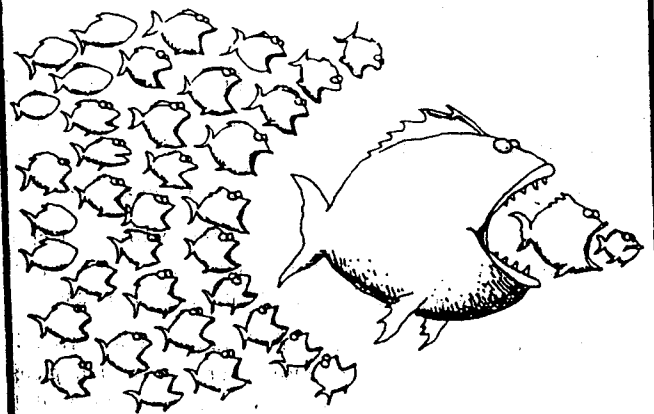
They found the size of mid- to late summer "dead zones," where plants and water animals can't survive, leveled off in deep channels of the bay during the 1990s but has been declining ever since. The timing is key be-



"If my dad asks you what you do for a living, say you're a marine biologist!"



"WE HAVE A SYMBIOTIC RELATIONSHIP. HE CLEANS MY TEETH; THEN I EAT HIM."



A FOOD WEB!