Chemical Oceanography Problem Set 2
23 February, 2022
Due 2 March, 2021

All answers are to be submitted by email to maltabet@umassd.edu either in MS Word or Excel format. Deadline for submission is 5 PM on 2 March. Late submission will result in the loss of one point per day from the 10 point total**.** You are strongly encouraged to review the problems early to clarify any questions you might have. Do not wait to the day before to ask for assistance, as there may not be a chance to respond. Use email to ask specific questions. This problem set is designed to be open book and open notes, but you are expected to work individually to obtain your answers. Essays and short answers must be in your own words. You should show all your work and clearly delineate how you derived your results where pertinent. This problem set constitutes 12.5 % of your overall grade. **You are expected to work independently in completing this problem set.**

(2.0) 1. Because you thought it would be fun, you bring a bucket of seawater (S=35) to the shores of the Dead Sea, ~380 m below sea level. You notice that barometric pressure is 1.055 atm. What are the concentrations in the bucket of N_2, O_2, and Ar when the bucket is equilibrated with atmosphere at a temperature of 20°C? If the bucket warms quickly to 30°C without gas exchange, what is the measured % O_2 saturation and AOU? Why does the change in AOU have nothing to do with biological activity? HINT: start with E&H Table 3A1.1

(2.0) 2. Typically, the ratio of dissolved gases is measured more precisely than their concentrations. For assessing biological productivity in the ocean, the ratio of photosynthetically produced O_2 to inert Ar has been used in this respect. First, plot the concentrations of O_2 and Ar in seawater (salinity 35) in equilibrium with air for a 5 to 25°C range in temperature, every 0.5°. Use vertical scales sufficient to see any change in concentration and briefly explain why they occur. Calculate the ratio of O_2 to Ar for the same temperature range and plot separately. Compare and contrast variations with temperature of the O_2/Ar ratio with their concentrations. Last, explain why the O_2/Ar ratio is a better indicator of biological production than O_2 concentration.

(3.0) 3. How and why does ozone in the stratosphere benefit Earth's biosphere. What are the natural chemical processes leading to its formation and destruction? Why was it important that an international agreement (Montreal Protocols) was reached to limit the production and release of chlorofluorocarbons? What does Antarctica have to do with this? How does ozone form in the troposphere and why is that a problem?

(3.0) 4. Characterize the changes in atmospheric CO_2 (and their causes) that have occurred over the last 120,000 years. How do we know about them? What are the major arguments and lines of evidence that recent CO_2 changes will lead to increases in Earth' temperature? Include a discussion of the greenhouse effect.

Include chemical formulas and reactions to illustrate your answers