Name____Date___________Period___________

Marine Chemistry

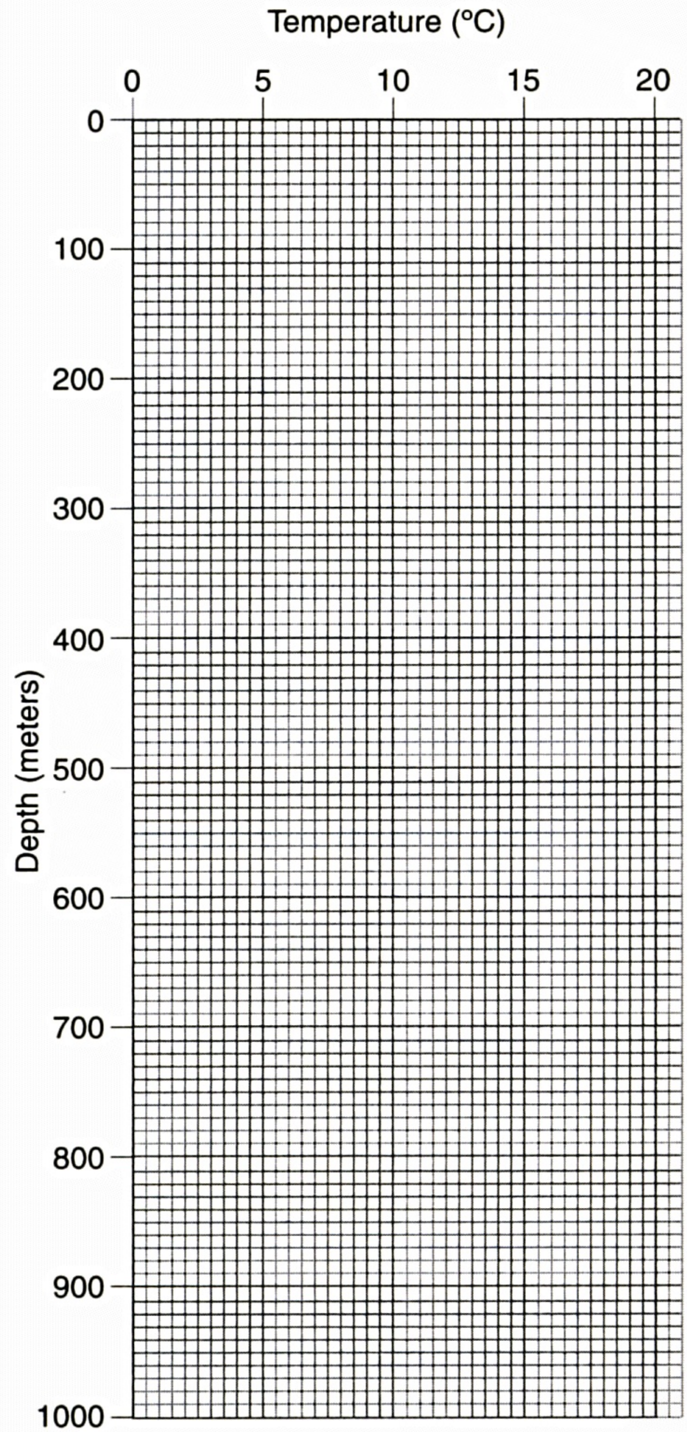
Lab Sheets

Part I: Profiling and Seawater Analysis

Temperature Profiling I

1. The chart below includes temperature and salinity data for a location off the California coast. Your goal is to chart the temperature profile and to *identify* the surface (mixing) layer, thermocline and deep zone. Be on the lookout for seasonal thermoclines as well.

Depth (meters)	Temperature (ºC)	Salinity (ppt)
10	14.56	31.22
20	14.50	31.40
30	14.48	31.56
40	12.72	31.88
50	10.86	32.40
75	9.20	33.24
100	8.82	33.60
150	7.77	33.88
200	7.10	33.94
250	6.57	33.98
300	6.15	34.01
400	5.49	34.07
500	4.01	34.14
600	4.65	34.20
700	4.36	34.26
800	4.10	34.31
1000	3.51	34.41

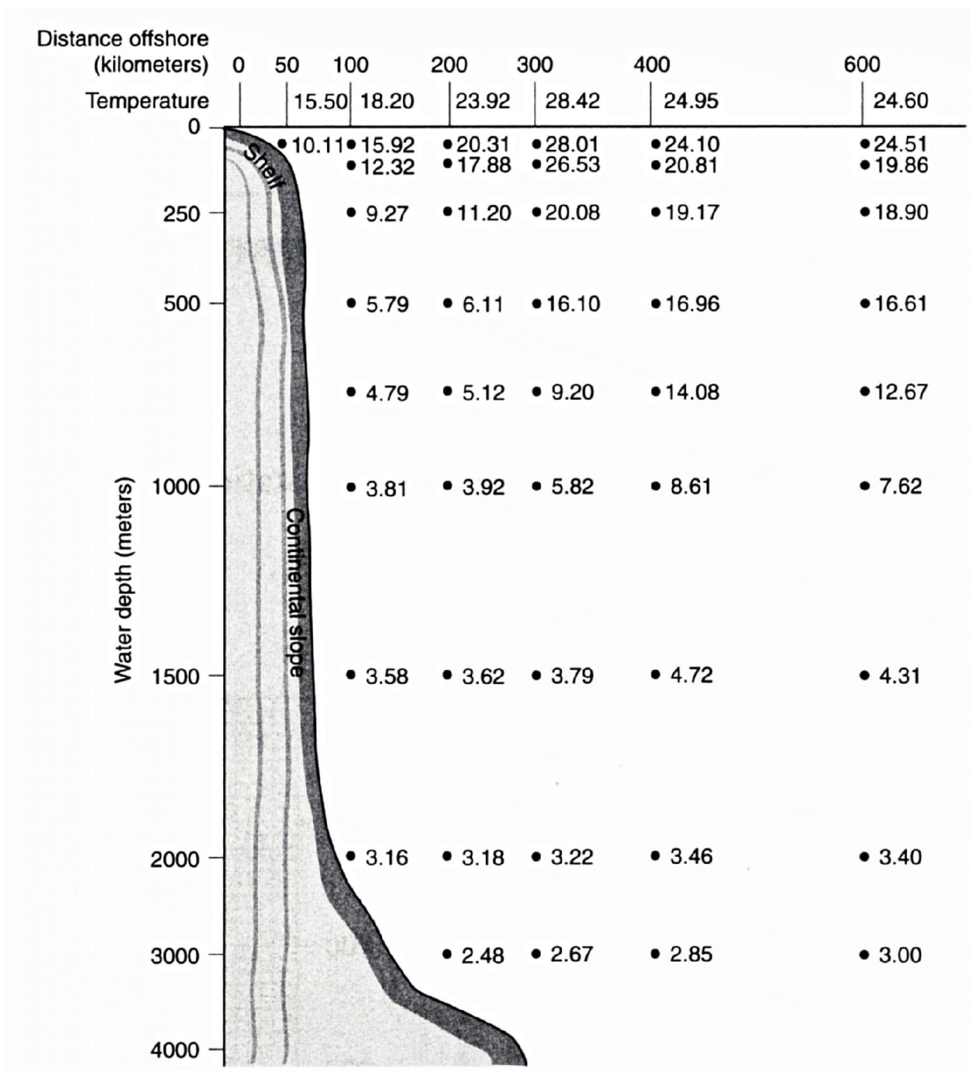


2. Based on the temperature profile, what season was this data taken in? Support your answer.

Temperature Profiling II

3. This example is a bit more involved than Profile I. Back in meteorology, you were introduced to the concept of isopleth mapping on pressure maps. Now the identical process will be used to examine a three dimensional temperature profile. This profile was created by temperature probes that were dropped vertically through the water column in six locations off the coast of North Carolina. For the chart, identify the isotherms in 2ºC intervals. Then, take a critical look at what those isotherms are saying about the ocean. To get a better feel for the data, consider using colored pencils to enhance certain temperature profiles. If you like, devise a color scheme for the various temperatures. If you do this, I recommend using red to represent the warmest water and blue/violet to represent the coldest.

When completed, also identify any thermoclines (seasonal and/or permanent). They can be identified by closely spaced isotherms.



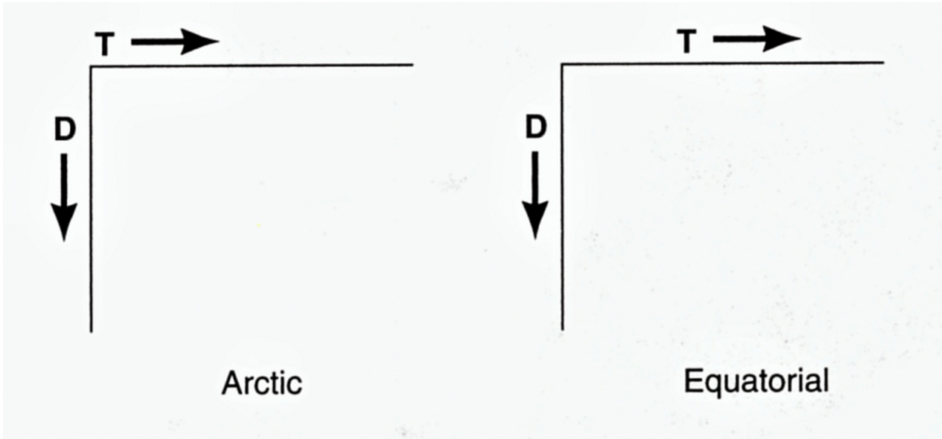
4. Look closely at the temperature profile. How do you explain the pattern of the isotherms along the part of the diagram identified as the continental slope?

5. There should be an unusually warm surface feature visible on the profile as well. Considering this profile was taken off the east coast of the United States, how can this feature be explained? Approximately how large is it and how deep does it penetrate into the water column?

6. Refer to the world temperature map on the Temperature (text) page. Based on these temperature patterns, where should the ocean water with the greatest density be located? What could logically be expected about the height of the ocean at these locations with regard to "sea level"?

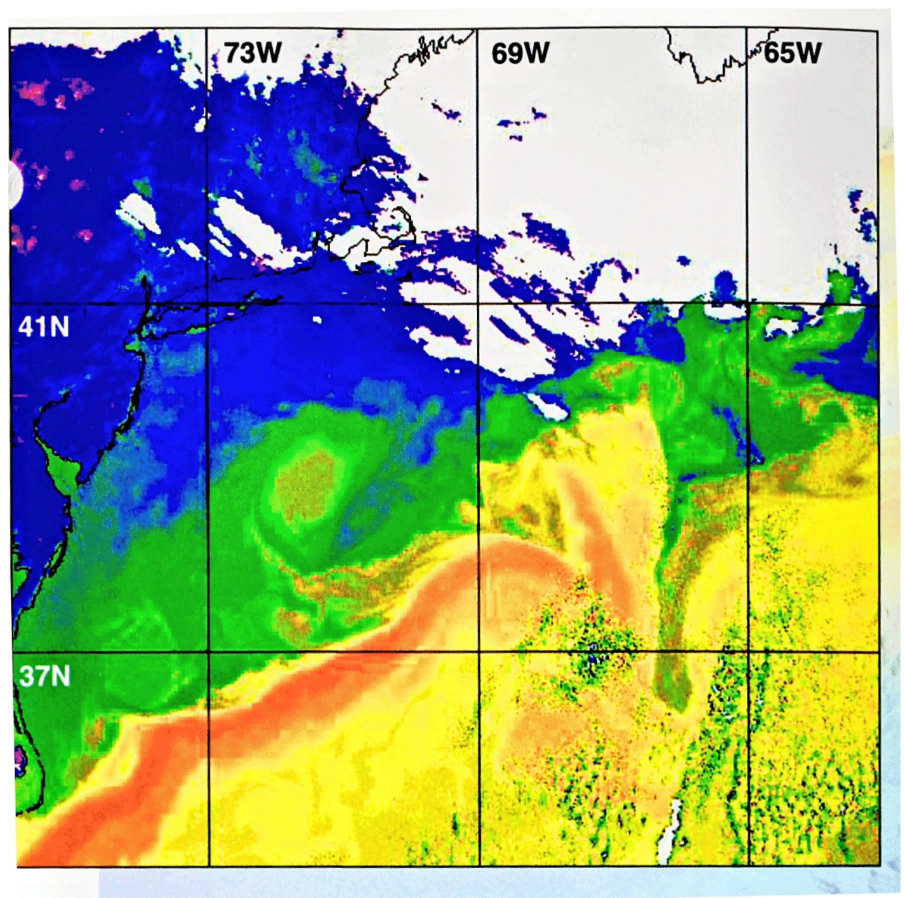
7. Look at the difference in temperature averages between the eastern and western equatorial Pacific. What is the primary cause of this pattern? Does the same pattern exist in the Atlantic? (Hint: Think *Meteorology 6* notes).

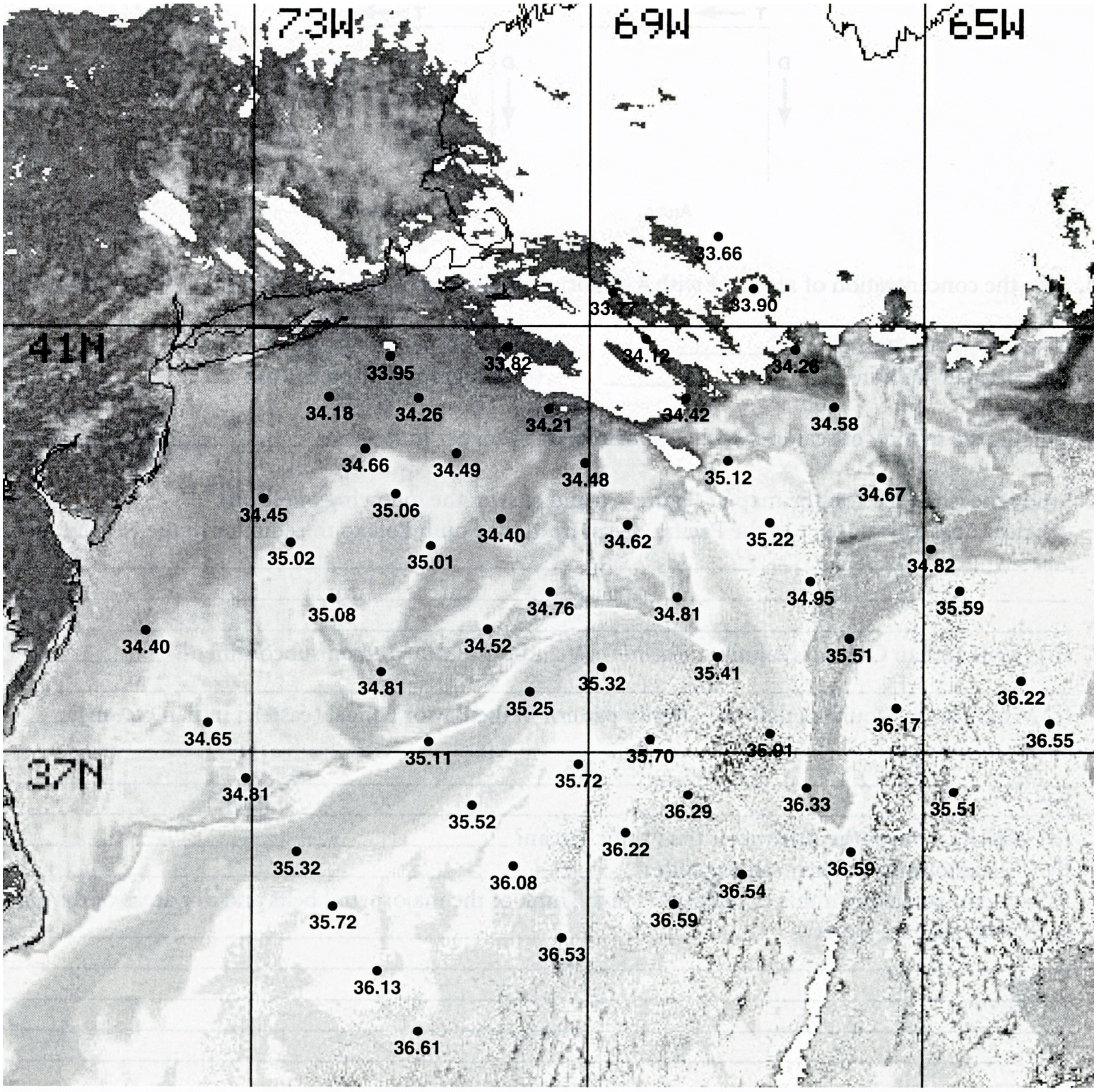
8. How would a depth/temperature curve from the Arctic region look different from a depth/temperature curve from an equatorial ocean. Sketch the curve for each region and explain your answer.



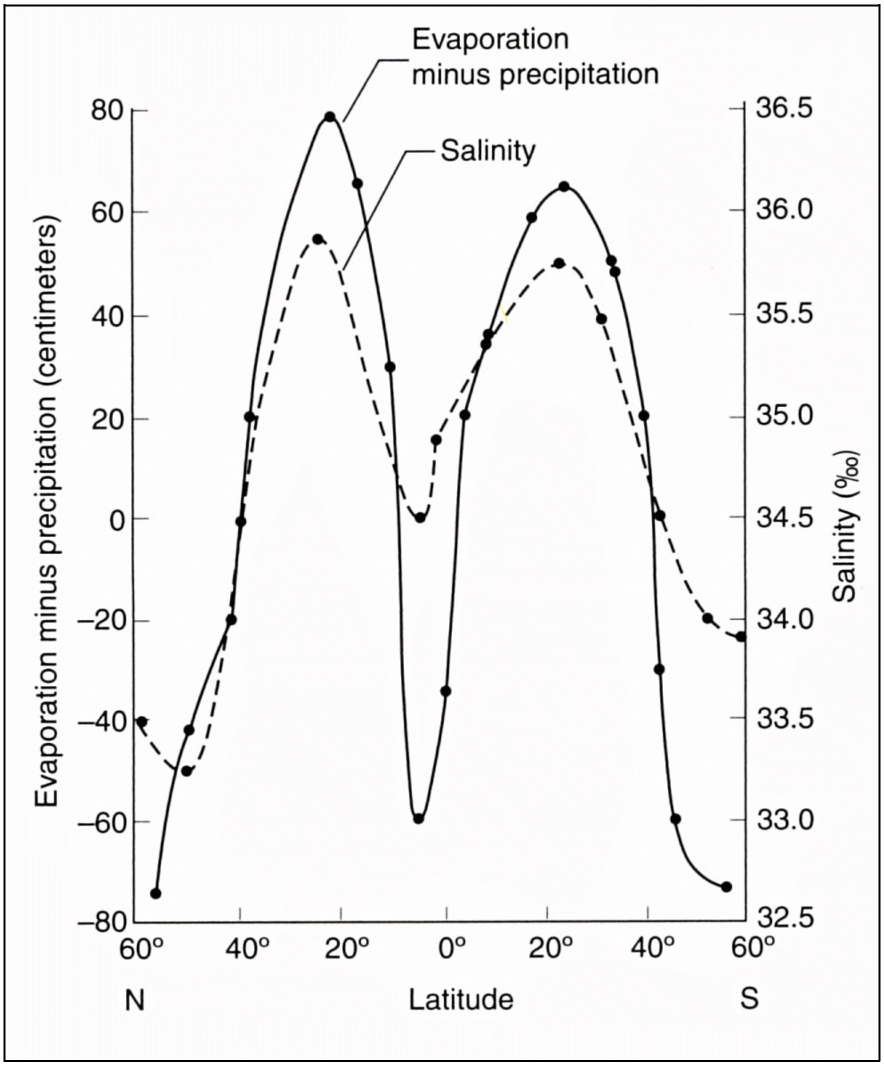
Salinity Profiling

9. Like temperature salinity can show unusual patterns as well. In the image below, a US NOAA satellite scanned the ocean off the coast of New England. The image was captured by the satellite's Advanced Very High Resolution Radiometer (AVHRR) scanner and has been color coded according to sea surface temperature (SST). Reds are the warmest and blues are the coolest. White pixels represent cloud cover. If you look closely, you should be able to make out the coast of the Delmarva Peninsula, Long Island and Cape Cod. On the following page, the same image is shown in grey scale. Each data point on that chart was collected by salinity probes placed in the water by a research vessel. On the chart, draw in isohalines for salinity values in .5 ppt increments and then use that data to answer the questions that follow.





10. SST profiles often assume similar shapes to the coastline they border. You should notice the same pattern does *not* exist with regard to salinity. How can the salinity pattern shown be explained?



11. The chart above represents an idealized graph of ocean salinity levels plotted against evaporation - precipitation from 60ºS latitude to 60ºN latitude. How can this pattern be explained? In addition, assuming this was a specific date during the year rather than a long term average, around what date would this curve be most accurate? Again, you will find the notes *Meteorology 6* very useful here.

Source: Laboratory Exercises in Oceanography, 3rd Ed., W.H. Freeman and Company, New York, NY, exercises 7-1, 7-2, figures 7-5, 7-7

Part II: Field Observations

For Part II of this lab, you will set up a variety of controlled experiments to illustrate the patterns charted in Part I. Each set of 2-4 students will require the following equipment:

- 1 water tank w/divider
- 1 clamp and rod assembly
- 1 digital thermometer
- 4 400-500 ml beakers
- 1 hot plate
- Small quantity of colored food dye
- Ruler
- Salt
- Scale or balance

Model 1: Temperature Simulation 1

Prepare 250 ml of water in two beakers with one chilled to a cold temperature and the other heated on the hot plate so that it is hot to the touch. The actual temperature difference between the two samples is not as important as the total difference in temperature. Put a few drops of red food coloring in the warm water and several blue drops in the cold water.

Pour the cold sample into one side of the tank and the warm sample into the other. Then, lift the barrier between them slowly and carefully allowing the two sides to mix. Observe what occurs.

Temperature Readings: Warm body________ (ºF) Cold body________ (ºF)

12. Describe the appearance of the two water bodies when they were permitted to mix together.

13. Using the ruler and the empty chart below, identify the various temperature zones found in the tank and label them accordingly. Take temperature readings every .25".

Original Experiment

Using supplies provided by your instructor and/or those supplied independently, your task is to design an original experiment that will support or refute one of the major concepts discussed in Part I of the lab or in the notes Oceans 1. Although the typical format for labs used routinely in bio./chem./phys. is rarely used in the geosciences, this is one where it will be useful. For this lab, please write up the experiment using the following format used by Penn State University. Details about this type of format can be found at http://writing.engr.psu.edu/workbooks/laboratory.html

- Abstract (5 points)
- Introduction (10 points)
- Procedures and Methods (15 points)
- Results and Discussion* (20 points)
- Conclusions (20 points)
- Appendices (including. References) (0 points)

***Some type of quantitative data is expected for this lab.**

The completed lab should be typed and formatted in order as shown above. Total points earned will be scaled to the actual point value of the lab (usu. 20-30 pts.).

Hints/Advice

- Discuss the best way to accomplish this task with your group.
- The experiment should try to simulate ocean conditions as much as possible. For example, heating up water to 120°F might give quicker results but it is *not* representative of the real oceans' surface temperature.
- Be creative in this lab but stay focused on a single, legitimate, aspect of marine chemistry. This can be accomplished by carefully controlling variables so that only one aspect of ocean water is being measured.
- Make sure all materials to be brought in by the group are accounted for prior to the lab period.
- Remember that the experimental window is usually limited to a single block period.