Name: _____ Class time: _____

Geology 12: Thermodynamics of Water Exercise

Purpose: to explore the relationship between salinity, temperature, and density of water. Slight changes in density are difficult to measure quantitatively, but they can be easily observed when two liquids of different densities are combined.

Materials: 2 beakers, 1 graduated cylinder or beaker, scale, thermometer, salt, ice, water.

⇒ **Read through and understand each procedure <u>before</u> you begin.**

Procedure #1 *Salinity and density*

1) Fill a graduated cup to the 200 ml (1 ml = 1 cm^3) mark with room temperature tap water.

   Without weighing: how much does the water in the beaker weigh? _____ g

2) The average salinity of ocean water is _____ o/oo. How much salt must you

   add to the water to make it that salinity: _____g. Weigh out that quantity of salt and add it to the beaker. Stir until all the salt has dissolved.

3) **A**dd 2 or 3 drops of dye to the salt solution.

4) Fill a clear cup to within about 2 cm of the top with room temperature tap water. The exact amount is not critical.

5) Very carefully and s-l-o-w-l-y (to minimize turbulence) add about 1 cm^3 of the saline solution to the water in the clear cup. What happens?

   _____

   Repeat adding the saline water a few times. How long does it take the water to travel to

   the bottom? _____ seconds.

6) Add about 20 g more salt to the solution. What effect do you think this will have on how

   long it take to travel to the bottom of the tube?_____

   Try it. Were you right? _____

7) CONCLUSION: Which is denser? (circle one) ***fresh*** ***salty water***

Procedure #2 *Temperature and density*

1) Fill a beaker with ice and add tap water so that the **water level** is at the 400 ml line.

2) Observe the temperature of the water in the beaker. What is its *starting* temperature?

   _____ °C. What is its *final* temperature? _____°C.

3) Add 2-3 drops of dye to the ice water solution. Note how it mixes before stirring.

4) Refill the graduated cylinder to within about 2 cm of the top with clean **warm** tap water. The exact amount is not important.

5) Very carefully and s-l-o-w-l-y (to minimize turbulence) add about 1 cm^3 of the cold water solution to the warm water in the graduated cylinder. What happens?

   _____

6) CONCLUSION: Which is denser**?** (Circle one) ***warm water*** ***cold water***

7) Did the cold water sink faster or slower then the salty water? _____

8) CONCLUSION: Remember the speed with which the salty water and the cold water sank. Which of these two properties do you think is most important for causing water to sink in

   the ocean? ***temperature*** ***salinity***

Procedure #3 *Temperature and salinity*

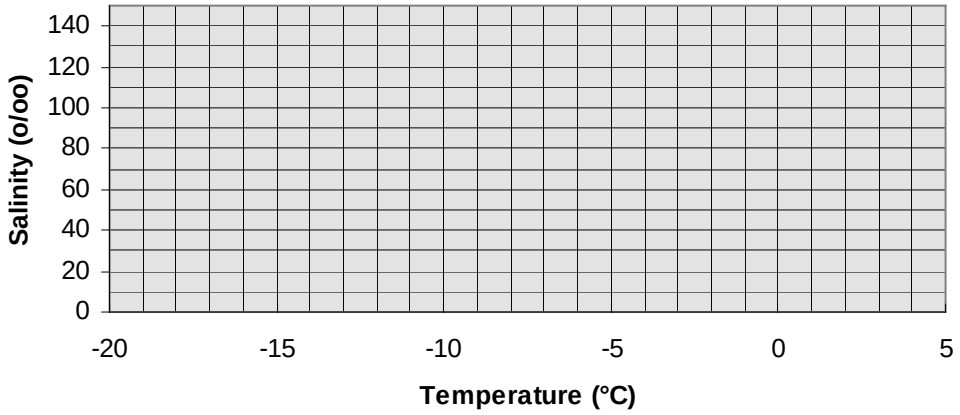
1) Add enough water to bring the level in the ice water beaker back up to the 400 ml line.

2) Weigh out 4 quantities of salt, each weighing 7g. (Use "weighing papers". Make sure you properly account for the weight of the paper.)

3) Add one of the quantities to the ice water. Wait for the temperature to stabilize then record the result below. Repeat this procedure with each remaining quantity of salt.

Quantity #	Total Weight of Salt added	Total Salinity	Final Temperature
1	0g	**0** o/oo	**0** °C
2	7g	o/oo	°C
3	14g	o/oo	°C
4	21g	o/oo	°C
5	28g	o/oo	°C

4) Plot the values of salinity and temperature on the following graph. Include the value for no salt at all.



5) Given these data, what would be the triple-point for water with a salinity of 140 o/oo?

_____

Applying what you've learned

Based on your observations in this exercise, answer the following questions.

1) As a river flows into the ocean does the river water ***sink*** or ***float*** ? (circle one)

2) Do you think it is possible to make two water samples with different temperatures and salinities but the same density? _____ Give a reason for your answer.

_____

3) What do you think you would observe if you measured water temperature at various depths in the ocean? _____

4) When you made your solution you added water up to the 400 ml line. After all the ice melts where do you expect the water level to be? ***Above***, ***below*** or ***at*** the line? (Circle one)

Why? _____

_____

5) Remember how the dye mixed with the room temperature water compared to how it mixed with the cold water. Why did they behave differently?

_____