

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

For the midterm exam, you will be graded on the accuracy of your answer (facts and errors), your ability to synthesize concepts, and the clarity of your answers. The amount of space given for each answer indicates the approximate expected length, but you should feel free to use as little or as much space as you require to adequately answer the question.

**Section I: Short definitions or concepts. A sentence or two is generally enough information. Describe or define the following (4 pts each):**

- 1)  $f$ -ratio
  
- 2) Accessory pigment
  
- 3) PSU (photosynthetic unit)
  
- 4) Liebig limitation
  
- 5) regenerated production

**Section II. Short answer. Answer each question with a drawing, paragraph, etc. (not an essay; 6 pts).**

- 6) Give three reasons for why we think size is important in the ocean. You can use example organisms to explain your points.

7) Most land plants, and many algae, are green in color. Why? If we lived on a planet with very little blue light (but otherwise the same as our sun), what color would you expect the plants to be (and why)?

8) Draw the Z-scheme for photosynthesis. Identify where in the Z-scheme you would expect iron-limitation to result in decreased growth rates. What, in simple terms, does the Z-scheme describe?

9) What factors limit biological productivity in the ocean?

10) Membranes are very important for many biological processes, including phytoplankton. Give at least two examples for why membranes are important, and describe for those two examples, what the membrane is doing (in other words, why is it important to have a membrane for that example?)

**Essay Question. Answer ONE of the following questions. Your response will be graded on content, clarity, and critical thinking (50 pts).**

- 1) Here in Monterey Bay, we often get harmful algal blooms caused by the dinoflagellate *Alexandrium catenella* (causes paralytic shellfish poisoning) and the diatom *Pseudo-nitzschia australis* (causes amnesic shellfish poisoning). Many people think that the increase in harmful algae is due to increased eutrophication (humans adding nutrients to the coastal ocean). Recent studies have provided the following information for these two organisms:

	Alexandrium		Pseudo-nitzschia	
	Ks	Vmax	Ks	Vmax
Nitrate	14 ( $\mu\text{M}$ )	4.6 (h <sup>-1</sup> )	2.82	10.5
Ammonium	2	8.4	5.37	7.1
Urea	28	44	10	4.0

Based on your understanding of nutrient kinetics, which organism do you think would respond more to eutrophication? Margalef suggested that there is a seasonal pattern to the occurrence of groups of organisms, such as diatoms and dinoflagellates. When would you expect to see these organisms in Monterey Bay, and why (i.e. what conditions are diatoms and dinoflagellates generally adapted to)? We rarely see coccolithophores in Monterey, but if we did, when do you think they would be in the Bay, compared to diatoms and dinoflagellates?

- 2) You've been invited to the White House to explain to President Bush "this iron thing". He's been told by his advisors that dumping iron in the ocean is a good way to mitigate global warming. When you get there, he tells you that he knows you have been indoctrinated by people like Ken Bruland, Phil Boyd, and Kenneth Coale, and that he's not convinced "the iron thing" is real. As proof, he tells you that he's read the Boyd et al. SOIREE paper, and it doesn't demonstrate that iron fertilization would have any impact on the global ocean. Answer the following:
- Do you agree or disagree with President Bush's statement? Why?
  - If you could add ONE measurement to the SOIREE experiment to help prove your point, what would it be and why?
  - If you convinced President Bush that dumping iron in the Southern Ocean for the next 50 years would be a good thing, explain what the general consequences (for the biology) would be, and what would limit productivity in the Southern Ocean (assuming you're adding enough iron to make it non-limiting).

**Extra Credit: (2 points each)**

- How many different species of ocean fish exist (+/-10%)?
- How many species of Nixi were there, and what is the name of one of these species (or sub-species)?



